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Hazards and Protection

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BIBLIOGRAPHY ON NUCLEAR REACTOR FUEL REPROCESSING AND WASTE DISPOSAL

Volume 4

HAZARDS AND PROTECTION 4.00

T. F. Connolly

Oak Ridge National Laboratory
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ORNL-2971

Vol. 4

CHEMISTRY—SEPARATION PROCESSES
FOR PLUTONIUM AND URANIUM

BIBLIOGRAPHY ON NUCLEAR REACTOR FUEL REPROCESSING AND WASTE DISPOSAL

Volume 4

Hazards and Protection

T. F. Connolly

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PROCESSING OF NUCLEAR REACTOR FUELS – A BIBLIOGRAPHY

Introduction

This volume includes Section 4.0 of eight sections of a bibliography on nuclear reactor fuel reprocessing and waste disposal. The collection will be a unit, and cross references are made between volumes. The decimal coding of headings is designed for ease of cross referencing, filing, expansion, and for future use in an automatic microfilm viewer-printer now being developed.

Cutoff points are somewhat arbitrary: overlapping into the area of feed materials, for example, is kept to a minimum, even though fuel reprocessing and fuel refabrication can be a continuous operation. Continuous on-site reprocessing of aqueous reactor fuels is only lightly covered.

Section 1.0, Chemistry and Physics of Important Elements, contains many references to separation methods and conditions, particularly on a laboratory scale. Cross references to that section from Sections 2.0, 3.0, and 6.0 – to each of which it may be considered as peripheral – would be too numerous to be included and should be assumed for each element. Special tests or uses (e.g., as construction materials or reagents in standard processes) are treated in the appropriate sections.

The complete collection includes about 7000 abstracts, nearly all from Nuclear Science Abstracts, representing books, bibliographies, symposia, journals, and contractors' topical reports. Most of the material dates from the 1955 Geneva Conference to the present. A serious lack is material from progress reports, and a program for the detailed abstracting and indexing of progress reports is therefore under way at ORNL (with the helpful cooperation of the Cataloging Section of the AEC-DTI Extension).

HAZARDS AND PROTECTION 4.0

Though specific hazards involved in the disposal of radioactive wastes are considered under the appropriate section (8.0), many of the required controls and standards apply also to other stages of fuel reprocessing and are therefore treated in this general section. Shipping, dosimetry, insurance - and state and national regulations concerning them - are referenced in detail.

Concerning limits and standards, the deliberately pessimistic tone of the report of the Ad Hoc Committee of the National Committee on Radiation Protection (Science, 131, 3399, p 482-86) is based on the present vague state of knowledge of the biological effects of radiation, the lack of proof of any threshold beneath which a dose is harmless, and the assumption of cumulative effects for even the smallest doses. After stating that background radiation (taken to be 100 mrem per year) should not be exceeded by the general population except for clear compensatory benefits, the committee treats occupational exposure as a risk voluntarily taken in which "...extent and nature of the exposure can, in principle, be foreseen by the individual..."

This and other references indicate that the question of limits of radiation dosage is an open one, involving judgments partly conditioned on each side by considerations other than purely technical. For example, medical studies indicate possible secondary biological effects of radiation (lowered resistance to bacterial infection, aging, slow healing of wounds, and synergistic effects of combined ingention and external irradiation) which can always be assignable to other causes - but which should be considered as possible future legal, if not public, issues.

If the suggested pyrometallurgical short - decay processing and direct refabrication of recycled power reactor fuels comes into use, radiation levels will be considerably higher than those experienced in familiar aqueous solvent extraction processes. Fuels recycled, as planned, after the minimum tolerable decontamination (regardless of the process) will require special precautions against alpha, gamma, X, and neutron radiations from U^{232} and the heavier isotopes of plutonium. Some of the objections to pyrometallurgical processing--the need of extra shielding, remote or semiremote handling, and of mechanical decladding--are partly removed by the fact that these recycled fuels demand such treatment in any case. Problems of high temperature and corrosion may be accepted on the grounds that the problem of radiation damage to organic solvents is evaded, that valuable alloying materials otherwise lost are preserved, and that waste volumes are smaller. The hazards to be accepted arise from the handling

of frequently corrosive molten metals, the high but as yet undetermined radiation levels, the use of dangerous fluorides and corrosive fluorine (in the cases of combination with volatility processes), and sometimes the production of corrosive wastes which are volatile under self-generated heating. Also, vacuum (or inert gas) pumping and filtering systems and air monitoring will be required to control the toxic heavy-metal vapors and particulate radioactive material associated with several of the processes.

See the comments under "Special Processes" and "Head-End" treatments (6.17 and 3.01).

The section on reactor radiation hazards is required by the fact that responsibility for radiation protection on sites including reactors and processing plants cannot be divided.

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RADIOACTIVE AND NONRADIOACTIVE 4.01

See also, under PROCESS CHEMISTRY AND ENGINEERING, (SPECIAL) PROCESSES (6.17).

AIR CLEANING 4.01.01

See also, under PLANTS AND EQUIPMENT, INSTRUMENTATION AND CONTROL-- Radiation Measurement (5.11.05).

and, Sampling Equipment -- See (5.15.01)

20986 CF-59-9-44
Oak Ridge National Lab., Tenn.
ADDITIONAL INFORMATION ON EUROCHEMIC AIR SAMPLING SYSTEM. E. M. Shank. Sept. 15, 1959. 2p. $1.80(ph), $1.80(mf) OTS.

Information relative to the proposed Eurochemic air sampling system is presented in the form of questions and answers. (auth)

485 HW-SA-38
General Electric Co. Hanford Atomic Products Operation, Richland, Wash.
MONITORING FOR AIR-BORNE RADIOACTIVE MATERIALS AT HANFORD ATOMIC PRODUCTS OPERATION. J. K Soldat. June 1959. 20p.

Presented at the Air Pollution Control Association Meeting, Los Angeles, California, June 21-26, 1959. OTS.

Methods employed at Hanford Atomic Products Operation to monitor for air-borne radioactive materials are described. Criteria used to establish the atmospheric monitoring program include recommendations of the National Committee on Radioactive Protection, H.A.P.O. Radiation Protection Standards, amounts and types of radioisotopes discharged to the atmosphere, and the meteorology and population density of the plant environs. Fixed and portable instrumentation measures and records external radiation dosage rates, and/or collects various types of samples. The samples are analyzed by radiochemical techniques for both gross radioactivity and specific radioisotopes. (auth)

AIR SAMPLING 4.01.01.01

445 HASL-58(p.208-11)
New York Operations Office. Health and Safety Lab., AEC.
AIR SAMPLING PROCEDURES IN EVALUATING EXPOSURES. H. Glauberman and W. B. Harris. 4p.

Statistical treatment of available data shows that in most cases no one type of sample will suffice to evaluate a variable occupational exposure properly. Multiple general air (GA) samples obtained at carefully selected locations by an experienced sampler in a continuous process area may be employed to evaluate occupational exposure with reasonable confidence. This is possible in a continuous operation, with little change in air turbulence, where the change in concentration within a location is small compared to the difference in concentrations between locations over long periods of time. In a plant where various operations are performed, some intermittently, repetitive GA samples alone will not represent true exposure and can vary from it by many orders of magnitude. The use of breathing zone (BZ) samples alone, taken at different time intervals, will also lead to an erroneous occupational exposure, much greater than the true one. A close appraisal of true exposure may be achieved by obtaining multiple GA samples in all areas normally occupied by plant personnel as well as repetitive BZ samples at all operations conducive to high concentrations. The GA sample normally will tend to underestimate an operator's exposure and the BZ sample to overestimate it, but by time weighting the average concentrations for both types of samples an operator's exposure may be closely evaluated. The data indicate that this type of treatment yields reasonably reproducible results. (auth)

RADIOACTIVE AND NONRADIOACTIVE 4.01

AIR CLEANING 4.01.01

AIR SAMPLING 4.01.01.01

418 HASL-58(p.23-9)
Union Carbide Nuclear Co. Y-12 Plant, Oak Ridge, Tenn.
AIR SAMPLING FOR THE CONTROL OF INTERNAL EXPOSURE FROM ENRICHED URANIUM AT Y-12.
G. R. Patterson, Jr. 7p.

The program is described for determining the concentration of uranium in the air being breathed by persons working in the enriched uranium processing areas of the Y-12 Plant of Union Carbide Nuclear Company at Oak Ridge, Tennessee. The aim of the program, ways to accomplish this aim, and the methods used to process the data accumulated are mentioned. The Y-12 Plant limit for permissible concentration of air-borne uranium and its origin or derivation are given. The sampling program and techniques are rather standard, but mention is made of three unique features: the use of a cardboard planchet to simplify handling of samples, the use of automation to expedite sample counting, and the use of several twin-head sample collectors and statistical analysis to determine over-all program precision and optimum sampling frequency. Figures illustrate air sampling and counting equipment and graphs show uranium concentrations determined by the program. (auth)

433 HASL-58(p.147-50)
Mallinckrodt Chemical Works, St. Charles, Mo.
IS THERE SIGNIFICANT CORRELATION BETWEEN ALPHA SURFACE CONTAMINATION AND AIR CONCENTRATION OF RADIOACTIVE PARTICLES IN A URANIUM FEED MATERIALS PLANT? W. L. Utnage. 4p.

A study of alpha surface contamination and alpha air concentration was made to determine whether or not there is significant correlation between surface contamination and air concentration in a plant where normal operations contribute sufficient alpha dust particles to the environmental air to produce average air concentrations greater than zero but less than the MAC established by NBS handbooks. It is concluded from the results of this survey that there is no correlation between alpha surface contamination and air concentrations in uranium feed materials plants designed and operated as currently approved. At present we do not have, and do not know how to design, a process for refining thousands of tons of uranium concentrate per year that would enable the absolute confinement of uranium. So long as we operate under the philosophy that some uranium in air, creating air concentrations less than one MAC, is acceptable, very little emphasis should be placed on surface contamination. If the uranium refining operations were to be done on the basis that there should be no escape of normal uranium, then obviously greater emphasis would have to be placed on surface contamination, and the contamination would have to be reduced to a very low level. (auth)

444 HASL-58(p.200-7)
Los Alamos Scientific Lab., N. Mex.
AIR SAMPLING PROCEDURES IN EVALUATING EXPOSURES TO URANIUM. E. C. Hyatt and H. F. Schulte. 8p.

Air sampling procedures used to evaluate the degree of air contamination in uranium workshops are discussed. Design features and performance of air sampling equipment are described. (C.H.)

450 HASL-58(p.219-21)
New York Operations Office. Health and Safety Lab., AEC.
AIR SAMPLING SUMMARY. W. B. Harris. 3p.

The effectiveness of air sampling to evaluate the hazards during uranium processing is discussed. It is pointed out that the type of operation will strongly influence the type of air sampling program. It is concluded that air sampling gives a good estimate of exposure. (C.H.)

11304 ✓
A LARGE VOLUME ELECTROSTATIC AIR SAMPLER.
Sidney C. Stern, David R. Steele, and Orvil E. A. Bolduan (Chemical Corps, Fort Detrick, Md.). Arch. Ind. Health 18, 30-3(1958) July.

A large-volume air sampler consisting of an electrostatic precipitation chamber, a wet-collection system for removing material, a high-voltage power supply, and an air mover is described. (auth)

RADIOACTIVE AND NONRADIOACTIVE 4.01

AIR CLEANING 4.01.01

AIR SAMPLING 4.01.01.01

2131 TT-777
THE DESIGN PRINCIPLES OF INSTRUMENTS FOR MONITORING RADIOACTIVITY AND DETAILS OF THE MONITORING NETWORK OF THE GERMAN METEOROLOGICAL SERVICE. (Grundsätzliches Über die Konstruktion der Geräte zur Radioaktivitäts-Überwachung und Einzelheiten des Netzes des Deutschen Wetterdienstes). Max Hinzpeter. Translated by D. A. Sinclair (National Research Council of Canada) from Beitr. Physik Atmosphäre 30, 207-10(1958). 7p.

A monitoring network of 10 stations was established in 1955 by the German Meteorological Service. Measurements were made of the specific beta activity of the air near the surface, beta activity of the precipitation, and gamma radiation when the activity exceeds a certain value. The measuring procedures and instruments employed are described. (C.H.)

Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Augusta, Ga.
A SENSITIVE CONTINUAL MONITOR FOR THE DETECTION OF AIRBORNE PLUTONIUM. Alwyn C. Lapsley. Feb. 1957. 13p. Contract AT(07-2)-1. $0.50(OTS). (DP-208)

A continual monitor that detects airborne plutonium dust has been built. An air impactor is used to collect the plutonium and to reject the background alpha activity in the air. The threshold for detection is between one-half and twice the maximum permissible biological concentration of plutonium. Such a concentration is detected within ten minutes of its appearance in the atmosphere. The operation of the monitor is completely automatic. (auth)

3025
AN AUTOMATIC PROGRAMMING FILTER SAMPLER. Gilbert S. Raynor (Brookhaven National Lab., Upton, N. Y.). J. Air Pollution Control Assoc. 7, 122-4(1957) Aug.

A design is presented for an automatic air sampling device. The device will take discrete samples periodically and can be constructed easily with stock parts. (W.L.H.)

415
AN AUTOMATIC MONITOR FOR URANIUM CONTAINED IN THE AIR. I. Iori and T. Rossini (CISE Labs., Milano). Energia nucleare (Milan) 4, 319-22(1957) Aug.

An automatic and fast instrument for the measurement of alpha radioactivity in the air is described. It is particularly suitable in laboratories where uranium and its salts are handled, because it distinguishes the alpha radioactivity by uranium from that by radon. (auth)

39 RFP-85
Dow Chemical Co. Rocky Flats Plant, Denver.
INTEGRATED AIR SAMPLING PROGRAM FOR A RADIOACTIVE PLANT. T. S. Chapman. June 17, 1957. 13p. Contract AT(29-1)-1106. $3.30(ph OTS); $2.40(mf OTS).

8286
CORRELATION BETWEEN URANIUM AIR DUST SURVEYS AND URANIUM URINE DATA. R. L. Hoover (National Lead Co. of Ohio, Cincinnati). Proc. Health Phys. Soc. 49-52(1957).

In assessing air dust problems associated with the handling of uranium, a good correlation was found between air dust levels and uranium urine data. Two typical cases of incident exposures are presented as examples. (J.S.R.)

8290
THORIUM MAXIMUM PERMISSIBLE AIR CONCENTRATIONS AND AIR SAMPLING PROBLEMS. J. W. Healy (General Electric Co., Richland, Wash.). Proc. Health Phys. Soc. 177-87(1957).

A review of some of the possible radiological problems involved in the handling of thorium was made. The maximum permissible body burden and the MPC in water and in air are given. The uncertainties in the calculation are discussed. The problems of air sampling are discussed in detail. It is evident that unless the concentration of the daughter elements are low, counting measurements are of limited application to the measurement of thorium. (J.S.R.)

5714 DP-188
Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Augusta, Ga.

RADIOACTIVE AND NONRADIOACTIVE 4.01

AIR CLEANING 4.01.01

AIR SAMPLING 4.01.01.01

A CONTINUOUS MONITOR FOR AIRBORNE PLUTONIUM. Dowdey C. Collins. Nov. 1956. 16p. Contract AT(07-2)-1. $0.20(OTS).

A continuous monitor has been developed that can detect one MPC (maximum permissible concentration) of Pu in air within ten minutes. Application details are described to assist other groups in adapting the equipment to their needs. (auth)

A VERSATILE PORTABLE AIR SAMPLER. H. S. Jordan and R. N. Mitchell (Los Alamos Scientific Lab., N. Mex.). Am. Ind. Hyg. Assoc. Quart. 17, 303-4(1956) Sept.

A dependable high vacuum portable air sampler with means for positioning the sampling head is described in detail. The description would enable the average small shop to fabricate the unit without undue difficulty. The sampler has been in successful use over a period of twelve months. (auth)

892 AERE-HP/M-110
Gt. Brit. Atomic Energy Research Establishment, Harwell, Berks, England.
AIR SAMPLING WITH THE ANNULAR IMPACTOR. D. C. Stevens. Aug. 28, 1956. 17p.

The annular impactor is a selective air sampling device. It has been found to have a high collection efficiency (~90%) for the dust particles produced in the course of operations of Pu laboratories and low efficiency (~5%) for the natural radon decay products. It therefore enables samples of airborne Pu dust to be counted without the delay necessary with filter paper samples for the decay of natural radon daughter products. Operating recommendations are given. (auth)

2429
SIMPLE DEVICE FOR THE TRACKING AND MEASUREMENT OF RADIOACTIVE GASES CONTAINED IN AIR. (to Auergesellschaft Aktiengesellschaft). German Patent DAS 1037 030. Aug. 21, 1958. Atompraxis 5, 330(1959). (In German)

A simple testing capillary tube is described through which the air to be tested is drawn by a hand-operated gas detection pump. The capillary tube contains a fluorescent layer which is sensitive to alpha radiation. The crystals of the luminescent material are coated with activated silica gel or mixed with its crystals. The silica gel absorbs the air being pulled through the tube. If the air is contaminated, a glow which can be detected and measured quantitatively with photocells or multipliers, appears in the luminescent layer. (J.S.R.)

21704
STATEMENT OF LESLIE SILVERMAN, SC. D., PROFESSOR OF ENGINEERING IN ENVIRONMENTAL HYGIENE, DIRECTOR OF RADIOLOGICAL HYGIENE PROGRAM, HARVARD UNIVERSITY. p.1629-49 of "Hearings on Industrial Radioactive Waste Disposal. Volume 2."

Various types of air and gas cleaning apparatus are described. Economic aspects and shortcomings of each apparatus are given. (C.J.G.)

5994 A/CONF.15/P/126
LA MESURE CONTINUE DE LA RADIOACTIVITE DES AEROSOLS ATMOSPHERIQUES. (Continuous Measurement of the Radioactivity of Atmospheric Aerosols.) Robert Quivy (Inst. Interuniversitaire des Sciences Nucléaires, Brussels and Faculté Polytechnique de Mons, Belgium). 19p.

In order to measure continuously and without delay the radioactive pollution of the atmosphere, the alpha and beta activities of dust collected on filters are detected simultaneously. By the simultaneous detection of the alpha and beta particles emitted by the deposit on the filter, the relative value of the atmospheric pollution is easily determined. To calculate the absolute value of the pollution, the geometric yield of the counter, the distribution law for the dust in the filter layers, and the absorption of beta particles in the filter are determined. (tr-auth)

8624 AEC-tr-3969
CONTINUOUS MEASUREMENT OF THE RADIOACTIVE AEROSOL CONTENT OF THE AIR. W. Buchner. Translated for Los Alamos Scientific Lab. from Atompraxis 3, 382-8(1957). 11p. JCL.

A review of methods for collection and counting of radioactive aerosols in air is presented. Theoretical and practical aspects are discussed, and calculation methods are demonstrated by examples. (J.R.D.)

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12173 TID-7551(p.108)
Illinois. Univ., Urbana.
STUDY OF THE FUNDAMENTAL PROPERTIES OF AEROSOLS. H. F. Johnstone. p.108 [of] FIFTH ATOMIC ENERGY COMMISSION AIR CLEANING CONFERENCE HELD AT THE HARVARD AIR CLEANING LABORATORY, JUNE 24-27, 1957. 1p.
Work on removal of aerosols from gases by introducing charged pellets at the center of a cyclone is reported. (T.R.H.)

4502
CONCENTRATION CHANGES IN AN AEROSOL. E. R. Wooding (Imperial Coll. of Science and Tech., London). Proc. Phys. Soc. (London) B70, 65-70(1957) Jan.
The rate of coagulation of an aerosol was calculated by Smoluchowski on the assumption that every collision resulted in the coalescence of two particles. The coagulation rate when there is a potential barrier round the aerosol particles is now calculated and two examples are considered. (auth)

6350
CONDENSATION PROCESSES FOR THE EXTRACTION OF RADIOACTIVITY FROM AIR. Rama (Tata Inst. of Fundamental Research, Bombay). Nature 184, Suppl. 23, 1789-90 (1959) Dec. 5.
Results are reported from an investigation of procedures for the separation of very fine radioactive aerosols from the atmosphere. A method is described which involves passing air through an air conditioning coil and condensing some of the moisture on the cold fins. It is believed that the method shows promise for the removal of radioactivity from large quantities of air. (C.H.)

ABSORPTION OF VAPORS BY LIQUID AEROSOLS. V. Alexander Gordieyeff. Aug. 17, 1956. 53p. (CWLR-2052)
Results are presented of the second part of the study on interaction of vapors and aerosols, i.e., absorption of vapors by airborne droplets. The absorption mechanism by airborne droplets does not differ significantly from that by the stationary bulk of absorbent. The peculiarities of the aerosol state are responsible for extremely fast rates of absorption and desorption, differential sorbate transfer between particles of different sizes, differential growth of particles of different sizes, and cloud effects interfering frequently with the process of absorption. Airborne droplets may generally be regarded as poor carriers of volatile toxic vapors.

ADSORPTION OF VAPORS ON SOLID AEROSOLS (DUSTS). V. Alexander Gordieyeff. Aug. 17, 1956. 59p. (CWLR-2051)
Results are presented of the first part of a study on the mechanism of interaction of vapors and aerosols, and deals with adsorption of vapors on airborne porous dusts. The essential mechanism of adsorption by bulk dust and its airborne fraction is identical. The peculiarities of the aerosol state are responsible for the extremely fast rates of adsorption and desorption, differential sorbate transfer between particles of different sizes, tendency to a decreasing sorptivity as a decreasing particle volume decreases pore volume, cloud effects interfering with adsorption and causing an increase of sorptivity with an increased concentration of the airborne mass, and relatively low sorptivity and vapor retentivity in saturated atmospheres. Generally, airborne dusts may be regarded as poor carriers of volatile toxic substances.

5378 COO-1016
Illinois. Univ., Urbana. Engineering Experiment Station.
BIBLIOGRAPHY ON AEROSOLS, 1950-1955. Supplement to Report SO-1003. W. J. Scheffy, comp. June 1, 1956. 117p. Contract AT(11-1)-276. $0.60(OTS).

COSTS 4.01.01.03

12171 TID-7551(p.92-7)
Harvard [Univ.], Boston. School of Public Health.
ECONOMIC SURVEY OF AIR AND GAS CLEANING OPERATIONS WITHIN THE AEC. Richard Dennis, Charles E. Billings, and Leslie Silverman. p.92-7 [of] FIFTH ATOMIC ENERGY COMMISSION AIR CLEANING CONFERENCE HELD AT THE HARVARD AIR CLEANING LABORATORY, JUNE 24-27, 1957. 6p.
How a survey of air and gas cleaning operations at AEC sites is to be conducted is discussed. The in-

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formation gathered will make it possible to establish design and cost criteria leading to economical, more efficient air and gas cleaning. A copy of a proposed questionnaire is included. (T.R.H.)

12172 TID-7551(p.98-107)
Los Alamos Scientific Lab., N. Mex.
AIR CLEANING COSTS—A STUDY OF THREE SYSTEMS. Harry S. Jordan. p.98-107 [of] FIFTH ATOMIC ENERGY COMMISSION AIR CLEANING CONFERENCE HELD AT THE HARVARD AIR CLEANING LABORATORY, JUNE 24-27, 1957. 10p.
The air cleaning facilities at Los Alamos Scientific Laboratory for DP West Site, CMR Building, and Ten Site are described. The cost figures at each location are given including depreciation, operation, maintenance, and original cost of installation. The wet methods are found inherently more expensive than dry filtration. It is recommended that consideration be given to the ease of changing filter media, especially in highly contaminated places where special equipment and procedures are required. (T.R.H.)

FILTERS 4.01.01.04

See also, under PLANTS AND EQUIPMENT, FILTERS (5.08).

5529 HW-61917
General Electric Co. Hanford Atomic Products Operation, Richland, Wash.
FILTERING ABRASIVE-WHEEL URANIUM CUTTINGS.
A. K. Postma and J. D. McCormack. Sept. 18, 1959. 9p.
Contract AT(45-1)-1350. OTS.
A number of filters were tested in the search for a device capable of efficiently removing the particles suspended in the 327 Building cut-off cell waste. A two-stage filter system consisting of a five-micron commercial filter followed by a wool felt filter was found satisfactory, removing practically all particles larger than one micron at the required flow conditions. Estimates indicate that the amount of particulate material not retained by this system would be about 2% of that which penetrates the presently used glass wool filters. The over-all decontamination of the cell wastes cannot be accurately estimated because an unknown fraction of the total activity is in solution. (auth)

11806
AN ELECTRONIC FILTER FOR THE PRECIPITATION OF RADIOACTIVE AEROSOLS. W. Riezler and W. Kern (Univ. of Bonn). Nukleonik 1, 191-5(1959) Apr. (In German)

An electronic filter for the precipitation of radioactive fission products from the atmosphere is described. The filter cross section is 80 × 80 cm^2, the air throughput is 1700 m^3/hr, and the degree of precipitation is 70 to 90%. The theory of the particle charge and precipitation, as well as the advantages and disadvantages of the electronic filter in comparison with the conventional fiber filter, are discussed. ~~(tr-auth)~~

21070
PURIFICATION OF AIR FROM RADIOACTIVE AEROSOLS. Med. Rabotnik, No. 96, 3(1958) Dec. 2.
Methods which use filtration materials made from crumbled rubber, porous air-permeable rubber, foam plastic, and filtration cardboard to trap radioactive aerosols are discussed. Filters saturated with radioactive substances caught from air are burned in special furnaces and the ashes buried. Air purification in some methods is 99% efficient. (C.J.G.)

13904 NYO-4614
Harvary Univ., Boston. Air Cleaning Lab.
EVALUATION OF THE ELECTRO-PL AND ELECTRO-KLEAN DUST COLLECTORS. Richard Dennis, Edward Kristal, and Leslie Silverman. July 21, 1958. 50p.
Contract AT(30-1)-841. $7.80(ph OTS); $3.30(mf OTS).
Results are presented from performance tests on the Electro-PL and Electro-Klean air cleaning devices. Both devices were tested for moderate cleaning of low loadings such as those encountered in the atmospheric dust range. (C.H.)

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12176 TID-7551(p.120-9)
Harvard [Univ.], Boston. School of Public Health.
SLAG WOOL FOR ACID GAS AND MIST REMOVAL. Charles Kurker, Jr., Charles E. Billings, and Leslie Silverman. p.120-9 [of] FIFTH ATOMIC ENERGY COMMISSION AIR CLEANING CONFERENCE HELD AT THE HARVARD AIR CLEANING LABORATORY, JUNE 24-27, 1957. 10p.

Three mineral fibers, Kaowool, Mineralite, and Baldwin-Hill, were evaluated for their efficiency in removing H_2SO_4, SO_3, SO_2, HNO_3, N_2O_4, and HF from gas streams. It was found that 2-in. filters at 4 lb/cu ft packing density remove 30 to 80% of acid mist and 72% of acid gases. Slag wool is useful for combined simultaneous removal of acid gases, mists, and solids. (T.R.H.)

1257 CEA-656
France. Commissariat à l'Énergie Atomique, Paris.
VENTILATION DES ENCEINTES RADIOACTIVES. (Ventilation of Radioactive Enclosures). F. Caminade and H. Laurent. May 1957. 19p.

This study deals with the individual equipment of small installations: glove boxes, manipulation boxes with outside control and, if necessary, production chambers (maximum useful volume: 5 m^3). The performance of three types of "ventilators", and the modifications provided by the addition of filters, are measured and compared. (auth)

4418 AERE-HP/M-112
Gt. Brit. Atomic Energy Research Establishment, Harwell, Berks, England.
THE PERFORMANCE OF COMPOSITE "KOMPAK" FILTERS IN THE VENTILATION SYSTEM OF BUILDING 351, 1954–1956. R. F. Hounam, Oct. 22, 1956. 5p.

Composite "Kompak" filters loaded with an additional web of superfine fiberglass glass wool as well as the usual web of filterdown have given satisfactory performance as inlet filters in ventilation systems. A service life of two years was obtained before the filters became choked with dust. Tests have yielded no evidence of blow-off from the composite filters. (auth)

ELECTROSTATIC MECHANISMS IN AEROSOL FILTRATION BY MECHANICALLY CHARGED FABRIC MEDIA AND RELATED STUDIES. Leslie Silverman, Edward W. Conners, Jr., and David M. Anderson. Sept. 4, 1956. 61p. (NYO-4610)

Test results are presented in which a mechanically induced electrostatic charge on certain fabrics is employed as an aid in the removal of particulate matter (atmospheric dust) from air at room temperature. The theory of mechanically induced static charges and some experimental data are presented.

3779 KAPL-1463
Knolls Atomic Power Lab., Schenectady, N. Y.
COLLECTION EFFICIENCY OF AIR CLEANING AND AIR SAMPLING FILTER MEDIA IN THE PARTICLE SIZE RANGE OF 0.005 TO 0.1 MICRON. J. J. Fitzgerald and C. G. Detwiler. Dec. 9, 1955. 51p. Contract W-31-109-Eng-52. $7.80(ph OTS); $3.30(mf OTS).

1778 AECU-3119
Little (Arthur D.) Inc., Cambridge, Mass.
MEDIA FOR AIR CLEANING AND AIR-ASSAY PURPOSES. Final Summary Report for period ending December 31, 1954. Oct. 3, 1955. 48p. (Includes Appendices A, B and C.). Appendix-D: PROPERTIES OF VARIOUS FILTERING MEDIA FOR ATMOSPHERIC DUST SAMPLING. Walter J. Smith and Norman F. Surprenant. July 1, 1953. 25p. Contract AT-(30-1)-1013.

Work was completed on the high-temperature, high-efficiency air filter. A survey was made of air-sampling practices at 37 laboratories. Analysis of the survey results indicated that 22 different kinds of air-sampling filter media were in use among the laboratories questioned. A group of five media has been proposed as adequate for meeting all requirements. Laboratory work was done on

COMPARATIVE STUDY OF ALTERNATIVE FIBROUS GLASS AND SAND EXHAUST VENTILATION AIR FILTER INSTALLATIONS FOR PUREX. Lyle L. Zahn, Jr. Dec. 14, 1953. Changed from OFFICIAL USE ONLY July 6, 1956. 18p. (HW-30142)

Results are presented from a study of the relative merits of fibrous glass and sand filter installations for the Purex Plant ventilation air system. Data are presented on both

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the economics and operating characteristics of the two installations. Reasons are given for the superiority of fiber glass.

8493
EFFICIENCY OF THE FILTERS AGAINST RADIOACTIVE AEROSOL. ON THE RADIOACTIVE CONTAMINATION AND ITS REMOVAL. Toyohiko Miura and Kikuzi Kimura (Inst. for Science and Labour, [Tokyo]). Rôdô Kagaku 35, 818-23(1959) Dec. (In Japanese)
Dust filters were examined using a radioactive solid-aerosol, decay product daughters of Rn^{220}. An examination with a thermal precipitator revealed that the major part of particles in the radioactive aerosol were smaller than 0.5 μ in diameter. Twenty-one kinds of filters were tested. The filtering efficiency was highest in asbestos fiber filters. A radioautographic examination revealed that the radioactive substance penetrated as deep as 1.4 to 1.5 mm into the filter layer. (auth)

GASES 4.01.01.05

See also, under PROCESS CHEMISTRY AND ENGINEERING, REAGENT ADJUSTMENT AND RECOVERY (6.16.04).

20944*
PURIFICATION OF HIGH-TEMPERATURE PROCESS GASES IN A CENTRIFUGAL-FOAM DUST-CATCHER. V. P. Savrayev. Tsvetnye Metal. No. 1, 62-70(1959).
Some wet gas methods used in the purification of process gases are reviewed, and the disadvantages are indicated. A dust-catcher, based on the condensation of water vapor on the particles, is described. It consists of a cyclone connected to a frothing bubbler. The cyclone has a helical inlet and internal cylinders. Water from the bubbler passes through the cyclone. After successful laboratory tests, tests on zinc, lead, and copper plants with direct use of the heat content of gases for water evaporation were made. The performance is compared with that of high-speed turbulent dust catchers. (J.S.R.)

12154 TID-7551(p.26-8)
Oak Ridge National Lab., Tenn.
AIR CLEANING ACTIVITY AT OAK RIDGE GASEOUS DIFFUSION PLANT. R. C. Smith. p.26-8 [of] FIFTH ATOMIC ENERGY COMMISSION AIR CLEANING CONFERENCE HELD AT THE HARVARD AIR CLEANING LABORATORY, JUNE 24-27, 1957. 3p.
A discussion of fluorine recovery, fluorine determination in air, and measurement of radioactive dust contamination in air at a gaseous diffusion plant is presented. (T.R.H.)

11038 ✓ WAPD-PWR-CP-2428
Westinghouse Electric Corp. Atomic Power Div., Pittsburgh.
REMOVAL OF RADIOIODINE FROM PWR PLANT CONTAINER AIR. A. S. Kesten. [Sept. 26, 1956]. 12p. $3.30(ph OTS); $2.40(mf OTS).
The effectiveness of Chemical Warfare Service filters and of filter-type air monitors was tested for the removal of radioiodine from air streams. The test apparatus simulated the chemical environment expected in the event of leakage of primary coolant from the Pressurized Water Reactor. (C.H.)

7046 HW-43060
General Electric Co. Hanford Atomic Products Operation, Richland, Wash.
NO_2 EXPOSURES FROM OPERATIONS IN THE 224 U BUILDING. W. E. Gill. May 15, 1956. 12p. Contract [W-31-109-Eng-52]. $3.30(ph OTS); $2.40(mf OTS).
The problem of air contamination by NO_2, HNO_3, and UO_3 from the calcination pots in building 224 U is surveyed. The recommendations for remedying the situation are given. (T.R.H.)

7068 HW-43099
General Electric Co. Hanford Atomic Products Operation, Richland, Wash.
REDUCTION OF AIR BORNE CONTAMINATION — UO_3 PLANT. W. P. Ingalls and Kenneth L. Sanborn. May 11, 1956. 16p. Contract [W-31-109-Eng-52]. $3.30(ph OTS); $2.40(mf OTS).
Scope and design criteria are given for improvements to the UO_3 Plant electric pot agitation, electric pot covers, and the HNO_3 off-gas system which should reduce air-borne contamination. (T.R.H.)

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8553 AEC-tr-3981
PRESENT TECHNICAL POSSIBILITIES FOR RADIATION MONITORING IN GASES, USING IONIZATION CHAMBERS. H. Boehm. Translated for Los Alamos Scientific Lab. from Atompraxis 3, 369-72(1957). 7p. JCL.

The continuous monitoring of air and other gases for their content of toxic radioactive constituents in the vicinity of reactors, laboratories, and U mines and reduction plants is discussed. The design and construction of an ionization chamber for radiation monitoring are presented. (W.L.H.)

2117 AERE-Med/R-2643
United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England.
MONITORING FOR CARBON MONOXIDE AND CARBON DIOXIDE. A. Holmes. Aug. 1958. 25p. $0.70(BIS).

A discussion of existing CO and CO_2 monitoring methods is presented along with a brief summary of health aspects of these gases. A selected method using an infrared gas analyzer for instantaneous and continuous monitoring of either gas is described. (J.R.D.)

6560
CONCENTRATION OF AN EMANATION IN THE AIR. J.-C. Philippot and A. Becker. Bull. inform. sci. et tech. (Paris) No. 33, 12-23(1959) Oct. (In French)

The connection between the apparent activity measured with a given detecting system and the actual concentration of the natural and artificial radioactive products in the air is investigated. The following points were studied: the equilibrium between the radioactive products, which is established on the filter-paper during the sampling; the decay chain of the various emitters and the sensitiveness of the detector to the different radiations; the influence of warping of the filter-paper and the absorption which is produced in front of these radiations; the determination of the geometrical factor of the detector. This study was made for the case of three different experimental devices. The agreement between these three cases and the theoretically predicted results is quite satisfactory. (auth)

14519 A/CONF.15/P/738
Rochester, N. Y. Univ. School of Medicine and Dentistry.
AN EVALUATION OF INHALATION HAZARDS IN THE NUCLEAR ENERGY INDUSTRY. J. N. Stannard. 15p. $0.50(OTS).

Prepared for the Second U. N. International Conference on the Peaceful Uses of Atomic Energy, 1958.

Factors to be considered in evaluating inhalation hazards in the nuclear energy industry are reviewed. A survey of results from recent studies indicates that power reactors present potentially a much greater inhalation hazard than weapons fall-out. It is concluded that it is unsafe to extrapolate from aerosol data pertinent to chemically toxic materials to radioactive aerosols. The hazard may be related more to numbers of particles than to the mass of material. Submicroscopic particles may be the most hazardous because of their numbers. While the gastrointestinal tract may at times contain more material than other organs, it is questionable if it should be considered the most critical organ. The accumulation of material in pulmonary lymph nodes, particularly after prolonged inhalation exposure, may greatly exceed that in lung. Lymph node accumulation may limit exposure under many conditions, and calculation of maximum permissible doses on this basis may be required. The lung is considered as a moderately radiosensitive organ with clearly measurable damage resulting from exposure to 1000 and 2000 r. Induction of invasive cancer by radioactive materials deposited in lung has been demonstrated, and the order of damage can be estimated. In normal operations, the mining and processing of uranium ore may involve the largest number of individuals and be the most likely source of radioactive inhalation hazard in nuclear energy work. Ventilation of mines and mills and the use of respiratory protective equipment can aid greatly in relieving this hazard. (C.H.)

A VENTURI SCRUBBER INSTALLATION FOR THE REMOVAL OF FISSION PRODUCTS FROM AIR. H. S. Jordan and C. G. Welty (Los Alamos Scientific Lab., N. Mex.). Am. Ind. Hyg. Assoc. J. 20, 332-6(1959) Aug.

A local exhaust collection system and a venturi scrubber installation for the cleaning of exhaust air contaminated with acid mists and mixed fission products are described in detail. It was determined that 20 cfm exhausted by a local slot exhaust hood would control the maximum evolution of gases from a 1500 ml beaker.

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Features of the exhaust system that were designed to offset the hazard of perchloric acid condensation in the system included welded stainless steel construction, sloping horizontal runs, regulating valves only on vertical sections, and adaptability to cleaning by simple washdown. The feasibility of a venturi scrubber with a caustic solution as the scrubbing medium for low loadings of iodine vapors (2.4×10^{-4} to 7.3×10^{-3} $\mu g/m^3$) was indicated by an average removal efficiency of 95 per cent. Air-cleaning efficiencies for acid mists were dependent on the type of acid suspended in the air stream. Removal efficiencies of 90 per cent and 95 per cent were obtained with nitric acid and oxides of nitrogen loadings of 2 grams/m^3, and with perchloric acid loadings of 3 grams/m^3, respectively. Total fission product loadings ranging from 0.01 to 0.4 mc/m^3 were removed from the contaminated air with an average efficiency of 94 per cent. (auth)

440 HASL-58(p.180-4)
New York Operations Office. Health and Safety Lab., AEC.
ENVIRONMENTAL CONTAMINATION. Martin S. Weinstein. 5p.
Results of environmental pollution studies conducted by HASL at natural uranium processing facilities indicate little, if any, contamination of soil, water, or air. Estimates indicate a loss of about $2,000,000 worth of uranium in stack effluents at three major facilities over a 14-year period. Examination of some of the economic aspects of environmental pollution control indicates the practicality of the installation of air cleaning equipment. (C.H.)

11041
AIR TREATMENT IN ACTIVE LABORATORIES. C. Fisher and A. V. Bestre (Matthew Hall & Co. Ltd.). Nuclear Power 2, 311-14(1957) Aug.
General considerations in design and construction of air treatment facilities for "hot" labs are discussed. Filters, fans, and seals are considered, and the special cases of glove boxes, hot cells, and chemical separation are treated. (T.R.H.)

12156 TID-7551(p.30-1)
Westinghouse Electric Corp. Bettis Plant, Pittsburgh.
AEC BETTIS PLANT AIR CLEANING ACTIVITIES. P. R. Bolton and J. E. Ross. p.30-1 [of] FIFTH ATOMIC ENERGY COMMISSION AIR CLEANING CONFERENCE HELD AT THE HARVARD AIR CLEANING LABORATORY, JUNE 24-27, 1957. 2p.
The types and performance of filters used at Bettis Plant for removal of radioactive particulates and acid fumes and mists from process air are outlined. Both wet and dry collectors are described. (T.R.H.)

12159 TID-7551(p.35-40)
Knolls Atomic Power Lab., Schenectady, N. Y.
AIR CLEANING OPERATIONS AT KAPL. W. H. Truran. p.35-40 [of] FIFTH ATOMIC ENERGY COMMISSION AIR CLEANING CONFERENCE HELD AT THE HARVARD AIR CLEANING LABORATORY. JUNE 24-27, 1957. 6p.
The air cleaning systems at Knolls Atomic Power Laboratory are briefly described and operating experience such as preventive maintenance inspection, maintenance, filter service life, and cleaning is summarized. (T.R.H.)

AIR POLLUTION. Kingsley Kay (Dept. of National Health and Welfare, Ottawa, Can.). *Anal Chem.* 29, 589-604(1957).
A review, including 498 references, is presented which is concerned with the study of aerosols and gas and vapor analysis. Aerosol collection techniques are reviewed along with methods of aerosol analysis, physical measurements on suspended particles, and aerosol generators. The topics given under gas and vapor analysis are: collection of gases and vapors; analysis for nitrogen oxides; ozone and related oxidants; hydrocarbons and related problems; etc.

10055
HEATING AND VENTILATING AT HARWELL G. M. Harbert (Atomic Energy Research Establishment, Harwell, Berks, England). Nuclear Power 1, 75-8(1956) June.
Various methods of heating laboratories at Harwell are discussed. Utilization of waste-heat from BEPO, the natural uranium, graphite moderated research reactor, to provide space heating and hot water is described in some detail and the limitations of the system are related. The trend of mechanical ventilation systems in radioactive lab-

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oratories is reviewed and features of some unusual systems are explained, including the use of glass ducts and the operation of axial-flow fans in series to provide high head and so increase the useful life of high-grade filters which, being active, present a disposal problem. (auth)

VENTILATING RADIOLOGICAL LABORATORIES. Melville G. Kershaw (E. I. du Pont de Nemours & Co., Inc., Wilmington, Del.). Chem. Eng. Progr. 52, Symposium Ser. No. 19, 15-24(1956).

Basic concepts and a description of successful solution, to ventilating problems encountered in radiological laboratories are given. Radioactive contaminants, solid or gaseous, must be confined, controlled, collected, removed or diluted to prevent recirculation or contamination of surrounding areas. The control of radioactive contamination requires proper partitions, enclosures, hoods, etc. Air must flow from clean areas toward and into the more contaminated areas. (auth)

7429 TID-7513(Pt. I)
Division of Reactor Development, AEC.
FOURTH ATOMIC ENERGY COMMISSION AIR CLEANING CONFERENCE HELD AT ARGONNE NATIONAL LABORATORY, NOVEMBER 1955. 320p. $1.50(OTS).

Air cleaning operations, equipment, and research projects at AEC and associated installations are described. (C.H.)

DECONTAMINATION OF WASTE GASES. Detailed Project Status Report. Job 11. Sept. 23, 1949. Decl. Jan. 11, 1956. 60p. (KLX-55)

The results of a laboratory investigation of possible procedures for removing radioactive particulate material entrained in gas streams has indicated that, by use of a steam injection technique, removal efficiencies approaching those currently being obtained by CWS-6 filter paper and sand filters can be realized in a commercial wet impingement plate scrubber operating on a nonradioactive dust suspension which approximates actual plant conditions. Operating the scrubber alone proved unsatisfactory. A preliminary investigation of the effect of sonic agglomera-

21705
AIR CLEANING STUDIES. Leslie Silverman (Harvard Univ., Cambridge, Mass.). p.1650-59 of "Hearings on Industrial Radioactive Waste Disposal. Volume 2."

A discussion is given of air cleaning problems with reference to methods for removal of iodine from air, inexpensive devices for incinerating solid waste, economic feasibility of air and gas cleaning, and the development of filtration devices. (C.J.G.)

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11264
POSSIBLE IMPROVEMENT IN MASKS AND PROTECTIVE FILTERS AGAINST RADIOACTIVE POWDERS. Pierre-Octave Robert. Compt. rend. 246, 2886-9(1958) May 19. (In French)

It is shown that even the best masks are not capable of assuring protection in a very contaminated area. However, by the use of three or more layers of the filters and a filter weight increase of 50%, the maximum permissible dose would not be attained in 100 8-hr days. The pressure drop with a mask of this type would be 6 mm. (J.S.R.)

11261
RESPIRATOR PROBLEMS IN ATOMIC ENERGY PRACTICE. G. W. C. Tait and T. H. Byington (Atomic Energy of Canada, Ltd., Chalk River, Ont.). Am. Ind. Hyg. Assoc. J. 19, 123-5(1958) Apr.

As a result of the NRX reactor accident of December 12, 1952, large crews were dependent upon respirators for protection during the dismantling and rebuilding of the damaged reactor. The efficiency of the respirators used for protection of the workmen is discussed. (C.H.)

11220
RESPIRATORY PROTECTION EQUIPMENT DEVELOPMENTS BY THE U. S. ARMY CHEMICAL CORPS. Allan L. West (Army Chemical Center, Md.). Am. Ind. Hyg. Assoc. J. 19, 140-8(1958) Apr.

In addition to its mission of developing respiratory protective equipment for protection of the United States armed forces against the hazards of toxicological warfare agents, the U. S. Army Chemical Corps has the responsibility for the procurement, storage, and issue

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of several types of safety and rescue type respiratory protective equipment for use by agencies of the Department of Defense. An illustrated discussion is presented on the following classes of individual respiratory protective equipment which have been standardized by the U. S. Army Chemical Corps: military protective masks, special purpose gas masks, self-contained breathing

11221
THE RESPIRATOR PROBLEM, AN INDUSTRIAL HYGIENIST'S VIEWPOINT. Harry S. Jordan (Los Alamos Scientific Lab., N. Mex.). Am. Ind. Hyg. Assoc. J. 19, 149-53(1958) Apr.
Problems in the development and testing of respiratory protective equipment are summarized. (C.H.)

13441 ✓ AECU-4144
Los Alamos Scientific Lab., N. Mex.
BIBLIOGRAPHY ON RESPIRATORS. Gretchen R. Riese and Ruth M. Hendrickson, comps. Jan. 7, 1958. 31p. Contract [W-7405-eng-36]. (D-BIB-18). $6.30 (ph), $3.00(mf) OTS.
A bibliography containing over 200 references to periodical and patent literature is presented. (T.R.H.)

7494
TRANSISTORIZED VOICE AMPLIFIER FOR USE WITH RESPIRATORY MASKS. J. R. Gaskill and O. L. Meadors (Univ. of California, Livermore). Nucleonics 18, No. 2, 82(1960) Feb.
A transistorized voice-amplifier system was developed for use in various types of respirators worn while handling radioisotopes or other toxic materials. A schematic diagram and a description of the system are included. (B.O.G.)

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487 UCRL-5593
California, Univ., Livermore. Lawrence Radiation Lab.
THE CONTROL OF BERYLLIUM HAZARDS. Carl L. Lindeken and Orville L. Meadors. July 15, 1959. 23p. Contract W-7405-eng-48. OTS.
The toxicological properties of beryllium and compounds of beryllium are briefly reviewed, together with the historical development of the recommendations for maximum permissible beryllium air concentrations. The application of the enclosure technique for the control of beryllium hazards is described. Emphasis is placed on the design objectives of partial and total enclosures and the related function of auxiliary components. Monitoring procedures used to evaluate the performance of enclosures are discussed. (auth)

19070 IGIS-37(RD/R)
United Kingdom Atomic Energy Authority. Industrial Group H. O., Risley, Lancs, England.
BERYLLIUM HEALTH HAZARDS AND PROTECTION. U. R. M. Chadwick. May 2, 1959. 31p.
Comprehensive selection is presented of some 222 references to classified and unclassified literature on the subject and includes a selection of general references on the properties, uses, and fabrication of the metal. The references were obtained from the U.K.A.E.A. abstracts index to classified British, Canadian, and American reports, and Nuclear Science Abstracts (to June, 1958). (auth)

6420
BERYLLIUM HANDLING. REDUCING THE HEALTH RISK. R. O. R. Brooks (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Nuclear Power 3, 112-14(1958) Mar.
The precautions used at Harwell for the handling of beryllium and its compounds are outlined and discussed. Building design, interior finish, air purification, protective enclosures, hazards of dry sweeping, waste disposal, and contamination checking are considered. (J.S.R.)

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BERYLLIUM 4.01.02

1264 DMIC-Memo-2
Battelle Memorial Inst. Defense Metals Information Center, Columbus, Ohio.
SOME NOTES ON SAFE HANDLING PRACTICES FOR BERYLLIUM. Webster Hodge. Sept. 22, 1958. 14p.
Information based on limited literature references and observations of shop operations by DMIC personnel is presented. It is pointed out that no safe handling recommendations for a new facility can be made on the basis of available information; however, the references and descriptions may be useful as guide lines in shops where beryllium is being handled for the first time. Maximum allowable concentration is considered, along with methods of air sampling and hood systems for collection and disposal of dust. In addition, the experiences of several organizations which handle beryllium are reviewed. (J.R.D.)

12962 MAB-135-M
National Research Council. Materials Advisory Board.
REPORT OF THE PANEL OF TOXICITY OF BERYLLIUM. July 31, 1958. Includes Reprint: HEALTH HAZARDS FROM BERYLLIUM. Merril Eisenbud. Reprinted from The Metal Beryllium published by The American Society of Metals, 1955. 29p. Contract DA-36-039-sc-76436.
A study of the sources of hazards from beryllium during its storage, fabrication, and testing of fabricated parts is reported. Permissible concentrations, handling precautions, and policing procedures are discussed. A recommended research program for further study of beryllium hazards in connection with its use in aircraft is outlined. (T.R.H.)

1265 HASL-36
New York Operations Office. Health and Safety Lab., AEC.
HEALTH PROTECTION IN BERYLLIUM FACILITIES SUMMARY OF TEN YEARS OF EXPERIENCE. A. J. Breslin and W. B. Harris. May 1, 1958. 62p. $1.75 (OTS).

7166
A NEW LABORATORY FOR BERYLLIUM RESEARCH. John D. Abbatt, F. L. Griffiths, and P. J. Phennah. G.E.C. Atomic Energy Rev. 1, 154-9(1958) Mar.
After a brief summary of the precautions necessary when working with beryllium, a full description is given of a laboratory specially constructed for such work by the G.E.C. at Erith. Details, including illustrations, are given of the air-conditioning arrangements and of operating procedures. A brief description of the method used for monitoring beryllium concentrations is included. (auth)

1711 AERE-R-3000
United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England.
THE CONTROL OF BERYLLIUM HANDLING AT A.E.R.E. HARWELL. R. O. R. Brooks. July 1959. 22p. BIS.
This is a revised version of AERE-Med/R-2119.
Beryllium and its compounds as potential health hazards are discussed together with methods, both engineering and medical, for protection of personnel handling beryllium in its various forms. (J.E.D.)

11194 AEC-tr-3577
THE TECHNOLOGY AND PROPERTIES OF BERYLLIUM. Goran Lagerberg. Translated for Oak Ridge National Lab. from a report of the AB Atomenergi, Stockholm, 1958. 55p. $9.30(ph), $3.60(mf) JCL or LC.
The literature study gives a survey of the technology and characteristics of beryllium, especially in regard to the possibilities for using it as cladding material in gas-cooled reactors. The physical characteristics, metallurgy, workability, mechanical characteristics, welding, and corrosion of beryllium are discussed. Also discussed are special methods for the fabrication of cladding tubes, changes in beryllium due to neutron radiation, and health risks involved in working with beryllium. (auth)

12666 LMSD-2260
Lockheed Aircraft Corp. Missile Systems Div., Palo Alto, Calif.
BERYLLIUM. A Search of the Unclassified Literature. Wanda G. Bradshaw. Nov. 1, 1957. 57p. Contract NOrd-17017.
A search of the literature on beryllium metal was made in order to present in a comprehensive form the sources of information available in the unclassified literature. The search covered topical and progress

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BERYLLIUM 4.01.02

reports and journal references, with emphasis on the period 1947 to 1957. References to compounds of Be such as the carbide, oxide, or nitride were excluded from the scope of this report. References to Be–Cu alloy were not included with the exception of irradiation effects. Only those references on Be toxicology and safety which appeared to be of interest to the laboratory worker or engineer were included. The literature on the analytical chemistry of Be was so extensive that it was not summarized. (auth)

BERYLLIUM-HAZARD DETECTION USING POLONIUM-210 ALPHAS. R. Gold (Illinois Inst. of Tech., Chicago). Nucleonics 15, No. 11, 114, 116, 118(1957) Nov.

Samples of air-borne Be dust are collected on filter paper and exposed to a flux of Po^{210} α particles. The γ-ray yield of the $Be^9(\alpha,n\gamma)C^{12}$ reaction can then be used to analyze the Be content of the filter paper in 5 to 10 min. The predominant 4.43-Mev γ transition to the C^{12} ground state is detected with NaI(Tl) crystals. (L.T.W.)

3021 AERE-E/S-24
Gt. Brit. Atomic Energy Research Establishment, Harwell, Berks, England.
THE DEVELOPMENT AND PRODUCTION OF A MOBILE BERYLLIUM MONITOR. T. W. Hodge. Sept. 1957. 12p.

A Ford van was reconditioned and modified. The front part of the van was sealed to include the monitor and operator's seats and a self-contained generator set was provided. (M.H.R.)

12657
BERYLLIUM. HAZARD EVALUATION AND CONTROL COVERING A FIVE YEAR STUDY. R. N. Mitchell and E. C. Hyatt (Los Alamos Scientific Lab., N. Mex.). Am. Ind. Hyg. Assoc. Quart. 18, 207-13(1957) Sept.

12152 TID-7551(p.23-4)
Brush Beryllium Co., Cleveland.
AIR CLEANING ACTIVITIES AT BRUSH BERYLLIUM COMPANY. Hal J. Shafer. p.23-4 [of] FIFTH ATOMIC ENERGY COMMISSION AIR CLEANING CONFERENCE HELD AT THE HARVARD AIR CLEANING LABORATORY, JUNE 24-27, 1957. 2p.

Air cleaning practices and equipment used at Brush Beryllium Co. are briefly reviewed. (T.R.H.)

6459 AECU-3505
Illinois Inst. of Tech., Chicago. Armour Research Foundation.
DETECTION OF AIR-BORNE BERYLLIUM DUST. Final Report Covering the Period from May 1955 to February 1957. R. Gold and C. A. Stone. Apr. 25, 1957. 85p. Project No. A-057. Contract AT(11-1)-346.

Present chemical techniques for analyzing minute amounts of beryllium are involved and quite time consuming. A method has been developed, utilizing the yield of neutrons and gamma rays from Be^9 under alpha particle bombardment. Samples of air-borne beryllium dust collected on filter paper are exposed to Po^{210} alpha particles and can be analyzed in a matter of minutes. A 3 × 3 inch NaI(Tl) crystal and low voltage discriminator are used to detect the gamma ray yield (4.45 Mev). This yield has been correlated with the beryllium content of filter paper down to ~ 0.2 μg. This technique should greatly facilitate the evaluation of industrial beryllium dust hazards. (auth)

15828 AECU-4143 and Suppl.
Los Alamos Scientific Lab., N. Mex.
BIBLIOGRAPHY ON THE TOXICOLOGY OF BERYLLIUM. Gretchen R. Riese, comp. Jan. 2, 1957. 40p. Includes Supplement. 14p. Contract [W-7405-eng-36]. (D-BIB-1 and Suppl.). $9.30(ph), $3.60(mf) OTS.

This bibliography on the toxicology of beryllium includes references from the medical literature between 1942 and 1956. (C.H.)

10804 KAPL-M-JEL-1
[Knolls Atomic Power Lab., Schenectady, N. Y.]
A REVIEW OF BERYLLIUM AND URANIUM AIRBORNE CONTAMINATION IN KAPL SHOP AND LABORATORY AREAS. J. E. Loy. Jan. 17, 1951. Decl. Jan. 28, 1957. 8p. Contract [W-31-109-Eng-52]. $1.80(ph OTS); $1.80 (mf OTS).

Beryllium Advisory Committee, AEC.
CURRENT KNOWLEDGE OF DISEASE ENCOUNTERED IN THE HANDLING OF BERYLLIUM AND ITS COMPOUNDS: CLINICAL, PATHOLOGICAL, EXPERIMEN-

RADIOACTIVE AND NONRADIOACTIVE 4.01

BERYLLIUM 4.01.02

TAL, AND ENGINEERING DATA. Symposium Held at the Massachusetts Institute of Technology, Cambridge, Massachusetts, January 18, 1950. 69p. $10.80(ph), $3.90(mf) OTS.

This symposium deals with the clinical reports on beryllium illness in various industries, engineering control of beryllium hazards, basis for environmental control of beryllium poisoning, pathology of acute diseases, chronic occupational and non-occupational pulmonary berylliosis, pathology of beryllium-induced skin lesions, and biochemical effects of beryllium. A report on animal studies is given. (J.E.D.)

Australia. Defense Research Labs., Maribyrnong, Victoria. THE TOXICITY OF BERYLLIUM; INFORMATION CIRCULAR 15. Claire R. Taylor. 44p. (NP-1722).

Abstracts of 63 papers and articles dealing with various aspects of the toxicity of Be and its compounds are included.

DUSTS AND POWDERS 4.01.03

See also, under PLANTS AND EQUIPMENT, FILTERS (5.08).

6816 NP-6281

Brussels. Centre D'Etudes Pour Les Applications de l'Energie Nucleaire.

MESURE DE L'ACTIVITE DES POUSSIERES EN SUSPENSION DANS L'AIR. (Measurement of the Activity of Dusts in Suspension in Air.) R. Boulenger. July 6, 1956. 11p. (B-1242).

6741 NYO-4869

New York Operations Office. Health and Safety Lab., AEC.

HEALTH AND SAFETY IN POWDER METAL HANDLING. W. B. Harris. Apr. 1957. 23p. $0.20(OTS).

The use of metal powders of interest to the AEC is discussed. Those properties of powders which present unusual problems of health and safety are presented together with the possible effects which these powders may have on workers and their environment. Protective measures and equipment for controlling fire, explosion, and health hazards are presented. (auth)

GENERAL IDEAS ON THE IMPORTANCE OF POWDER CONTAMINANTS IN NUCLEAR PLANTS. Emilio Iranzo González. Energia nuclear (Madrid) 1, No. 4, 46-58(1957) Oct.-Dec. (In Spanish)

Atmospheric contaminants from diverse industrial operations constitute a major health problem, especially in plants where work is done with radioactive materials. The various methods used to collect air samples in such plants are described in detail. (J.S.R.)

1698

PULMONARY EFFECTS FROM RADIOACTIVE BARIUM SULFATE DUST. H. Cember, T. F. Hatch, J. A. Watson, and T. Grucci (Univ. of Pittsburgh). Arch. Ind. Health 12, 628-34(1955) Dec.

Rats were exposed by intratracheal insufflation to radioactive barium sulfate particles at levels of 4.5 mc., 45μc, and 4.5μc radiosulfur, and were serially killed over a nine-month period. A very small increase in the intensity of inflammation and cicatrization was observed in the animals that received the highest dose. This increase, however, was not considered significant and was not attributed to radiation. It is therefore suggested that the intense radiation dose delivered to the small volume of lung tissue in the immediate vicinity of the barium sulfate particles may not be as hazardous as might be expected or that the latent period for production of serious radiation injury is very much longer than the nine-month period over which these animals were observed. (auth)

CHEMICAL ENGINEERING IN THE INDUSTRIAL DEVELOPMENT OF BORON HYDRIDES. Lewis A. Barry (Callery Chemical Co., Penna.). Chem. Eng. Progr. 54, No. 10, 152-4, 156, 158(1958) Oct.

The problems confronting a boron hydride process designer are investigated. The most perplexing problems result from the extreme reactivity, moisture and air sensitivity, and toxicity of boron hydrides. Discussions of these problems and of the process at Callery Chemical Company are presented. (J.R.D.)

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DUSTS AND POWDERS 4.01.03

TOXICITY OF HIGH-ENERGY FUELS. William H. Schechter. Arch. Ind. Health 17, 362-6(1958) May.

The boron hydrides, and some of the related compounds used in high-energy fuels, are toxic and their safe use depends upon proper knowledge and safety practices. No permanent damage was observed in employees handling these materials over a ten-year period. (C.H.)

THE HAZARD OF RADIOACTIVE CONTAMINATION BY THE USE OF Co^{60}. Julius K. Ries (Der I. Frauenklinik der Universität, Munich). Strahlentherapie 104, 605-8 (1957). (In German)

Investigations have proved that Co^{60} in the form of macrobalt as it is used nowadays, and with its present working equipment produces a concentration of radioactive cobalt through the plastic mass in the wood implements. This Co^{60} appearing mostly in dustlike particles provokes the great danger of radioactive contamination of the working rooms and endangers the personnel to get infected even through inhalation of the air. Macrobalt, therefore, should be used only with utmost caution and with the same protective measures which are prescribed for the use of open isotopes, as long as the proposals to abolish the dangers are not yet realized. (auth)

415 HASL-58(p.3-9)
Mallinckrodt Chemical Works, St. Charles, Mo.
A SUMMARY OF FIFTEEN YEARS OF EXPERIENCE WITH DUST PROBLEMS IN THE REFINING AND FABRICATION OF URANIUM. Mont G. Mason. 7p.

The fifteen years of experience with uranium production shows no clinical or medical evidence of damage to workers from chronic exposure, even though some workers had potential high chronic dust exposure in the early years. Dust control continues to be a major health protection problem. The uranium industry as a whole does not have well defined standards for health protection and is faced with continued controversy in the matter of protection versus cost. It is imperative that adequate standards be developed so that the industry can proceed in an orderly manner. Whether the data indicate a need for the program to be conservative or liberal is secondary to the need for uniformity and for a clear definition of minimum performance requirements. (auth)

ZIRCONIUM. I. HYGIENIC STANDARDS. II. SIGNIFICANT PROPERTIES. III. INDUSTRIAL HYGIENE PRACTICE. IV. SPECIFIC PROCEDURES. V. LITERATURE REFERENCES. Am. Ind. Hyg. Assoc. J. 19, 446-7(1958) Oct.

The hazards of acute and chronic exposure to zirconium dust are reviewed. Industrial hygiene practices are outlined. 13 references. (C.H.)

895
A STUDY OF THE EFFECTS ON THE LUNG OF INDUSTRIAL EXPOSURE TO ZIRCONIUM DUSTS. C. E. Reed (Corvallis Clinic and the U. S. Bureau of Mines, Albany, Oreg.). Arch. Ind. Health 13, 578-80(1956) June.

FIRE 4.01.04

RADIOACTIVE MATERIALS AND INDUSTRIAL FIRE PROTECTION. F. R. Farmer (United Kingdom Atomic Energy Authority). Atom No. 22, 9-16(1958) Aug.

Information is presented on the development of safe practices for fire protection and fire prevention where radioactive materials might be involved. Discussions are included on: hazards of radioactive materials and regulations for the application of radioactive materials, the increasing use of radioactive materials in industry, the behavior of radioactive materials exposed to high temperatures or fire, and the industrial user's obligations. (J.H.M.)

15229 TID-7569
Office of Industrial Relations. Safety and Fire Protection Branch, AEC.
PROCEEDINGS OF THE 1958 ATOMIC ENERGY COMMISSION AND CONTRACTOR SAFETY AND FIRE PROTECTION CONFERENCE, HELD AT ATOMIC ENERGY COMMISSION HEADQUARTERS BUILDING, GERMANTOWN, MARYLAND, JUNE 24-25, 1958. May 15, 1959. 124p. $2.50(OTS).

Sixteen papers are included. Separate abstracts have been prepared for each paper. (W.L.H.)

15232 TID-7569(p.10-11)
Division of Inspection, AEC.
VIEWS OF THE AEC INSPECTION DIVISION ON

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FIRE 4.01.04

SAFETY AND FIRE PROTECTION. Arthur Tackman. p.10-11 [of] PROCEEDINGS OF THE 1958 ATOMIC ENERGY COMMISSION AND CONTRACTOR SAFETY AND FIRE PROTECTION CONFERENCE, HELD AT ATOMIC ENERGY COMMISSION HEADQUARTERS BUILDING, GERMANTOWN, MARYLAND, JUNE 24-25, 1958. 2p.

The primary inspection and appraisal objectives are those of line management. Every effort is made to assure that the inspection methods and techniques are such as to demand priority attention to the safety- and fire-protection requirements, to assure line management of full information concerning such practices, and to give line management the most critical evaluation. (W.L.H.)

9575 CF-56-7-157
Oak Ridge National Lab., Tenn.
REPORT OF EXPLOSION AND FIRE IN HYDROGEN LIQUEFIER APPARATUS. T. W. Hungerford, J. E. Lain, and B. M. Beeler. July 31, 1956. 11p. Contract [W-7405-eng-26]. $3.30(ph OTS); $2.40(mf OTS).

535 AECU-3100
Atomic Energy Commission, Washington, D. C.
RADIATION HAZARDS IN FIREFIGHTING. Safety and Fire Protection Technical Bulletin No. 4. [1955]. 39p.

Safety and Fire Protection Technical Bulletins 1-3 are not available.

Firefighting techniques are discussed for use when radioactivity is a factor. It is pointed out that radiation should be neither feared nor ignored but should be regarded as another hazard to be taken in stride as a result of education and understanding. (C.H.)

20058 CEA-tr-X-133
INSPECTION GÉNÉRALE POUR LA LUTTE CONTRE L'INCENDIE. (General Inspection for Fire Fighting.) Translated into French from Circular No. 23 of Statens Brandinspektion, Stockholm, Sweden. 46p.

The precautions and procedures to be used by the fire department during disasters at installations where radioactive material is present are presented. The properties of radioactive substances and the dangers inherent in their manipulation are discussed. (J.S.R.)

10355 CF-58-6-6
Oak Ridge National Lab., Tenn.
ESTIMATE OF THE PROBABILITY AND CONSEQUENCES OF IGNITION OF THE HRT CHARCOAL BEDS. R. E. Adams and W. E. Browning. June 3, 1958. 11p. Contract [W-7405-eng-26]. $1.80(ph OTS); $1.80 (mf OTS).

The ignition temperature of Columbia G activated charcoal in a flowing oxygen stream was determined to be 290°C under conditions simulating the inlet of the HRT charcoal beds. Calculations of charcoal temperatures resulting from beta decay of adsorbed fission gases from the HRT indicate that this temperature will not be reached provided the reactor power does not exceed 10 Mw with an accompanying oxygen flow not exceeding 2 liters/min. At lower power levels higher oxygen flow may be tolerated. If, by a combination of circumstances, ignition of the charcoal should occur, it will be possible to extinguish the fire by stopping the oxygen flow. The down-stream propagation of the combustion front is slow enough to allow detection and corrective action to be taken before a serious situation occurs. (auth)

7635 AERE-R-3067
United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England.
SOME ASPECTS OF FIRES IN GLOVE BOXES. C. Jackson, T. W. Hodge, D. H. Swingler, and A. J. Smith. Oct. 1959. 27p. BIS.

A series of tests was carried out to determine the magnitude of the stresses to which a glove box and its associated fittings would be subject if a fire occurred within the box. From this information an attempt was made to forecast the probable effect of accidental fires. A few fire-extinguishing agents were tested in the light of estimated requirements. (auth)

See also, this section,

PYROPHORICITY (4.01.10).

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FLUORINE 4.01.05

See also, under PROCESS CHEMISTRY AND ENGINEERING,

SPECIAL PROCESSES--Fused Salt-Fluoride Volatility (6.17.11),

Fluorox (6.17.09).

21061 NASA-TN-D-63
National Aeronautics and Space Administration. Lewis Research Center, Cleveland.
FIELD EXPERIMENTS ON TREATMENT OF FLUORINE SPILLS WITH WATER OR SODA ASH. R. James Rollbuhler, George R. Kinney, and Lorenz C. Leopold. Sept. 1959. 15p. $0.50(OTS).

Water and soda ash were investigated for use as deluge agents to reduce contamination from F spills. Thirty to 40% of the released F was captured by these agents. The reactions were rapid, however, no damage to the test structure was noted. Liquid F caused violent reactions. Fine water sprays were more effective reactants than were coarse. (J.R.D.)

14231 NASA-M-1-27-59E
National Aeronautics and Space Administration. Lewis Research Center, Cleveland.
DESIGN AND OPERATING CRITERIA FOR FLUORINE DISPOSAL BY REACTION WITH CHARCOAL.
Harold W Schmidt. Feb. 1959. 18p.

Design and operational criteria were determined for the utilization of the charcoal–fluorine reaction for fluorine disposal. The disposal-rate limit was found to be inversely proportional to the charcoal-bed particle diameter. Fluorine dilution and moisture content of the charcoal do not affect the reaction significantly. (auth)

13448 IGR-TM/CA-0157
United Kingdom Atomic Energy Authority. Industrial Group. Capenhurst Works, Capenhurst, Ches., England.
A FLUORINE FIRE IN THE GAS-HANDLING SYSTEM OF A MASS SPECTROMETER USED FOR URANIUM HEXAFLUORIDE ANALYSIS. E. J. Robbins. Dec. 11, 1958. 4p.

A fire which occurred in the gas-handling system of a mass spectrometer was caused by the action of fluorine on a polythene diaphragm. As a result fluorine should not be admitted to any inlet system containing polythene. (auth)

EMISSION OF FLUORIDES FROM INDUSTRIAL PROCESSES; A REVIEW. Konrad T. Semrau (Stanford Research Inst., Menlo Park, Calif.). J. Air Pollution Control Assoc. 7, 92-108(1957) Aug.

An investigation has been made of atmospheric pollution by fluorides emitted from industrial processes in which fluorine compounds are manufactured. Thermodynamic considerations and previous studies indicate that the principal mechanism of liberation of fluorides in high-temperature processes is pyrohydrolysis, which results in formation of HF. The principal variables in pyrohydrolysis in most industrial processes appear to be the equilibrium of the reaction, the water vapor concentration in the process atmosphere, and the factors determining mass transfer. Significant formation of SiF_4 appears to be limited to cases involving thermal decomposition of fluosilicates or reaction of fluorides and silica with acids at relatively low temperatures.

1287 BNL-470
Brookhaven National Lab., Upton, N. Y.
ACCIDENT IN CONTINUOUS-DISSOLVER PILOT PLANT OF FLUORIDE VOLATILITY PROJECT ON MAY 15, 1957.
Gerald Strickland, F. L. Horn, Richard Johnson, and O. E. Dwyer. July 10, 1957. Revised Aug. 20, 1957. 44p. $9.30(ph OTS); $3.60(mf OTS).

A series of explosions, estimated at five, occurred over a period of ten seconds within the continuous dissolver pilot plant, of the Fluoride Volatility Project on May 15, 1957. The explosive reactions occurred in the dissolver vessels as a result of violent chemical reactions between uranium and an interhalogen mixture. Just what the conditions were which triggered the explosions, have not been definitely established. Nevertheless, based upon the

FLUORINE AND FLUORINE COMPOUNDS

7956 TID-3507
Technical Information Service Extension, AEC.
U. S. ATOMIC ENERGY COMMISSION REPORTS ON

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FLUORINE 4.01.05

ELEMENTAL FLUORINE. Sidney F. Lanier, comp. May 1957. 13p. $0.15(OTS).

An annotated bibliography is presented which contains 42 references on generation, cell design, handling, analysis, toxicity, and other topics of interest in the commercial production of F_2. (T.R.H.)

6222 GAT-184(Rev. 1)
Goodyear Atomic Corp., Portsmouth, Ohio.
A STUDY OF THE FLUORIDE CONCENTRATION IN THE SCIOTO RIVER AND TRIBUTARY STREAMS. H. L. Burkhardt, H. L. Caterson, B. Kalmon, and R. A. Manning. Apr. 1, 1957. 14p. Contract AT(33-2)-1. $0.20(OTS).

As part of the program of insuring that dangerous or obnoxious waste materials are not discharged from the Portsmouth area gaseous diffusion plant, GAT maintains a program of monitoring the plant waste water for fluoride content. This program was inaugurated in August 1954. Monitoring points are located along the Scioto River, both above and below plant site, and along the tributary streams into which plant waste water is discharged. Fluoride content of the Scioto River as reported in two surveys by the U. S. Public Health Service, prior to the operation of the plant, is compared to the fluoride data obtained by the GAT monitoring program. Calculations using these data are made to show the effect of plant effluent on the fluoride content of the Scioto River. (auth)

DISPERSAL PATTERNS AND EFFECTS OF FLUORINE VENT GASES. H. L. Burkhardt, H. C. Caterson, R. A. Manning, and B. Kalmon. June 29, 1956. 11p. (GAT-185)

The Goodyear Atomic Corporation program to follow the offsite movement of fluorine compound waste gases, which are vented directly to the atmosphere in the course of production operations, is presented. The program includes routine monthly vegetation, air, water, and mud sampling, aerial and ground photographic studies in color, and compilation of meteorological data. Results indicate no appreciable F_2 uptake in surrounding water, soil, or vegetation. It is concluded that dispersal of F_2 vent gases is in accordance with an inverse square law. This fact makes it improbable that damaging concentrations could move from the plant site without leaving widespread evidence of damage to onsite foliage, or without causing immediate complaints from GAT personnel of oppressive F_2 odor.

7445
INHALATION TOXICOLOGY OF CHLORINE TRIFLUORIDE. II. Chronic Toxicity. Henry J. Horn and Robert J. Weir (Hazleton Laboratories). Arch. Ind. Health 13, 340-5 (1956) April.

Dogs and rats were exposed to an average concentration of 1.17 ppm of chlorine trifluoride for a total period of six months on a six-hour-per-day, five-day-per-week basis. Signs of toxicity in the dogs consisted of coughing, sneezing, rhinorrhea, lacrimation, salivation, panting-type respiration, and occasionally coughing up a frothy fluid. After about two months both dogs had recurrent bouts of pneumonia, which resulted in the death of one dog on the 115th day of the experiment. Signs of toxicity were not so pronounced in the rats, but after several weeks they had a blood-tinged discharge about their nares and eyes. Furthermore, they

5040
PROTECTIVE COATING COMPOSITION COMPRISING A POLYMER OF CHLOROPRENE AND AN ALKALINE EARTH METAL FLUORIDE. Allan J. Carter, et al (to U. S. Atomic Energy Commission). U. S. Patent 2,734,042, February 7, 1956.

This protective coating composition is particularly useful in coating, impregnating or close association with fibrous materials to produce a fabric which provides protection to workers with chemically corrosive substances such as F_2, Cl_2, HF, and the like. The coating consists essentially of a synthetic rubber base, Neoprene G N, which is compounded with an alkaline earth fluoride. (auth)

8781 AECD-3776
[Madison Square Area, Manhattan District, New York.]
THE TOXICITY OF FLUORINE. J. L. Ferry. [nd]. Decl. Nov. 29, 1955. 15p. (M-4883). $3.30(ph OTS); $3.00(mf OTS).

The biological effects of fluorine and fluorine compounds on man and animals are presented. Also presented are the principle hazards of fluorine from the industrial standpoint. (W.L.H.)

7139 HW-24495
[Hanford Works, Richland, Wash.]
REMOVAL OF HYDROGEN FLUORIDE FROM AN AIR STREAM BY ADSORPTION IN A DOREX CHARCOAL

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FLUORINE 4.01.05

FILTER. K. M. Harmon. May 16, 1952. Decl. Feb. 2, 1956. 4p. Contract [W-31-109-Eng-52]. $1.80(ph OTS); $1.80(mf OTS).

A Dorex charcoal filter was evaluated with respect to its use for removal of low concentrations (0.2 mol. %) of HF gas from an air stream. The charcoal absorbed 48g of HF before the efficiency dropped from the 96 to 98% level. Marble chips appear to be more suitable than charcoal. Absorption of 99% was obtained for 4-8 mesh chips. (F.S.)

376

TOXICOLOGICAL AND METABOLIC EFFECTS OF FLUORINE-CONTAINING COMPOUNDS. J. Larner. *Ind. Med. and Surg.* 19, 535-9(1950).

Various aspects of the toxicity of the element are discussed. The discussion is documented with 103 references.

19076 ✓ RISLEY-5006/21

Gt. Brit. Springfields Works, Springfields, Lancs, England.

THE INDUSTRIAL TOXICOLOGY OF FLUORINE AND CERTAIN FLUORIDES. E. F. Edson. Oct. 1949. 33p.

A review is presented of the major toxicological data concerning fluorine, hydrofluoric acid, uranium hexafluoride, and certain other fluorides. Major characteristics of the four groups of fluorine compounds and their fate in the body are summarized. Types of injuries caused by various fluorine compounds are discussed. Medical information on toxicological and therapeutic aspects of fluorine hazards is given. (C.J.G.)

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PROCEEDINGS OF THE SECOND UNITED NATIONS INTERNATIONAL CONFERENCE ON THE PEACEFUL USES OF ATOMIC ENERGY, HELD IN GENEVA, 1 SEPTEMBER–13 SEPTEMBER 1958. VOLUME 23. EXPERIENCE IN RADIOLOGICAL PROTECTION. Geneva, United Nations, 1958. 461p. $14.50.

New developments in radiation protection and recovery are reviewed. Topics discussed include developments in experimental therapy, methods for the assessment of biological contamination, radiation in the natural environment, experience in radiological protection and the control of radiation hazards, the evaluation of radiation hazards, the development of instruments for the detection of contamination, and the treatment of internal contamination. (C.H.)

DANGEROUS PROPERTIES OF INDUSTRIAL MATERIALS. N. Irving Sax. New York, Reinhold Publishing Corp., 1957. 1473p.

Approximately 9,000 chemicals are listed, and available information is included on the physical properties, formula, constants, toxicity, fire hazard, explosion hazard, disaster control, ventilation control, personnel protection, personal hygiene, first aid, and storage and handling. An introductory discussion of toxicology is presented. Other topics discussed include ventilation control; personnel protection and personal hygiene; atmospheric pollution; radiation hazards; industrial fire protection; the storage and handling of hazardous materials; reactor safeguards; allergic disease in industry; and shipping regulations. An index to synonyms is included. (C.E.)

1717 WADC-TR-57-118(II)

RCA Service Co., Inc., Camden, N. J.

A RADIOBIOLOGY GUIDE. PART II. F. DeWitt Kay, Jr. and Warren Hobson, Jr. May 1959. 126p. Project title: HEALTH HAZARDS OF MATERIALS AND RADIATION. Task title: HUMAN FACTORS OF NUCLEAR OPERATIONS. Contract AF33(616)-5491.

Part II of the USAF Radiobiology Guide examines the practical aspects of radiation protection and radiological health. The following topics are treated: biological effects of radiation, monitoring instruments and techniques, health physics, radiation exposure control, facility design, protective devices, decontamination, permissible doses, emergency procedures, medical treatment of radiation injury, handling and shipping radioactive material, and disposal of radioactive waste. Both military and nonmili-

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tary sources were used in compiling this volume. A typical radiological laboratory has been assumed, and discussions have been directed to its requirements relating to radiation protection. A detailed table of radioisotope data also is included. (auth)

20035 TID-7572(p.25-38)
National Bureau of Standards, Washington, D. C.
GENERAL PHILISOPHY OF HEALTH PHYSICS.
Lauriston Taylor. p.25-28 of SYMPOSIUM ON HEALTH PHYSICS IN BIOLOGY AND MEDICINE, HELD AT THE UNIVERSITY OF PUERTO RICO SCHOOL OF MEDICINE, SAN JUAN, MAY 26-28, 1958. 14p.

The background of the problem of protection against the harmful effects of radiation is reviewed. A summary is presented of the criteria of the International Commission on Radiological Protection, the International Commission on Radiological Units and Measurements, and the U. S. National Committee on Radiation Protection and Measurement. Changes in these criteria during prior years are discussed. (C.H.)

20044 TID-7572(p.114-40)
Tracerlab, Inc., Richmond, Calif.
HEALTH PHYSICS PROBLEMS ENCOUNTERED IN THE INDUSTRIAL USES OF RADIOISOTOPES.
George G. Manov. p.114-40 of SYMPOSIUM ON HEALTH PHYSICS IN BIOLOGY AND MEDICINE, HELD AT THE UNIVERSITY OF PUERTO RICO SCHOOL OF MEDICINE, SAN JUAN, MAY 26-28, 1958. 27p.

Radiological physics problems which are encountered in the industrial uses of atomic energy and radioisotopes are reviewed. Technical, educational, legal, and budgetary problems encountered by industry are discussed. The engineering aspects of the utilization of atomic energy are mentioned briefly, and administrative and health physics problems are discussed in detail. (C.H.)

413 CF-59-6-39
Oak Ridge National Lab., Tenn.
RADIATION HAZARDS FROM RECYCLED REACTOR FUEL. E. D. Arnold. June 9, 1959. 17p. OTS.

The radiation hazards associated with recycled nuclear reactor fuels will greatly complicate the handling and refabrication of these fuels. This problem is most serious with U^{233} and Pu fuels where the presence of U^{232} and the heavier isotopes of Pu contribute energetic alpha, gamma, and neutron radiations at levels many times that from isotopically pure U^{233} and Pu^{239}. Present knowledge of the radiation hazards associated with recycled fuel and the additional data needed to make a thorough evaluation of these hazards are summarized. (auth)

4485
PLANNING FOR A RADIATION ACCIDENT. Eugene L. Saenger (Univ. of Cincinnati). Am. Ind. Hyg. Assoc. J. 20, 482-7(1959) Dec.

With careful organization and training of both plant and community health facilities the confusion of radiation accidents can be significantly decreased. Rational approaches to potential radiation accidents are described and discussed. (C.H.)

20053 TID-7577(p.46-82)
Oak Ridge National Lab., Tenn.
IMMEDIATE EVALUATION OF DOSES FROM EXTERNAL RADIATION AND FROM INTERNAL CONTAMINATIONS IN THE EVENT OF A RADIATION ACCIDENT. Karl Z. Morgan. p.46-82 of SYMPOSIUM ON TECHNICAL METHODS IN HEALTH PHYSICS, RISÖ, DENMARK, MAY 25-28, 1959. 38p.

Two types of radiation exposure during accidents include exposure to external sources and exposure from internal sources. The first and most important consideration in radiation accidents is the prevention of such accidents. Appropriate training programs, the proper design and operation of buildings and facilities, and the effective functioning of an adequate health physics program cannot prevent all radiation accidents, but they can reduce the probability of their occurrence and can minimize their serious consequences. The second important consideration is early warning and immediate action when an accident happens. There is no doubt that the prompt exit of personnel during the Y-12 accident on June 16, 1958, and during the Argonne accident on June 2, 1952, prevented more serious consequences; and had there been similar retreat from the scene of the first two serious Los Alamos accidents (August 21,

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1945, and May 21, 1946), there is reason to believe the human exposures would have been materially reduced, and perhaps the two fatalities could have been prevented. An important part of the prompt action during the period of a radiation accident is the immediate identification of the individuals who received high exposures. Several features of personnel monitoring meters enable one to make this identification. The third step in an accident is a careful estimate of the absorbed dose from the various types of radiation, i.e., from neutrons, gamma radiation, beta rays, etc., received by each of the accident victims. In addition, information should be obtained on the energy spectra of the radiation, the dose distribution throughout the body, and the dose rate. All these factors furnish information that is useful in determining the seriousness of the exposure and in deciding on the subsequent medical treatment. The absorbed dose information is obtained from the personnel monitoring meters, from area meters, from the activation of Na-24 and P-32 in the body, and from a study of the radiation source and the flight path of each of the exposure victims. The fourth and last step in a radiation accident is that of re-entry and cleanup. Sometimes these steps must be taken quickly but with considerable caution and forethought. For example, a critical assembly that resulted in the accident may go critical again with the slightest provocation, or in the case of a radium spill, cutting off or isolating part of the ventilation system may prevent serious human exposure and contamination resulting in a great financial loss. (auth)

21818 ✓ NP-7914
Australia. Commonwealth X-Ray and Radium Lab., Melbourne.
ANNUAL REPORT FOR THE YEAR ENDED JUNE 30, 1958. D. J. Stevens. Jan. 1959. 21p.
Radium, radon, x ray, radioactive isotope, protection, and advisory services of the Laboratory are discussed and some statistical data are presented. (W.D.M.)

19066 ✓ AECU-4277
Carbide and Carbon Chemicals Corp. K-25 Plant, Oak Ridge, Tenn.
PROCEEDINGS OF THE SECOND INDUSTRIAL MEDICAL CONFERENCE, CARBIDE AND CARBON CHEMICALS CORPORATION, HELD AT K-25 PLANT DISPENSARY, OAK RIDGE, TENNESSEE, AUGUST 18-20, 1948. 119p. (KZ-6778). $16.80(ph), $5.70(mf) OTS.
Topics discussed at this conference include the pharmacology of uranium, the control of industrial uranium exposures, radiation monitoring in industrial plants, the medical supervision of workers in atomic energy plants, lead poisoning, air analysis in the control of industrial lead exposures, industrial mercurialism, mercury vapor hazards in an instrument shop, thallium poisoning, pulmonary edema, the use of oxygen in the treatment of pulmonary edema, treatment of chemical injuries of the eye, the management of hearing problems in industry, the management of visual problems in industry, and the use of I.B.M. equipment for developing routine medical department reports as well as for carrying on special statistical studies. (C.H.)

California. Univ., Livermore. Radiation Lab.
GASEOUS DETONATION — BIBLIOGRAPHY. G. R. Maynard and Fred Frost. Oct. 28, 1957. 28p. Contract (W-7405-eng-48). (UCRL-5071).
This is a compilation of 296 references to published literature and to classified and unclassified reports. The subjects included are gaseous detonation, explosions and shock waves; liquids and solids; and instruments used in measuring and studying gaseous detonations. The following sources were consulted: *Physics Abstracts*, 1941-date; *Engineering Index*, 1941-date; *Chemical Abstracts*, 1941-date; *U. S. Government Reports*, 1955-date; *Cumulative Book Index*, 1938-date; and *Applied Mechanics Reviews*, 1952-date.

~~7062~~ ✓
ALUMINUM IN THE ENVIRONMENT OF MAN. Irene R. Campbell, Jules S. Cass, Jacob Cholak, and Robert A. Kehoe. Arch. Ind. Health 15, 359-448(1957) May.

Bureau of Mines.
AMMONIUM NITRATE: ITS PROPERTIES AND FIRE AND EXPLOSION HAZARDS (A REVIEW WITH BIBLIOGRAPHY). G. S. Scott and R. L. Grant. June 1948. 32p. (BM-IC-7463).

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THE ACTIVATION OF ANTIMONY IN ADHESIVE PRODUCTS. H. R. Lukens, Jr. (Shell Development Co., Emeryville, Calif.). Nucleonics 17, No. 1, 83(1959) Jan.

A potential radioactive hazard was encountered subsequent to a 30-day pile irradiation of some steel samples at a thermal neutron flux of 5×10^{11} n/cm^2/sec. The hazard was caused by black plastic electrical tape used to seal the sample containers and by adhesive radioactivity warning labels used to provide immediate post-irradiation radioactivity warning. During activation of the steel sample, the tape and labels developed enough activity to measure about 100 mr/hr at 1 ft several weeks later, and in addition these adhesive materials became brittle and powdery. Half-life and gamma-energy determination indicated that the offending isotope was 60-day Sb^{124}. The use of adhesive materials such as these should be preceded by an assessment of this potential hazard. (J.H.M.)

4178
A STUDY OF INHALED ARSENIC-74 IN MAN. Robert H. Holland, Mary Sue McCall, and Henry C. Lanz (Univ. of Texas Southwestern Medical School, Dallas). Cancer Research 19, 1154-6(1959) Dec.

Data are presented on the uptake, distribution, absorption, and elimination of arsenic-74 in man following inhalation. (C.H.)

United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England.
CADMIUM POISONING. Frances M. Turner. May 1957. 10p. (AERE-MED/M-17).

Acute and chronic cadmium poisoning, and prophylactic and therapeutic measures are discussed. 71 references to journal literature are included.

3706 AERE-Med/M-27
United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England.
MEMORANDUM ON THE HAZARDS AND HANDLING OF EPOXIDE RESIN SYSTEMS. Frances M. Turner. Oct. 1958. 9p. $0.25(BIS).

Cases are described which show that materials used in the production of epoxide-resin-polyamine systems can give rise to dermatitis. Animal experiments are mentioned which suggest that toxicity of the resins is relatively low, the polyamines being considerably more toxic and irritant than the uncured resins, which vary in toxicity. The cured resins under test appear to be innocuous. Methods of handling and personal protection which proved satisfactory are described. (auth)

4194 UR-558
Rochester, N. Y. Univ. Atomic Energy Project.
THE TOXICITY OF INDIUM. W. L. Downs, J. K. Scott, L. T. Steadman, and E. A. Maynard. Sept. 16, 1959. 57p. Contract W-7401-eng-49. OTS.

Data are presented on the toxic effects of indium, administered as a chloride ($InCl_3$) or as an oxide (In_2O_3), in rats, rabbits, and dogs. Data are included on the tissue distribution and excretion of indium-114. (C.H.)

Oak Ridge National Lab., Tenn.
SUMMARY OF THE PROPERTIES OF LITHIUM. C. K. McGlothlan. Jan. 3, 1958. 20p. Contract [W-7405-eng-26]. $3.30(ph), $2.40(mf) OTS.

A literature survey on the properties of Li is presented. Also, general information is given concerning moving and storage, fire control, and information on circulating systems in which it may be used. (J.R.D.)

Rochester, N. Y. Univ. Atomic Energy Project.
NICKEL CARBONYL, REVIEW OF LITERATURE. F. L. Haven. July 14, 1954. 17p. (UR-347).

In this review (12 references) nickel carbonyl has been shown to be a highly toxic substance. The symptoms and effects of inhalation of the compound are described, including its activity as a suspected carcinogen for the lungs. The mechanism of action, permissible limits for rabbits, recommended safe amount for 8 hr exposure, and meager data on therapeutics and prophylaxis in rats are given. The appendix includes material from a report on "Toxicity of Certain Heavy Metal Carbonyls" prepared by Carl Voegtlin in 1945.

4195 AEC-tr-3794
MATERIALS ON THE TOXICOLOGY OF RADIOACTIVE SUBSTANCES. PART I: STRONTIUM, CESIUM, RUTHE-

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NIUM, AND RADON. (Materialy po Toksikologii Radioaktifnykh Veshchestv. Vypusk I: Strontsii, Tsezii, Rutenii i Radon). A. A. Letavet and E. B. Kurlyandskaya, eds. Translated from a publication of the State Publishing House of Medical Literature, Moscow, 1957. 239p. OTS.

Data are tabulated from studies on the absorption, distribution, and excretion of strontium-89-90, cesium-134, ruthenium-106, and radon in laboratory animals. Data are included on the effects of chronic and high-dose exposure to the radioactive substances. The effects of nonradioactive strontium lactate and magnesium sulfate on the removal of radioactive strontium from the skeleton, and the effects of the subcutaneous administration of stable cesium on the excretion of radioactive cesium are discussed. (C.H.)

5509

THE HAZARD OF ORALLY PIPETTING TRITIUM OXIDE. Ben Bloom (National Inst. of Arthritis and Metabolic Diseases, Bethesda, Md.). J. Lab. Clin. Med. 55, 164(1960) Jan.

During oral pipetting it was determined that from 5 to 70 mμ/l of water is inspired per operation. The hazards of orally pipetting tritium oxide are discussed. (C.H.)

Industrial Hygiene Foundation [of American Inc., Pittsburgh] and Mellon Inst. [of Industrial Research], Pittsburgh.

REVIEW OF LITERATURE ON TOXICITY, PHYSIOLOGICAL EFFECTS AND MEDICAL USES OF ZIRCONIUM AND ITS COMPOUNDS. July 1954. 15p. (NP-5667).

A summary is presented of data obtained from a review of the literature covering the toxicity, physiological effects, and medical uses of Zr and its compounds. 62 references.

13677

EFFECTS OF RADIOACTIVE STRONTIUM ON ORGANISMS. I. A. Pigalev. Med. Radiol. 3, 80-4(1958) May-June. (In Russian)

A review is given on the immediate and delayed effects of radioactive strontium. (R.V.J.)

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See also, this section,

SHIPPING AND HANDLING OF RADIOACTIVE MATERIALS --Legal Aspects (4.02.05).

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Maximum Permissible Radiation Doses
Addendum to NBS Handbook 59 (April 15, 1958)
NBS Handbook 69 (June 5, 1959)

8636

SOMATIC RADIATION DOSE FOR THE GENERAL POPULATION. The report of the Ad Hoc Committee of the National Committee on Radiation Protection and Measurements, May 6, 1959. Science 131, 482-6(1960) Feb. 19.

At its meeting in November 1958, the executive committee of the National Committee on Radiation Protection and Measurements undertook to re-examine the problem of exposure of the population to man-made radiations from the point of view of somatic effects as distinct from genetic effects. It was concluded that the present data are still insufficient to establish the character of the dose-response curve for somatic effects. It was also concluded that at present there is insufficient knowledge of the mechanisms involved to serve as a guide in areas where the data are not available. The committee favored prudence in estimating the effect of low doses. It was decided to adopt as an assumption that a proportional relationship between dose and effect exists. This signifies that no threshold exists, that the radiation dose is completely cumulative, and that the effect is independent of the rate at which the radiation is delivered. The assumptions on which these conclusions were reached are briefly outlined and are discussed.

6276 A/CONF.15/P/2078

OPYTY K OBOSNOVANIYU PREDEL'NO-DOPUSTIMYKH POTOKOV TEPLOVYKH NEITRONOV. (Experiments Designed to Substantiate the Maximum Permissible Doses of Thermal Neutrons). A. G. Istomina and I. B. Keirim-Markus (U.S.S.R.) 16p.

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Experiments were made to determine the maximum permissible doses of thermal neutrons and protons using a paraffin phantom of the human body in which Na_2CO_3 was mixed with the paraffin. It was established that in an isotropic flux of thermal neutrons the gamma dose is constant inside the body, increases when approaching the surface, and decreases on the surface. The dose of protons monotonically decreases toward the center of the body. The maximum permissible fluxes of thermal neutrons on the surface of the body were calculated using several assumptions concerning the relative biological effectiveness (RBE) of protons. It was established that if the RBE of protons is taken as 10, the RBE of thermal neutrons in the parts where a maximum dose is created is equal to 2 to 3. Toward the center of the body the RBE of thermal neutrons decreases and approaches unity. (J.S.R.)

7293

MAXIMUM PERMISSIBLE EXPOSURE OF THE POPULATION-AT-LARGE TO SOURCES OF IONIZING RADIATION. Karl Z. Morgan (Oak Ridge National Lab., Tenn.). p.1614-33 of "FALLOUT FROM NUCLEAR WEAPONS TESTS. HEARINGS BEFORE THE SPECIAL SUBCOMMITTEE ON RADIATION OF THE JOINT COMMITTEE ON ATOMIC ENERGY, CONGRESS OF THE UNITED STATES, EIGHTY-SIXTH CONGRESS, FIRST SESSION ON FALLOUT FROM NUCLEAR WEAPONS TESTS, MAY 5, 6, 7, AND 8, 1959. VOLUME 2." Washington, D. C., Joint Committee on Atomic Energy, 1959. p.949-1967. (GPO)

Studies on animals and observations on man indicate that there are two types of radiation damage, one requiring threshold or minimum dose before radiation damage results and the other increasing linearly with the dose. It is not possible at the present time to state with absolute certainty that human exposure to ionizing radiation is harmful at very low dose rates of the order of natural background. For the present, levels of maximum permissible exposure of the population-at-large to ionizing radiation must be based on estimations involving extrapolations over two to three orders of magnitude below the experimental data that can be considered to be statistically significant. For the present it is assumed that radiation damage, such as genetic mutations, leukemic incidence, and shortening of life span, increase to some extent with any increase in dose taking place at any dose rate following any accumulated dose. It is assumed there is no threshold dose for radiation injuries. It is stated that it is incorrect to assume a linear relationship between dose and effect all the way from high chronic dose rates of 400 rad per 30 years to background dose rates of about 4 rad per 30 years. The thirty year interval is used as a convenient period for considering genetic damage to man since the average fathers and mothers have begotten half their children by this age. The recommended values of maximum permissible exposure to ionizing radiation are made on an international level by the International Commission on Radiation Protection and are made on a national level in the United States by the National Committee on Radiation Protection. The recommendations of both groups are very similar and while they apply primarily to occupational exposure they can be modified to extend to large population groups. (C.H.)

6699 A/CONF.15/P/2263

THE WORK OF THE INTERNATIONAL COMMISSION ON RADIOLOGICAL PROTECTION (ICRP). Rolf M. Sievert (International Commission on Radiological Protection). 7p.

The International Commission on Radiological Protection and its predecessor, the International X-ray and Radium Protection Commission, have been working on radiation protection problems since 1928. In 1934 the Commission introduced the concept of "maximum permissible dose" which was at that time fixed at 0.2 r per day or 1.2 r per week. In 1950 the Commission lowered this figure to 0.3 r per week. Both these doses referred to persons working occupationally with radiation. During recent years the Commission has extended its field of interest greatly and has now arrived at a certain differentiation of the maximum permissible levels to cover the need of recommendations not only for occupational work but also for persons outside what is called the controlled area and for the population as a

7656

RADIATION PROTECTION IN REACTORS AND IN NUCLEAR OPERATIONS. [PART] II. M. Oberhofer and P. Kienle (Technische Hochschule, Munich). Kerntechnik 1, 88-93(1959) Sept. (In German)

The natural radiation burden of man and the highest permissible dose are discussed. (tr-auth)

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6239 A/CONF.15/P/1653
FACTORS AFFECTING THE RELATIVE BIOLOGICAL EFFICIENCIES OF IONIZING RADIATIONS. K. C. Bora (Atomic Energy Establishment. Trombay. India). 30p.

A survey is presented of the available RBE data. both on plants and animals. and all the important and known biological effects studied so far It is suggested that while assessing the relative biological hazards of ionizing radiations on the human population in general and calculating the maximum permissible dose, the effects of various factors influencing the efficiency of an irradiation should be most carefully analyzed and critically examined. (auth)

2312
HUMAN EXPOSURE TO RADIATION. Karl Z. Morgan (Oak Ridge National Lab., Tenn.). Bull. Atomic Scientists 15, 384-9(1959) Nov.

A review is given on the maximum permissible radiation doses to humans considering both industrial and medical exposures. A comparison of common x-ray exposures is made between various medical examinations. (C.J.G.)

14524 A/CONF.15/P/751
National Bureau of Standards, Washington, D. C.
THE INFLUENCE OF LOWERED PERMISSIBLE DOSE LEVELS ON ATOMIC ENERGY OPERATIONS IN THE UNITED STATES. Lauriston S. Taylor. 9p. $0.50 (OTS).

Prepared for the Second U. N. International Conference on the Peaceful Uses of Atomic Energy, 1958.

It would appear that the introduction of lowered maximum permissible dosage levels and the age-proration principle for distributing the dose, should not introduce any insurmountable problems in the United States. A greater premium will be placed upon operating under minimal exposure conditions and the utilization of adequate monitoring and records systems. Radiation control outside of controlled areas will present some greater difficulties in a few instances, but even these difficulties do not appear to be too severe. Because radiation control practices in the United States have been conservative in the past, it is anticipated that little change will be required in operations or operational procedures upon the introduction of the lowered permissible dose levels and the age-proration principle. (auth)

499
PROTECTION IN RADIOTHERAPY. COBALT-60 AND CESIUM-137. Ruherí Pérez Tamayo (Escuela Nacional Medicina, Mexico City). Rev. mex. radiol. 13, 61-80 (1959) Mar.-Apr.

The international standards for radiation protection are summarized. The formulas for the calculation of shielding requirements are illustrated with examples of the problems found in the construction of the Departamento de Radioterapia del Hospital Francés. Definitions of the common terms used in discussions of radiation protection are given. (J.S.R.)

MAXIMUM PERMISSIBLE RADIATION EXPOSURES TO MAN. L. S. Taylor (National Bureau of Standards, Wash.). Health Phys. 1, 200-4(1958) Sept.

Basic rules and operational guides are outlined which were set forth by the National Committee on Radiation Protection and Measurements for use in the revision of handbooks on Maximum Permissible Radiation Exposures to man. (C.H.)

451 HASL-58(p.222-5)
Division of Biology and Medicine, AEC.
MEDICAL FINDINGS SUMMARY. T. S. Ely. 4p.

Data on the pathological effects of uranium in man and laboratory animals are summarized. The validity of the figures for maximum permissible levels for uranium set by the International Committee on Radiation Protection is discussed. (C.H.)

20052 TID-7577(p.26-45)
Oak Ridge National Lab., Tenn.
THE SCIENTIFIC BASIS FOR MAXIMUM PERMISSIBLE LIMITS OF INTERNAL CONTAMINATION. Walter S. Snyder. p.26-45 of SYMPOSIUM ON TECHNICAL METHODS IN HEALTH PHYSICS, RISÖ, DENMARK, MAY 25-28, 1959. 20p.

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Maximum limits of internal contamination depend on the conditions of exposure and also on the level of risk that is permitted. When possible, they are based on direct observation of the accumulation of the radionuclide in the body and of its effects on the body under similar conditions of exposure. For most radionuclides and for long-term chronic exposure, such data are not available, and the limit is set in terms of a maximum permissible dose rate to the various organs of the body. Such a limit is based on effects observed when the organ is irradiated at a similar level, either by another radionuclide or by external radiation, and on general experience with radiation effects at low levels of exposure. Some long-term data on the effect of radium in bone are known, and this is used to set the permissible level for radium and, by comparison of dose levels, for other radionuclides that deposit in bone. Clinical experiences with radiotherapy have provided considerable direct evidence of the effects of internal and external radiation on man. Laboratory experiments with animals have been the source of much relevant data but generally demand interpretation and revision for application to chronic exposure of man. The development of whole body counters has already provided some relevant data, particularly on retention of various isotopes and will doubtless be a tool of increasing importance in this work. Many of the data from the above sources are at dose levels considerably above those where the effects are marginal or difficult to detect and thus must be reinterpreted. The background level of exposure may be considered to give a lower limit even for the exposure of the whole population. (auth)

23029

RADIATION AND MAN: BASIC DATA—GLOBAL RADIATION LIMITS. Jack Schubert and Ralph E. Lapp (Argonne National Lab., Lemont, Ill.). p.3038-43 of "Hearings on Industrial Radioactive Waste Disposal. Volume 4."

It is proposed that international agreement be reached on establishing radiation limits applicable to the world's total population. Such a General Population Limit (GPL) would be at some point intermediate between the Fixed Natural Background (FNB) to which everyone is exposed and the OPL (Occupational Permissible Limit) set for small numbers of individuals occupationally exposed to radiation. It is proposed that the GPL be taken as a multiple of the FNB which in turn is fixed at 10 rem. The factors which enter into consideration of the global radiation limits are enumerated and contrasted with those involved in setting the present occupational levels. (auth)

THE PREPARATION OF INTERNATIONAL RADIATION PROTECTION RECOMMENDATIONS BY THE INTERNATIONAL COMMISSION ON RADIOLOGICAL PROTECTION (ICRP). R. G. Jaeger. Atomkernenergie 4, 261-7(1959) July-Aug. (In German)

A brief history of the International Commission on Radiological Protection is presented. The basic values of the maximum permissible doses and the latest ideas on maximum permissible dose for internal radiation are discussed and explained. (J.S.R.)

12197

INTERNAL DOSE FROM SHORT-LIVED RADIONUCLIDES. Karl Z. Morgan (Oak Ridge National Lab., Tenn.). pp. 149-60 in "The Shorter-Term Biological Hazards of a Fallout Field." Gordon M. Dunning and John A. Hilcken, eds. Washington, Atomic Energy Commission—Department of Defense, 1958. 236p. Available from U. S. Government Printing Office for $1.75.

National and international standards for radiation protection are discussed. Maximum permissible occupational exposure data are tabulated for a number of isotopes. (C.H.)

RADIATION PROTECTION PROBLEMS IN WORKING WITH RADIOACTIVE ISOTOPES. I. GENERAL FUNDAMENTALS AND DANGER POSSIBILITIES FROM EXTERNAL IRRADIATION. Gerd Böhler, Ernst Spode, and Günter Vormum (Deutschen Akademie der Wissenschaften, Berlin-Buch). Chem. Tech. (Berlin) 11, 94-6(1959) Feb. (In German)

The general fundamentals necessary to the understanding of the radiation protection problem are reviewed. After a brief description of the types of radiation, a comparison of the various dosage units is given.

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The principle of dose measurements and some measurement possibilities are discussed. The tolerance doses for external radiation are reported. (tr-auth)

1320

RADIOISOTOPIC CONTAMINATION OF THE BIOSPHERE. U. Croatto (Universita, Padua). Minerva Nucleare 3, 269-78(1959) Sept. (In Italian).

The various natural and artificial sources of ionizing radiations are first considered in regard to the biological injuries for which they are responsible. The various sources of ionizing radiations of natural or artificial isotopic origin are then discussed from a critical quantitative standpoint. Radioisotopic contamination and the somatic and genetic consequences of experimental nuclear explosions are finally considered in detail. (auth)

12184

RADIATION EXPOSURE AS A REASONABLE CALCULATED RISK. Lauriston S. Taylor (National Bureau of Standards, Washington). Health Phys. 1, 62-70(1958) June.

Maximum permissible exposures for radiation workers have been based, in the main, on levels that would not produce detectable injury to any individual. The impossibility of correlating radiation effects with small radiation dosage makes it impracticable to use this criteria indefinitely. It must be assumed that there is some undesirable effect from radiation exposures, even though these are not specifically detectable. We are thus confronted with the necessity for accepting some risk due to radiation exposure, even though this risk cannot be specifically defined. The addition of a risk philosophy in the establishment of radiation protection standards and the acceptance of occupational exposure becomes a necessity, if we are to continue the proper exploitation of radiation as a servant to man. Some comparison of the risk due to various types of radiation exposure is given. (auth)

8801

BASIC HEALTH PHYSICS. I. D. E. Barnes (AWRE, Aldermaston). Nuclear Power 2, 250-3(1957) June.

This first article of a series includes general information on the four main types of ionizing radiations, the measurement units of radiation and radioactivity, the biological effects of radiation, natural exposure to radiation, and permissible doses. (M.H.R.)

SAFETY TECHNIQUE IN THE EXTENSIVE INTRODUCTION OF RADIOACTIVE APPARATUS. G. G. Iordan, T. G. Neyman, and K. S. Furman. Priborostroenie No. 3, 21-2(1959).

It is necessary to issue specialized sanitary regulations for the application of radioactive apparatus with inherent gamma-sources for technological inspection purposes. In places where people are working who are not professionally engaged in work with ionizing radiation, the radiation dose originating from technological inspection apparatus should not exceed one tenth of the maximum admissible radiation dose. If this requirement is to be satisfied in practice, it is necessary to keep the dose rate on the surface of such apparatus below 0.2 microroentgen/second. Formulas for safety clearances are derived and applied to special cases. The safety clearances can also be determined with a dosimeter. It appears to be expedient that the manufacturers of radioactive apparatus should send a team of specialists to customers who will install the equipment in a suitable place. A report is given on the problems involved in transporting such equipment and on its regular inspection. (TCO)

MAXIMUM PERMISSIBLE INTERNAL DOSE OF RADIONUCLIDES: RECENT CHANGES IN VALUES. K. Z. Morgan (Oak Ridge National Lab., Tenn.). Nuclear Sci. and Eng. 1, 477-500(1956) Dec.

The development of dose rate standards and dosage units is briefly described. The recommendations of the April, 1956 meeting of the International Commission on Radiological Protection are summarized and the effects of these recommendations on operations of large atomic energy installations are discussed. It is concluded that, because of the conservative practice of health physics in the past, the new ICRP proposed changes in exposure standards will not require any major alteration of current practices. (auth)

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1706
THE APPLICATION OF EXTERNAL AND INTERNAL RADIATION EXPOSURE LIMITS. Karl Z. Morgan (Oak Ridge National Lab., Tenn.). Am. Ind. Hyg. Assoc. Quart. 16, 307-23(1955) Dec.
Units of measurement used for ionizing radiation are dedefined. Basic criteria for permissible exposures, types of experimental data needed to establish reliable maximum permissible exposure values, and administrative problems in applying maximum permissible exposure values are reviewed. 23 references. (C.H.)

16522
A NOMOGRAPH FOR MIXED RADIATIONS DOSIMETRY. G. M. Obaturov. Atomnaya Energ. 4, 585-6(1958) June. (In Russian)
A design is presented of a nomograph for simultaneous calculation of permissible doses of mixed radiation emitted by gases and aerosols along with equipment and working clothes. (R.V.J.)

DOSIMETRY OF RADIOISOTOPES. A. J. Bertinchamps and G. C. Cotzias (Brookhaven National Lab., Upton, N. Y.). Science 128, 988-90(1958) Oct. 24.
A nomogram is presented which permits the estimation of the radiation dose delivered by 30 isotopes of biological interest. Large working copies of this nomogram are available from the authors. (C. H.)

16138
TISSUE DOSES FROM FAST AND SUPERFAST NEUTRONS. M. I. Shal'nov. Atomnaya Energ. 4, 557-70(1958) June. (In Russian)
Tissue-like phantoms (water, paraffins, etc.) were irradiated by beams of fast and superfast neutrons. Experimental and theoretical curves were plotted for the maximum tissue doses for wide and narrow beams at 1 to 500 Mev. Tentative magnitudes of permissible doses for humans are suggested. (tr-auth)

11257 AFSWC-TN-57-30
Air Force Special Weapons Center, Kirtland AFB, N. Mex.
LIMITS FOR RADIATION CONTROL AND RELEASE OF AIR FORCE MATERIAL CONTAMINATED WITH FISSION PRODUCTS. James L. Dick and William R. Hurdlow. Apr. 1958. 42p. Project No. 7806. (AD-157163).
Supersedes AFSWC-TN-56-2.
Personnel working with aircraft and aircraft parts contaminated by mixed fission product debris are exposed to external and internal radiation hazards. Experiments have shown that the external hazard is, in every conceivable case, the limiting hazard for establishing safety precautions. Therefore, a beta-gamma survey of contaminated materials will be sufficient to determine if the material is to be released to an un-

4505 CEA-508
France. Commissariat à L'Énergie Atomique, Paris.
DANGERS DES RAYONNEMENTS AUPRES DES PILES A URANIUM. (Radiation Hazards near Uranium Reactors). H. Joffre. Jan. 1956. 32p.
Brief discussions on dose units, maximum permissible doses, and relations between units are included. Estimates and data are included on radiation hazards from irradiated U, air contamination, Th irradiated in U piles, and cooling systems. The characteristics of radioelements produced in reactors are tabulated. The radiation hazards in the case of reactor accidents are also briefly surveyed. (B.J.H.)

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See also, under FISSION PRODUCT, POISON, AND RADIOISOTOPE REMOVAL,

SOURCE PREPARATION--Calibration (2.45.03).

14525 A/CONF.15/P/757
Oak Ridge National Lab., Tenn. and Tennessee. Univ., Knoxville.
A SUMMARY OF DATA THAT WAS USED IN THE REVISION OF THE INTERNAL DOSE RECOMMENDATIONS OF THE INTERNATIONAL COMMISSION ON RADIOLOGICAL PROTECTION. K. Z. Morgan, I. H. Tipton, and M. J. Cook. 16p. $0.50(OTS).

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Prepared for the Second U. N. International Conference on the Peaceful Uses of Atomic Energy, 1958.

The report of the Internal Dose Committee of the International Commission on Radiological Protection has been revised and released for publication. The basic principles and fundamental philosophy of radiation protection are unchanged in this new publication, but a number of revisions are made. The most important of these is the reduction of maximum permissible concentration, MPC, of radionuclides in air, water, and food so that the average RBE dose rate to the total body of the recent data indicate that only 30% (rather than 55%) of the daughter products of Ra^{226} is retained in the body. The new MPC values correspond to a RBE dose rate of 0.56 rem per week to the bone, 0.6 rem per week to the thyroid or skin, 0.1 rem per week to the total body or gonads, and 0.3 rem per week to all other organs of the body. A major objective in the revision of the ICRP Handbook has been to obtain reliable values for the distribution of radioelements in the human body following many years of exposure. One of the best sources of such data is the normal distribution of stable isotopes of these elements in the human body. For the past six years a study of human tissue has been conducted by the Oak Ridge National Laboratory in cooperation with The University of Tennessee. This study includes a spectrographic analysis for 37 elements in 35 body organs, from over 300 autopsies that were supplied from 15 countries For elements such as Ca, Fe, Zn, Cu, Mn, etc., which are known to have a role in the body economy, the geographical variation is not large—reflecting the state of nutrition of the population. For other elements such as Sr, Cd, Pb, Al, and Cr which may compete with necessary elements in their normal roles, the geographical variation is striking. Some elements such as Cu and Zn in liver, Al in lung, and Cd in kidney, show marked variation with age of subject. Such data are useful not only in calculating the MPC values for the standard man but may serve also as a guide in making refinements to the MPC values when applying them to individuals of a given age, weight, eating habits, etc. MPC values are given for 86 radionuclides in the 1955 ICRP Handbook and for 227 radionuclides in the 1958 edition. Also, MPC values are given for insoluble as well as soluble radioactive materials and for several critical body organs resulting in a seven-fold increase in the number of MPC values. In a few cases (where sufficient data are available) the MPC values are based on a power function rather than an exponential function of the time of exposure. (auth)

8854

AN ABSOLUTE MEASUREMENT OF THE ROENTGEN.
L. Argiero and A. Rindi (Corso per le Applicazioni Mediche dell'Energia Nucleare, Leghorn). Minerva nucleare 3, 391-8(1959) Dec.

After an examination of the possible methods of measurement, a theoretical study of an absolute measurement with Co^{60} by means of a free air ionization chamber with parallel-plate electrodes was made. The ionization loss of the Compton electrons, which ionize out the chamber was calculated. By the measurement of the current generated from the ions collected in the chamber, it is possible to obtain the ionization loss and thus the absolute dose. (auth)

14471 A/CONF.15/P/2259
American Machine and Foundry Co., New York.
INTERNATIONAL COLLABORATION ON STANDARDS IN THE FIELD OF NUCLEAR ENERGY. Morehead Patterson. 14p. $0.50(OTS).

Prepared for the Second U. N. International Conference on the Peaceful Uses of Atomic Energy, 1958.

The importance of nuclear standards is discussed. A brief review of the international collaboration in this field is given. The proposal is made to let the International Organization for Standardization (ISO) coordinate the efforts from other groups. (W.D.M.)

6861 A/CONF.15/P/971
CONCEPTS AND MEASUREMENT OF DOSE. H. Fränz and W. Hübner (Germany). 7p.

In dosimetry the three different concepts of doses used include the absorbed dose with the unit rad, the exposure dose with the unit roentgen, and the relative biological effectiveness which is specified in rem. Applications in practical dosimetry of x and gamma radiation are discussed. (C.H.)

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ABSOLUTE MEASUREMENT OF β ACTIVITY. APPLICATION TO THE DETERMINATION OF THE Ra EQUIVALENT MILLIGRAM. Simone Vuccino. Ann. phys. 4, 147-84(1959) Jan.-Feb. (In French)

A study was made of the use of β-γ and γ-γ coincidence for the absolute measurement of activities. The principles of the method of coincidences were briefly considered, and the apparatus used was described in detail. The absolute calibration of the radioisotopes Na^{22}, Co^{60}, Sc^{46}, Na^{24}, Cu^{64}, Au^{198}, and Cs^{137} was investigated. The angular correlations between the radiations were studied, and the results are in good agreement with theory and with previous results. The results were also verified by several control methods using the 4π counter, liquid counters, and ionization chambers. By the use of two condenser chambers filled with air or argon, the Ra equivalent milligram of several radioisotopes was determined. The results are tabulated.

6898 ✓ A/CONF.15/P/2243
PROGRAM OF THE INTERNATIONAL COMMISSION ON RADIOLOGICAL UNITS AND MEASUREMENTS. L. S. Taylor and H. O. Wyckoff (National Bureau of Standards, Washington, D. C.); and L. H. Gray (Mt. Vernon Hospital, Northwood, Middx., Eng.). 8p.

Since 1925 the International Commission on Radiological Units and Measurements (ICRU) has been engaged in a continuous study of the units and techniques for the measurement of x rays and nuclear radiations and the intercomparison of the standards. With the introduction of the rad as the unit of absorbed dose it has been necessary to develop the supporting data necessary to apply to ionization and other measurements to convert the readings to ergs/gram. Best values of the following parameters have been developed: primary spectra, distribution functions for initial Compton recoil electron energy, slowing-down electron distribution functions, neutron energy spectra, LET spectra, and relative stopping powers. The application of some of these to particular problems are discussed. A new transfer standard

6263 A/CONF.15/P/1977
ON THE NECESSITY OF INTRODUCING A NEW RADIOBIOLOGICAL QUANTITY. Radu Grigorovici (C. I. Parhon Univ., Bucharest) and Mircea Oncescu (Inst. de Physique Atomique, Bucharest). 7p.

The introduction of a biophysical quantity, the biological dose, is proposed, which is defined in terms of the absorbed dose and the relative biological effectiveness. The unit of the biological dose is the rem, while the unit of the absorbed dose is the rad. The rem is the biological dose received by a tissue irradiated by a dose absorbed of 1 rad, with an incident radiation of unit biological effectiveness. (W.D.M.)

o569 ✓
COMPARISONS OF NATIONAL RADIUM STANDARDS. T. P. Loftus, W. B. Mann, L. F. Paolella, L. L. Stockmann, and W. J. Youden. J. Research Natl. Bur. Standards 58, 169-74(1957) Apr.

The national primary Ra standards of the Federal Republic of Germany and the Dominion of Canada have recently been compared with the two United States national primary Ra standards at the National Bureau of Standards. The comparisons were made using the standard electroscope and radiation balance, and the results obtained for these four Hönigschmid standards have been compared with those obtained in an earlier comparison of the United States primary Ra standards with that of the United Kingdom, which is also a Hönigschmid standard. In every case, agreement with Hönigschmid's values to within 0.2% has been obtained. (auth)

Battelle Memorial Inst. Radiation Effects Information Center, Columbus, Ohio.
FORMAT FOR REPORTING RADIATION-EFFECTS DATA. J. F. Kircher. May 15, 1959. 14p. Project No. 2133. Contract AF33(616)-6564.

The format used by the Radiation Effects Information Center (REIC) in reporting radiation-effects data is given. From the discussion, it is apparent that there is no simple way of reporting radiation-effects data that is applicable to all situations, nor is there any one unit that can be used to cover all situations. It is felt, however, that the methods and terminology outlined in this memorandum are the best available today that are generally applicable to nuclear-propulsion development programs. Recommendations for neutron and gamma-ray dosimetry techniques are given. The terminology used by the REIC is presented. Since there is not complete agreement among those working with radiation as

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to the best way of reporting or correlating data, the usage must be somewhat arbitrary. It is hoped that, by consistent usage of terms, the task of interpreting data from REIC Reports and Memoranda will be simplified. (auth)

14434
PROCEEDINGS OF THE SECOND UNITED NATIONS INTERNATIONAL CONFERENCE ON THE PEACEFUL USES OF ATOMIC ENERGY, HELD IN GENEVA, 1 SEPTEMBER–13 SEPTEMBER 1958. VOLUME 21. HEALTH AND SAFETY: DOSIMETRY AND STANDARDS. Geneva, United Nations, 1958. 255p. $10.50.

The work of the International Commission on Radiological Protection is reviewed. Operational experiences in health and safety in the field of radiation are discussed. Topics include dosimetry and standards, absorbed dose and radiological units, calibration of sources and counters, determinations of local radiation doses, counting techniques and equipment, high-level dosimetry using chemical and thermoluminescence methods, and neutron dosimetry. (C.H.)

3983 NP-7051
Lockheed Aircraft Corp., Marietta, Ga.
CONVERSION OF RADIATION DATA TO COMMON DENOMINATORS. W. T. Harper. Oct. 1958. 29p. Contract AF33(600)-32055. (NR-45).

A detailed procedure with sample calculations is given for converting radiation data to units useful for comparing data obtained at different facilities. Gamma radiation data are converted to units of carbon gamma dose (erg/g), and neutron data are converted to water neutron dose (erg/g). (auth)

8715 IGO-AM/W-39
Gt. Brit. Windscale Works, Sellafield, Cumb., England.
THE PREPARATION OF STANDARDS FOR THE DETERMINATION OF α AND β ACTIVITIES OF GRANULAR SAMPLES. Celia J. Banks and O. Jones. June 12, 1956. 4p.

6817 NP-6282
Brussels. Centre D'Etudes Pour Les Applications de l'Energie Nucleaire.
STANDARDISATION DES MESURES DU FOND CONTINU RADIOACTIF. (Standardization of the Measurements of Continuous Radioactive Background.) C. Godeau. June 22, 1956. 41p. (B-1243).

DETERMINATION OF NEUTRON INTENSITY AND GAMMA SPECTRUM OF NEUTRON SOURCES. L. B. Gnagey (Monsanto Chemical Co., Miamisburg, Ohio). IRE Trans. Nuclear Sci. NS-3, No. 3, 11-14(1956) June.

A very general discussion on the determination of neutron intensity and a gamma spectrum is given. The use and determination of secondary standards for neutrons and the design and resolution of the scintillation spectrometer for determination of the gamma spectrum are discussed. (M.H.R.)

6752 A/CONF.15/P/2087
SISTEMA RADIOMETRICHESKIKH IZMERENII PRI RABOTE S RADIOAKTIVNYMI IZOTOPAMI. (The System of Radiometric Measurements in the Application of Radioactive Isotopes. K. K. Aglintsev, M. A. Bak, V. V. Bochkarev, E. G. Gracheva, E. V. Ershova, and K. A. Petrzhak (U.S.S.R.) 17p.

A system of radiometric measurements used when dealing with radioisotopes is described. The system is based on the following: unification of measurement units; the setting up of standards, standard methods, and standard devices reproducing the size of the units; the setting up of model measurements and measurement devices; the development of methods for controlling the preparation; and the calibration of measurement devices. The basic requirements to standardize alpha, beta, gamma, and neutron sources are formulated, and recommendations are made on the selection of isotopes in the preparation of standard sources. Special consideration is given to the measurement of small activities corresponding to the isotopic maximum permissible concentration in water and air.

2419 WCRT-TM-56-88
Wright Air Development Center. Materials Lab., Wright-Patterson AFB, Ohio.

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FIRST MEETING OF THE ANP ADVISORY COMMITTEE FOR NUCLEAR MEASUREMENTS AND STANDARDS. S. A. Szawlewicz. July 26, 1956. 15p.

The attendance list, the agenda, the minutes and the recommendations of this committee are given. (M.H.R.)

PREPARATION, MAINTENANCE, AND APPLICATION OF STANDARDS OF RADIOACTIVITY. National Bureau of Standards Circular 594. W. B. Mann and H. H. Seliger. Washington, National Bureau of Standards, 1958. 59p. Available from U. S. Government Printing Office, Washington for $0.35.

The methods available for the preparation and maintenance of primary and secondary standards of radioactivity are reviewed. The applications of such standards to problems in physics are discussed. 204 references. (auth)

14011 AERE-I/R-1063(Rev.)
United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England.
AN ISOTOPE HANDLING CALCULATOR (MK. 2). R. West. June 1958. 7p. $0.32(BIS).

A calculator is described which at a single setting inter-relates the source strength, gamma dose rate, distance from source, and screening by lead. Direct reading values are given for the isotopes Na^{24}, Co^{60}, Ra or Rn, Ta^{182}, Ir^{192}, Au^{198}, I^{131}. The Mk. II calculator differs from the original only in the revised calibration of Ir^{192} and revised safe dose rates recommended by the International Commission on Radiological Protection. The calculators are obtainable from the Isotope Information Office, Harwell, England. (auth)

11329[V] NARF-57-31T
Convair, Fort Worth, Tex.
AIR SCATTERING OF GAMMA RADIATION FROM Co^{60}. J. R. Stokes and B. S. Burton. July 16, 1957. 20p. Project 6(1-9964). Contract AF33(600)-32054. (MR-N-156).

Air scattering of γ radiation from a Co^{60} source has been investigated experimentally. Measurements were made at 40 feet with a collimated γ spectrometer which allowed various regions of space to be examined for scattered radiation. The energy spectra were obtained to permit separation of the singly and multiply scattered components of radiation. Additional measurements are required to obtain a complete separation of these components. (auth)

11153
ON THE PROBLEM OF THE DEFINITION OF ROENTGEN IN THE RECOMMENDATION OF THE INTERNATIONAL COMMISSION FOR RADIOLOGICAL UNITS (1953). S. N. Ardashnikov and N. S. Chetverikov. Atomnaya Energiya 3, 238-44(1957).

The definition of roentgen (r), which was worked out at Stockholm in 1928 and at Chicago in 1937, was examined again in 1953, and a new definition was decided upon. This new definition still has the disadvantage that one roentgen is measured by the "amount of x or

DOSIMETRY OF NEUTRONS. L. Musumeci. Minerva nucleare 2, 303-7(1958) Oct. (In Italian)

The dosimetry of neutrons presents some particular aspects which are examined qualitatively. Such aspects concern the conditions in which neutrons are generated and their interactions with matter. The problem of the units and methods of dose measurements is discussed. In particular the difficulty of defining a correct unit from the physical point of view which has a direct biological meaning is considered. (auth)

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14434
PROCEEDINGS OF THE SECOND UNITED NATIONS INTERNATIONAL CONFERENCE ON THE PEACEFUL USES OF ATOMIC ENERGY, HELD IN GENEVA, 1 SEPTEMBER–13 SEPTEMBER 1958. VOLUME 21. HEALTH AND SAFETY: DOSIMETRY AND STANDARDS. Geneva, United Nations, 1958. 255p. $10.50.

The work of the International Commission on Radiological Protection is reviewed. Operational experiences in health and safety in the field of radiation are dis-

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cussed. Topics include dosimetry and standards, absorbed dose and radiological units, calibration of sources and counters, determinations of local radiation doses, counting techniques and equipment, high-level dosimetry using chemical and thermoluminescence methods, and neutron dosimetry. (C.H.)

4482 AERE-R-2924
United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England.
THE MEASUREMENT OF NEUTRON DOSE. A. B. Clare. July 1959. 33p. BIS.
The physical (as opposed to the biological) data which are used to derive the maximum permissible neutron flux are summarized. Problems which arise in field instrumentation designed to measure the neutron dose are surveyed. Methods for measuring dose include energy absorption in tissue equivalent chambers, flux detection with sensitivity inversely proportional to maximum permissible flux and threshold detection. In addition to continuous irradiation by neutron flux the special problems associated with particle accelerators and criticality accidents are considered. (auth)

6464 A/CONF.15/P/1393
DETERMINATION OF GAMMA ISODOSE CURVES WITH PLASTIC SCINTILLATORS. R. Dugnani Lonati (Centro Informazioni Studi Esperienze, Milan) and G. Skoff (Clinica S. Ambrogio, Milan). 10p.
A method is proposed to determine the distribution of the dose by the luminous intensity produced in a plastic scintillator of a suitable density and shape so as to represent the actual development in an irradiated body section, and the possibilities as well as technical characteristics are described. A scintillating plastic sheet enclosed in a transparent plexiglass phantom is exposed to a Co^{60} bomb, and the progress of luminescence in the scintillator is photographed. The blackening produced on the photographic plate is examined by means of a microphotometer, and by comparison with the value obtained with an ionization chamber, a system of calibration of blacking-dose in rad is established. (auth)

16671 AERE-R-2909
United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England.
RADIATION DOSIMETRY IN COBALT 60 INSTALLATION 2.C.1. G. S. Murray. Apr. 1959. 18p. $0.42 (BIS).
Dose rates have been determined in various geometrical relationships of source and sample with the object of providing extensive and accurate data for the users of this facility. The note describes the methods used, states the results graphically and in tables, gives details of the observations in an appendix and recommends good practice for making best use of the data. (auth)

1716 ORNL-2748(Pt.A)
Oak Ridge National Lab., Tenn.
RADIATION ACCIDENTS: DOSIMETRIC ASPECTS OF NEUTRON AND GAMMA-RAY EXPOSURES. G. S. Hurst and R. H. Ritchie, eds. Nov. 16, 1959. 114p. Contract W-7405-eng-26. OTS.
A system of dosimetry for persons involved in accidental criticality excursions is presented as part A of a two part report. The information is arranged to be useful as a reference for those responsible for implementing the system. Part A also contains a review and re-evaluation of the dosimetry of previous accidents and a synopsis of part B. Parts A and B together form a complete analysis of dosimetric and medical information pertinent to acute exposures of humans to mixed radiations. (J.R.D.)

254 HW-57399
General Electric Co. Hanford Atomic Products Operation, Richland, Wash.
SURFACE DOSE RATE MEASUREMENTS. J. F. Evans. Sept. 9, 1958. 22p. Contract W-31-109-Eng-52. $4.80(ph OTS); $2.70(mf OTS).
A procedure is presented for estimating the surface dose rates of gamma and high-energy beta sources. Conversion factors applicable to the Cutie Pie dose rate meter are derived. (W.D.M.)

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PRINCIPLES OF RADIATION DOSIMETRY. G. N. Whyte. New York, John Wiley and Sons. 1959. 130p.

There is as yet no universal agreement on the names to be assigned to some of the physical quantities that occur in dosimetry. Many of the terms used in this text are defined. Topics discussed include: the radiation field; the interactions of radiation with matter; the determination of x-ray spectral distributions; measurements of x-ray intensity; measurements of exposure dose; measurement of absorbed dose for x rays; dosimetry of charged particles; neutron dosimetry; and the design of secondary radiation detection instruments. (C.H.)

11606

BASIS AND POSSIBILITIES OF FILM DOSIMETRY. K. Becker. Atompraxis 4, 168-75(1958). (In German)

In an introductory survey of the literature, the advantages of film dosimetry are discussed, followed by a brief survey of the photographic elementary process and the forms in which ionizing radiation releases energy. Then there is a discussion of the wave-length dependence of film blackening, its measurement, and methods of reducing it, i.e., emulsion technique, metal filtering, and fluorescence screens, with their advantages and disadvantages. In conclusion, the filter-analysis method of evaluation and its limitations are discussed, together with practical requirements for dosimetric films and the dosimetry of complex radiation mixtures (β and neutron dosimetry). It is concluded that the known processes all have numerous weaknesses and are not sufficiently universal in their application; however, improvements can be made. 64 references. (auth)

13635

DOSIMETRIC CHARACTERISTICS OF THE RADIATION FROM FISSION FRAGMENTS IN URANIUM. K. K. Aglintsev. A. N. Gorobets. V. P. Kasatkin. and E. S. Kondakova. Atomnaya Energ. 4. 461-4(1958) May (In Russian)

Calculations were made of various dosimetric characteristics of fission fragments: the content of the mixture in % during the irradiation of uranium for t_0 = 100 days. with the cooling period τ = 15 to 540 days, and the variations in the time activity of the mixture for 60, 100. and 150 days. Calculations are in good agreement with the results of radiochemical analysis. The mixture constant does not depend on t_0 (within the limits of 60 to 150 days and remains approximately constant in a τ range of 15 to 180 days). (tr-auth)

8855

PHOTOGRAPHIC DOSIMETRY OF X RAYS, GAMMA RAYS, AND NEUTRONS. M. Ladu (Comitato Nazionale per le Ricerche Nucleari, Rome). Minerva nucleare 3, 399-405 (1959) Dec. (In Italian)

A survey is given on the photographic dosimetry of X, γ rays and neutrons, pointing out the advantages and limitations of the method. Mention is given to calibration, to the causes of errors, and to the proceedings by which an acceptable response for the personnel security can be obtained. (auth)

6161 NARF-57-9T

Convair, Fort Worth, Tex.

ANALYSIS OF LEAD SHADOW SHIELD EXPERIMENT. R. L. Kloster. Feb. 27, 1957. 53p. Project 6(1-9964). Contract AF33(600)-32054. (FZK-9-113).

Gamma dose rates behind lead shadow shields in water were calculated and compared with experimental measurements. The Ground Test Reactor served as the source for these measurements. The results are shown as functions of three variables: source-shield separation distance, shield thickness, and source-detector separation distance. The dose rates are analyzed in relation to the geometrical arrangement of the lead shield, detector, and source. Interrelationships of the dose rate components (primary source gammas, water-capture gammas, lead capture gammas, and gammas scattered around the shadow shield) are discussed. The analysis showed that primary and water-capture gamma rays are the important contributors to the total dose rates for most realistic shadow shield designs. However, under certain circumstances, lead capture and scattering around the shield become important. (auth)

THE DETERMINATION OF X RAYS AND PHOTOCHEMICAL REACTIONS. Robert Wichard Pohl. Strahlentherapie 108, 356-60(1959) Mar. (In German)

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All discussions in dosimetry should be based on the fact that the commercial ionization dosimeters do not determine a quantity, characteristic for a radiation field as it would be done by radiation intensity and irradiation intensity. Such a quantity can only be determined by dosimeters, absorbing the entire incoming radiation. By ionization dosimeters one gets only energy concentrations $\Delta W/\Delta m$ which are generated in irradiated air or in irradiated solids. Many errors and wasted discussions could be avoided if dose were not the reading at the scale of commercial dosimeters but a physical quantity defined by an equation. After this clearing up it is possible to use methods for studies of the biological effects of x rays which had been successful for the quantitative examination of photochemical reactions. (auth)

10903 HW-30492
[Hanford Atomic Products Operation], Richland, Wash.
STANDARD PRACTICES COUNTING MANUAL. L. C. Schwendiman. Jan. 4, 1954. Changed from OFFICIAL USE ONLY July 6, 1956. 65p. Contract [W-31-109-Eng-52]. $10.80(ph OTS); $3.90(mf OTS).

Data are presented which can be used to determine the disintegration rates of radioactive samples from counting rates measured with routinely used laboratory instruments. Emphasis is placed on isotopes of particular interest to the radiological sciences programs. Decay tables are included. The various factors affecting counting rates are discussed and methods are described by which these factors were determined. (C.H.)

6728 A/CONF.15/P/1211
CONTRIBUTION A LA DETECTION DES RAYONNEMENTS EN VUE DU CONTROLE ET DE LA PROTECTION. (Radiation Detection for Control and Protection.) Fuhrmann, [H]. Joffre, and Savouyaud (Commissariat à l'Énergie Atomique, Paris). 11p.

The improvements made in the fields of gamma-ray dosimetry by photographic films, alpha dosimetry and spectrometry, standardization and autonomy of the electronic components of radiation detectors, and the dosimetry of pulsed radiations are described. The sensitivity of film to x rays and chemical reagents was studied so that a correction could be applied to gamma film dosimetry for these factors. Research on alpha dosimetry led to the improvement of ZnS scintillation counting. The construction of an alpha spectrometer is described. A description is given of improvements made in ionization chambers, counters, and scintillators. The measurement of pulsed radiation of very short periods is discussed. (J.S.R.)

3157 IDO-16247
Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho.
EXPERIMENTAL AND THEORETICAL VALUES OF THE GAMMA DECAY DOSE RATE AND HEATING FROM SPENT MTR FUEL ELEMENTS. W. C. Francis and L. L. Marsden. Jan. 13, 1956. 58p. Contract AT(10-1)-105. $9.30(ph OTS); $3.60(mf OTS).

A project at the MTR to measure and calculate gamma decay dose rates and heating from spent MTR fuel elements as a function of fission time, cooling time, and distance from the source is reported. A comparison of these data is presented. Fuel elements with cooling times from $3\frac{3}{4}$ hours to 218 days after reactor shutdown and burn-ups from 3.5 to 35% have been studied. Experimental and theoretical data are generally in good agreement for dose rate measurements, but are not as consistent for heating values. (auth)

12570 GEAP-0974
General Electric Co. Atomic Power Equipment Dept., San Jose, Calif.
THE DETERMINATION OF FISSION PRODUCT GAMMA DOSES. William G. Ruehle, Jr. Feb. 25, 1957. 59p. $9.30(ph OTS); $3.60(mf OTS).

Graphite data and formulas are presented by which the gamma dose from an irradiated fission source may be easily and accurately computed. The determination of the fission product gamma dose would appear to require consideration of the more than 200 gamma sources formed by fission. Actually, a dose, accurate to 90% or better, can be computed by considering less than twelve fission products. (auth)

RADIOACTIVE AND NONRADIOACTIVE 4.01

LIMITS AND STANDARDS 4.01.07

DOSIMETRY 4.01.07.03

12616
CALIBRATION AND USE OF A SYSTEM OF FILM BADGES FOR PERSONAL DOSIMETRY FOR GAMMA RADIATION. P. Amadesi, N. Grimellini, G. Guenzi, and O. Rimondi (Università, Bologna). Minerva nucleare 3, 44-57(1959) Feb. (In Italian)

A method of calibration of a film-badge system for gamma radiations from radioisotopes is described. The criteria for the choice of emulsion and the system adopted for correcting the response from the energy dependence are shown. The energy dependence is corrected by a metallic filter, made by 1 mm of tin and 0.5 mm of lead superimposed. A systematic study of errors due to fading, dark room processes, and energy dependence is made. The error due to energy dependence from 80 to 200 kev (critical zone) was experimentally determined. Comparing the film-badge system with Victoreen pocket chambers it was seen that the analyzed film-badge does not present a systematic error greater than the chamber's error. The accuracy of the film-badge system is given by the formula: E = (6 % D + 4) milliroentgen, where D is the measured dose in "mr," neglecting, of course, the errors for the energy dependence. This film-badge system is used in personal dosimetry for workers in six nuclear laboratories in Italy. (auth)

21832 ORNL-1671(Del.)
Oak Ridge National Lab., Tenn.
NEUTRON FLUX AND TISSUE DOSE STUDIES WITH FISSION THRESHOLD DETECTORS. PART I. EXPERIMENTAL MEASUREMENTS. G. S. Hurst, J. A. Harter, P. N. Hensley, W. A. Mills. Mar. 30, 1954. Decl. with deletions Aug. 14, 1959. 13p. Contract W-7405-eng-26. $3.30(ph), $2.40(mf) OTS.

Methods and apparatus are described which were developed for the purpose of making neutron measurements in an effort to define tissue dose in terms of energy dissipated per gram of average wet tissue. The apparatus was used for measurements of radiation from an atomic explosion. The energy response of Pu^{239}, Np^{237}, U^{238}, Au, and S permitted the neutron energy spectrum to be resolved into five energy groups. A NaI scintillation counter was used to detect low-energy γ rays from the Pu fission products. Calibration of the system of threshold detectors is described, and typical field results are presented. (W.L.H.)

5845
RECENT DEVELOPMENTS IN GLASS DOSIMETRY. Norbert J. Kreidl and Gerald E. Blair (Bausch and Lomb Optical Co., Rochester, N. Y.). Nucleonics 14, 82-3(1956) Mar.

A glass has been formulated which responds linearly to radiation in the range 10^3 to 10^6 r. This glass is suggested for use in high-level dosimetry. (D.E.B.)

ENERGY DISCRIMINATION IN GAMMA-DOSE EVALUATION. L. F. Kocher (General Electric Co., Richland, Wash.). Nucleonics 16, No. 11, 151, 153-4, 156(1958) Nov.

Two methods that can be used to evaluate gamma doses measured with multiple-shield film dosimeters are (a) simultaneous equations in the case of x- and γ-ray exposures of known energies and (b) constant-density curves in the case of multiple-energy exposures. Some examples are given of the application of these methods to energy-discrimination studies with Du Pont 502 film packets. (auth)

RADIATION DOSIMETRY BY TRANSPARENT PLASTICS. J. W. Boag, G. W. Dolphin, and J. Rotblat (Univ. of London). Radiation Research 9, 589-610(1958) Dec.

The radiation-induced ultraviolet absorption in transparent plastics has been investigated in detail and found to be a convenient, rapid, inexpensive, and accurate method of measuring radiation doses between 10^5 and 2×10^8 rads. In methyl methacrylate (Perspex) the change in optical density at 2920 A is a linear function of the dose, up to about 3 megarads, and of the inverse of the thickness of the sample. Various factors that may influence the reproducibility of results have been investigated. The calibration curve, relating the change in optical density to the dose in rads, measured calorimetrically, is given. In polyethylene terephthalate (Melinex), which can be obtained in thin foils, the induced absorption was measured at 3250 A and calibration curves obtained up to 200 megarads. The rate of fading of the induced absorption and its bearing on the results are discussed. Some examples are given of the application of this technique to dosimetry. (auth)

RADIOACTIVE AND NONRADIOACTIVE 4.01

LIMITS AND STANDARDS 4.01.07

DOSIMETRY 4.01.07.03

11605 ✓
RADIATION DOSIMETRY BY CHEMICAL MEANS.
H. Bildstein (Österreichischen Studiengesellschaft für Atomenergie GmbH, Vienna). Atompraxis 4, 163-7 (1958). (In German)

A description is given of methods of chemical radiation dosimetry with solid, liquid, and gaseous systems of organic and inorganic substances. The possibilities of a selective dosimetry in mixed radiation fields are shown. 49 references. (auth)

1464 NARF-55-77T
Consolidated Vultee Aircraft Corp., Fort Worth, Tex.
CALIBRATION OF ANTHRACENE DOSIMETERS. F. W. Smith and F. N. Mortensen. Nov. 21, 1955. 34p. Contract AF33(038)-21117. (MR-N-30)

A type of anthracene scintillation detector was investigated in connection with the development of γ dosimeters. It was found to be sensitive in the range between 0.2 mr/hr to 20 r/hr, easily calibrated, and quite stable in response. The effects of temperature, angular response, and voltage stability were determined. (auth)

7423
STUDIES ON CHEMICAL CHANGE IN RADIOLYSIS. III. THE ACTION OF GAMMA-RAYS ON AQUEOUS SOLUTION OF OXALIC ACID. Masao Matsui. Sci. Papers Inst. Phys. Chem. Research (Tokyo) 53, 290-9(1959) Dec. (In English)

As preliminaries of the study for preparing oxalic acid by ionizing radiation, the stability of aqueous solutions of the acid against Co^{60} gamma rays is examined. A definite relationship between decomposition and total dose was found. Therefore, experiments were made for the purpose of applying oxalic acid to chemical dosimetry. (auth)

6687 A/CONF.15/P/331
DIVERSES EXPRESSIONS POSSIBLES DE LA TOXICITE DES SUBSTANCES RADIOACTIVES EN FONCTION DES PROBLEMES PRATIQUES POSES. (Various Possible Ways to Express the Toxicity of Radioactive Substances in Relation with the Involved Practical Problems.)
Henri Jammet and Georges Vacca (Commissariat à l'Énergie Atomique, Paris). 24p.

The toxicity of radioactive substances is difficult to express because of the diverse effects of radiation. Two types of toxicologic classifications are common: one as a function of the weight of the radioelement, the other as a function of the activity. A third classification, the maximum admissible number of nuclei in the organism, is suggested. The number of nuclei is based on H^3 as one. The three classification schemes are compared, a logarithmic expression of relative toxicity analogous to pH is proposed, and the relative toxicity of the principal radioisotopes is tabulated. ~~(J.S.R.)~~

974
FILM-BADGE DOSIMETRY: DEVELOPMENT OF A STANDARD CALIBRATION CURVE. D. G. Boyer (Idaho Operations Office, AEC, Idaho Falls). Nucleonics 13, No. 11, 106-9(1955) Nov.

4567 AERE-HP/M-16
[Gt. Brit. Atomic Energy Research Establishment, Harwell, Berks, England.]
DOSE TO TISSUE FROM RADIO-ELEMENT ON SKIN.
A. C. Chamberlain. [nd]. Decl. Dec. 20, 1956. 5p.

Three methods are used to calculate the dose at the base of the stratum corneum due to 1 $\mu c/cm^2$ of a β emitting isotope on the skin. For typical old fission products independent methods give 7.5 and 9.2 rep/hr per μc per cm^2. (auth)

726
DOSIMETRY OF GAMMA AND X RADIATION AND MONITORING OF RADIOACTIVE AEROSOLS.
K. Spurny and H. Kloudova (Univ. of Prague). Pracovni lekarstvi, Praha 10, 167-70(1958). (In Czech.)

Dosimetry of gamma and x radiation and monitoring techniques for detecting radioactive aerosols under industrial and laboratory conditions are described. The gamma and x radiation were measured with a divided ionization chamber with an adapted electrometer. The autoradiographic method was used for measuring radon concentrations in the atmosphere. Diaphragm filters were utilized for capturing the samples of radioactive aerosols. (R.V.J.)

RADIOACTIVE AND NONRADIOACTIVE 4.01

LIMITS AND STANDARDS 4.01.07

DOSIMETRY 4.01.07.03

20805
A NOMOGRAM FOR DOSAGE CALCULATIONS IN TELECOBALT THERAPY. Hassan Fateh (Montefiore Hospital, New York). Am. J. Roentgenol., Radium Therapy Nuclear Med. 82, 706-7(1959) Oct.
A nomogram is described which gives data on depth dose as % air dose at various depths (in cm) and outputs (r/min in air) and treatment times (min). (T.R.H.)

20857
DOSAGE TABLES FOR LINEAR RADIUM SOURCES FILTERED BY 0.5 AND 1.0 mm. OF PLATINUM. M. A. Greenfield, M. Fichman, and A. Norman (Univ. of California, Los Angeles). Radiology 73, 418-19 (1959) Sept.
Tables computed by linear interpolation from Sievert's integrals are presented for 0.5 and 1.0 mm Pt filters. (T.R.H.)

447 HASL-58(p.214)
[Robert A. Taft Sanitary Engineering Center], Cincinnati.
A TEST OF RESPONSE TO EXPOSURE. H. E. Stokinger. 1p.
A direct correlation is reported in exposure to vanadium, urinary excretion of vanadium, and quantitative measurements of the amount of cystine in the fingernails. The test has also been tried for a number of chronic diseases such as diabetes and heart disease. The test has never been applied in cases of radiation exposure, but it is suggested that it may have possibilities. (C.H.)

MERCURY 4.01.08

4484 IGIS-46(RD/R)
THE IMPORTANCE OF DETAILED EXAMINATIONS OF EMPLOYEES WORKING WITH MERCURY. PART I. PERIODICAL EXAMINATIONS OF EMPLOYEES SUBJECT TO KNOWN EXPOSURE (ESTIMATION OF THE MERCURY LEVEL IN THE URINE). J. Totusek. Translated by R. G. Evan (U.K.A.E.A., Risley) from Pracovní lékařství 6, 99-101(1954). 7p.
The results of the examinations of 93 persons from 6 different mercury processing plants, where the mercury concentration in the air was measured repeatedly are reported. In the tables, the author compares the objective diagnoses, together with the neurological findings and the Hg estimation in the urine, with the results of the periodical Hg measurement in the air. Houstková's method for the determination of mercury in biological materials is discussed. According to the author, collective findings of up to 200 gammas/liter urine indicate normal exposure, for up to 400 gammas/liter urine there is an expression of the possibility of poisoning, while values above 400 gammas/liter urine represent a diagnostic index, whereby the possibility of lower values does not exclude the possibility of poisoning. This fact is explained, in accordance with the findings of other investigators, by the irregular urine excretion, and by the individual mercury retention faculty of the organism. Finally, it is recommended that the limit of 0.1 gamma/liter air should be rigorously enforced, while there is even a possibility that this value might, after further study of the results, have to be reduced to 0.01 gamma/liter air.

5902 Y-1188
Union Carbide Nuclear Co. Y-12 Plant, Oak Ridge, Tenn.
PORTABLE MERCURY VAPOR DETECTOR. C. S. McMurray and J. W. Redmond. Jan. 7, 1958. 45p. Contract W-7405-eng-26. $1.25(OTS).
A description is given of a functional mercury vapor detector which is a portable, self-contained, survey instrument, and has a minimum range from zero to two-tenths milligram of mercury per cubic meter of air. (auth)

12656 TID-3067
Technical Information Service Extension, AEC.
MERCURY TOXICITY: A BIBLIOGRAPHY OF PUBLISHED LITERATURE. Hugh E. Voress and Naomi K. Smelcer, comps. July 1957. 54p. $1.50(OTS).
This title list contains 1676 references to articles on mercury toxicity that have appeared in technical journals from 1903 to the spring of 1955. The references are arranged alphabetically by senior author. (auth)

6632 UCRL-3714
California. Univ., Berkeley. Radiation Lab.
THE CONTROL OF MERCURY VAPOR IN LABORATORIES.

RADIOACTIVE AND NONRADIOACTIVE 4.01

MERCURY 4.01.08

C. R. Wintersteen. Mar. 6, 1957. 11p. Contract W-7405-eng-48. $0.15(OTS).

The problem of mercury vapor in laboratories need not be a serious one if the basic precautions are taken. The following program is recommended as adequate and practical for the typical research laboratory: make sure that good ventilation is available at all times; clean up spills as soon as possible, preferably by use of an approved vacuum cleaner; use an electronic detection device for monitoring work areas and equipment; use vapor-suppressive chemicals when necessary; make sure that the correct personal protective equipment is available; and establish a safety procedure and stress the importance of Hg vapor control by the use of safety bulletins and other printed material. (auth)

6664 AERE-ES/R-2124
Gt. Brit. Atomic Energy Research Establishment, Harwell, Berks, England.
CALIBRATION OF THE MERCURY VAPOUR DETECTOR TYPE "B." P. E. Thorpe and R. W. Marriott. Jan. 1957. 16p.

4260 UR-469
Rochester, N. Y. Univ. Atomic Energy Project.
THE INDUSTRIAL HYGIENE AND TOXICOLOGY OF MERCURY. Charles J. Spiegl. Nov. 6, 1956. 26p. Contract W-7401-eng-49. $0.25(OTS).

894 UR-468
Rochester, N. Y. Univ. Atomic Energy Project.
CHRONIC MERCURY POISONING: AN EVALUATION OF OUR PRESENT KNOWLEDGE. Aser Rothstein. Nov. 5, 1956. 7p. Contract W-7401-eng-49. $1.80(ph OTS); $1.80(mf OTS).

1925 KAPL-M-FGH-2
Knolls Atomic Power Lab., Schenectady, N. Y.
EVALUATION OF MERCURY VAPOR REMOVAL METHODS FOR CONFINED COMPARTMENTS. F. G. Haag. Feb. 1, 1956. 7p. Contract W-31-109-Eng-52. $1.80 (ph OTS); $1.80(mf OTS).

The activated charcoal adsorption process for removal of Hg vapor from habitable compartments of the "Seawolf" submarine was considered impractical. (T.R.H.)

MONITORING 4.01.09

See also, under PLANTS AND EQUIPMENT,

RADIATION MEASUREMENT--Surveys and Theory (5.11.05.06).

INSTRUMENTS 4.01.09.01

See also, under PLANTS AND EQUIPMENT,

INSTRUMENTATION AND CONTROL --Radiation Measurement (5.11.05).

INSTRUMENTS – Alpha 4.01.09.01.01

See also, this section,

PLUTONIUM (4.02.06).

6745 A/CONF.15/P/1682
DETECTEURS DE FAIBLE ACTIVITE D'EMETTEURS DE RAYONNEMENT ALPHA—APPLICATION DE CES DETECTEURS A LA MESURE DE LA CONTAMINATION DES EAUX, AEROSOLS ET SURFACE DE TRAVAIL. (Low Level Alpha Detectors and Their Use for the Measurement of the Contamination in Water, Aerosols and on Working Surfaces.) R. Boulenger and E. Gourski (Centre d'Etude de l'Energie Nucléaire, Brussels). 18p.

To measure the alpha activity levels lower than the maximum permissible level for contamination in air, water, and on surfaces that can come in contact with the skin, three types of alpha detectors were constructed and their performance studied. The types studied were proportional counter filled with air, proportional counter filled with methane or argon—methane mixture, and scintillation counter with zinc sulfide. A scintillation counter with a window for measurement of samples and a scintillation counter with window for use as a monitor were built. (J.S.R.)

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MONITORING 4.01.09

INSTRUMENTS – Alpha 4.01.09.01.01

16160 USNRDL-TR-326
Naval Radiological Defense Lab., San Francisco.
AN ALPHA SURVEY RADIAC FOR FIELD USE.
K. Sinclair and G. Kiyoi. May 14, 1959. 34p.

An alpha survey radiac employing a photomultiplier tube and scintillation detector has been developed. The instrument utilizes transistor circuitry and operates from two standard flashlight batteries. Four linear ranges are provided with full scale indication on the highest range corresponding to 10,000 $\mu g/m^2 Pu^{239}$. The instrument was designed with a separable probe and a telescoping extension for easier ground monitoring. A thorium metal source is attached to the instrument housing for checking instrument calibration in the field. The device conforms satisfactorily to the military requirements for altitude, humidity, vibration, shock, and storage. The operational battery life is in excess of 40 hours. Instrument error at low temperatures slightly exceeds the ±20% accuracy requirement; however, adequate measurements are readily made by using the thorium check source to provide a check point. Instrument response to low energy x rays is excessive. However, tests indicate that a simple lead filter will eliminate this difficulty. (auth)

5463
DETECTION OF PLUTONIUM IN AIR BY APPLICATION OF COINCIDENCE TECHNIQUES. A. Blanc and G. Roux (Centre d'Etudes Nucléaires, Saclay, France). p.163-8 of "Nuclear Electronics. II." (In French)

An apparatus for the detection of plutonium aerosols is described. It is based on the determination of the difference between the total α activity and the α activity caused by radon-thoron deposits. The radon-thoron activity is caused essentially by RaC′ and ThC′, which are formed by the beta decay of RaC and ThC. The transformations can be determined with precision because of the emission of an alpha particle a relatively short time after the emission of a beta. A schematic diagram of the apparatus used is given. The results obtained show that the use of the β-α pseudo-coincidence technique permits the detection of 1 dose-day of plutonium. (J.S.R.)

INSTRUMENTS – Beta 4.01.09.01.02

6891 A/CONF.15/P/2106
RAPID ASSESSMENT OF SURFACE RADIOACTIVE CONTAMINATION. F. Běhounek (Karlova Univ., Prague). 8p.

The determination of extended surface radioactive contamination by the usual β-ray counting is lengthy, unprecise, and unsensitive. It can be effected very quickly and with high degree of sensitivity when using the method of discharge of a conductor by the ions produced by the β rays of contaminating radioisotopes. The rate of discharge is directly proportional to the first power of the ion density in the vicinity of the conductor and to the square root of the surface specific activity. The experimental arrangement is very simple. The conductor, a piece of aluminum wire, is screwed on the charging plug of a routine pocket stylo-electrometer. The wire is placed in a distance of 10 cm from the active surface and parallel to it. Specific activities as low as 10^{-4} c/cm^2 of β emitters can be assessed within a few minutes with an accuracy of at least 15 per cent. (auth)

1722
DOSIMETRY OF β RADIATORS IN RADIATION PROTECTION. K. Sommermeyer and H. Opitz (Universität, Freiburg i B.). Atomkernenergie 4, 404-8(1959) Oct. (In German)

In handling radioactive isotopes, the fingers and the lenses of the eyes are specially sensitive to beta rays. The doses in the vicinity of the radioactive substances can easily be measured and calculated. For the measurements proportional chambers filled with methane gas are used, and for calculating "point-source" and "thick source" dose functions are used. (auth)

7264 ORNL-2158
Oak Ridge National Lab., Tenn.
POCKET ION CHAMBERS FOR BETA RADIATION DOSE. Harry H. Hubbell, Jr., Robert D. Birkhoff, and Raymond M. Johnson. May 23, 1957. 102p. Contract W-7405-eng-26. $0.55(OTS).

A pocket ionization chamber has been developed which in conjunction with a commercial gamma reading pocket chamber can be used to estimate the beta dose received, or if used alone, to measure the combined beta-gamma dose.

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INSTRUMENTS – Beta 4.01.09.01.02

The problem was to obtain a simple, rugged chamber which would have a wall sufficiently thin to pass the lower energy beta rays and which would give either no response for gamma rays or one of the same magnitude as the gamma reading pocket meter. Of the six dosimeters constructed and tested, the perforated aluminum walled chamber gave the best beta response. Its response over the range of average energies from about 52 kev to 694 kev varied from about 50% to about 80% of the dose received by the germinal layer of the skin. The response of this chamber to low energy gamma radiation (up to 700 kev) approxi-

9457 AERE-EL/R-1997
Gt. Brit. Atomic Energy Research Establishment, Harwell, Berks, England.
AN INTERIM REPORT ON RADIAC CONTAMINATION METER DEVELOPMENTS. W. Abson and O. H. Turner. June 1956. 14p.
A detailed study was made of the performance of a β-sensitive ionization chamber for monitoring fission product contamination of the skin and clothing. Data are tabulated. Data are included from preliminary studies on the performance of a β-sensitive Geiger counter used for the same purpose. Requirements for a monitor for assessing the β-radiation hazard from ingested radioactive material are also discussed. (C.H.)

11557
THE DOSIMETRY OF IONIZING RADIATIONS OF FINITE RANGE. S. N. Ardashnikov and N. S. Chetverikov (Ministry of Health, R.S.F.S.R., Moscow). Biophysics (USSR) (English Translation) 3, 469-90 (1958).
A method for calculating the integral absorbed beta dose is presented in which the finite range of the particles is allowed for. In essence it amounts to replacing the normal dose calculation by the calculation of the total range of the particles in the object. Its particular advantage is the comparatively simple and direct way this is done. (T.R.H.)

12565 AE-3
Aktiebolaget Atomenergi, Stockholm.
COMPARISON OF FILTER PAPERS AND AN ELECTROSTATIC PRECIPITATOR FOR MEASUREMENTS ON RADIOACTIVE AEROSOLS. R. Wiener. Sept. 1956. 7p.
Measurements were made in which electrostatic precipitators were compared with filter papers for collecting airborne radioactivity for alpha and beta measurements. The results show that the filter paper method is as good as the electrostatic method in determining beta-activity, disregarding clogging and moisture sensitivity of the filter paper, but it is inferior for alpha measurements. Experimental values of the alpha absorption factor for different types of filter papers are given. (auth)

INSTRUMENTS – Gamma and X 4.01.09.01.03

1632 HW-59612
General Electric Co. Hanford Atomic Products Operation, Richland, Wash.
A SCINTILLATION NUCLEAR INCIDENT ALARM MONITOR. W. G. Spear. Mar. 13, 1959. 13p. Contract W-31-109-Eng-52. OTS.
The design of a scintillation nuclear incident alarming instrument which can be reliably set to alarm in any gamma field intensity from one mr/hr to greater than ten r/hr is described. An inexpensive high-voltage supply, an inexpensive terphenyl-in-polyvinyltoluene crystal, a multiplier phototube, and a meter relay are the basic components. An addenda two-transistor booster amplifier can be used if necessary for very low-level triggering. The amplifier has a gain of approximately ten. The same instrument, with only a change in crystals to a boron zinc-sulfide crystal, can be used for fast or slow neutron alarming. Beta alarming can be included by supplying the crystal detector with an aluminized mylar light cover. Two such units can be operated in a dual or back-to-back fashion. Such operation requires both unit relays to close before activation of the main alarm relay. (auth)

4578
PERSONNEL PROTECTION INSTRUMENTS FOR USE IN GAMMA IRRADIATION CELLS. E. W. Pulsford (Atomic Energy Research Establishment, Harwell) and C. C. H. Washtell (Labgear, Cambridge). Nuclear Power 2, No. 10, 58-61(1957) Feb.

RADIOACTIVE AND NONRADIOACTIVE 4.01

MONITORING 4.01.09

INSTRUMENTS – Gamma and X 4.01.09.01.03

The requirement for instruments which will give warning and provide an indication of the hazard of dangerous conditions in irradiation cells is discussed. Circuits are shown for a γ alarm unit and of a portable γ dose-rate monitor. (B.J.H.)

6755 A/CONF.15/P/2110
A REPRODUCIBLE CHEMICAL DOSIMETER FOR MEASUREMENT OF LOW DOSES OF GAMMA AND X RAYS. Z. Spurný (Czechoslovakia). 8p.

A solution of resazurin in 96% alcohol in the mixture of carbon tetrachloride with absolute alcohol represents a single phase chemical dosimeter. The applied dose can be determined by visual comparison to a color standard with an accuracy of 15% or a higher one (± 5 per cent) by the measurement of pH of water added. Characteristics of this dosimeter were investigated. No special measures are required and the solution holds stable a few days in ground brown ampules. For a long stability the dosimeter system must be prepared in the absence of CO_2 and sealed in brown flasks. (auth)

19126 HW-60320
General Electric Co. Hanford Atomic Products Operation, Richland, Wash.
CRITICAL INCIDENT ALARM—MODEL I: INSTRUCTION AND MAINTENANCE MANUAL. P. R. Kelly. May 8, 1959. 14p. $3.80(ph), $2.40(mf) OTS.

The HAPO Critical Incident Alarm, Model I, is an instrument designed to give an audible and visual alarm signal in the event of a critical incident to which it is exposed. The instrument is self-contained, including the radiation detector, and is calibrated to alarm at 500 mr/hr in a gamma field. The system consists of a sodium iodide crystal, photomultiplier tube, meter, magnetic amplifier relay, power relay, alarms (siren and light), and power supply. (W.D.M.)

11553
CRYSTAL DOSIMETER. P. W. Levy (to U. S. Atomic Energy Commission). U. S. Patent 2,800,589. July 23, 1957.

The use of a crystal to record the gamma radiation dosage is described. The disclosed dosimeter comprises a crystal of $MgO \cdot 35\ Al_2O_3$, said crystal's optical transparency being a function of the gamma radiation received by the crystal. After the crystal is exposed to gamma radiation, its light transparency is ascertained and this figure is referred to a calibration curve to determine the radiation quantity to which the crystal was exposed. As a result of the rugged nature and chemical inertness of such crystals this crystal dosimeter is particularly useful in connection with medical work for recording gamma radiation dosages. (auth)

505
POCKET-TYPE GAMMA-RADIATION DOSIMETER. M. Aradenne, G. Yeger, B. Isayev, V. Roggenbuk, and G. Froylikh. Vsesoyuz. Sbornik Issledovaniya V Oblasti Dozimetrii Ioniziruyushchikh Izluchenii, Moskov, Akad. Nauk S.S.S.R., 112-14(1957). (Translated from Referat. Zhur. Elektrotekh., No. 2, 1959, p.151).

A pocket-type electrometer with a quartz filament and a reading microscope is described. The electrometer has a linear scale calibrated in milliroentgens. The scale span is 0 to 200 milliroentgens. Thirty experimental models of the instrument were tested. The charge leakage never exceeded 5% per day. The reading spread of individual meters did not exceed 10%.

7238
A CODE OF PRACTICE FOR X-RAY MEASUREMENTS. Brit. J. Radiol. 33, 55-9(1960) Jan.

A code is presented for use in measurements of radiation having a half-value thickness in the range 0.5 to 5 mm Cu. (C.H.)

INSTRUMENTS – Neutrons 4.01.09.01.04

1712 CF-59-10-41
Oak Ridge National Lab., Tenn.
CRITICALITY ACCIDENT APPLICATION OF THE ORNL BADGE DOSIMETER. E. D. Gupton, D. M. Davis, and J. C. Hart. Oct. 14, 1959. 20p. OTS.

Nuclear accidents have emphasized the need for a personnel meter with which the radiation dose may be determined accurately in a few hours. The badge-type dosimeter developed at ORNL fulfills this need. It contains an

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INSTRUMENTS – Neutrons 4.01.09.01.04

indium foil which permits the immediate segregation of anyone who may have had a medically significant dose of neutron radiation. A gold foil is used for thermal neutron measurement and sulfur is used for fast (2.5 Mev) neutron measurement. To be meaningful the gold and sulfur measurements must be correlated with the Threshold Detector Units of the type reported by Hurst. The film used in this badge is DuPont type 553 for beta-gamma measurement and Eastman type A for neutron measurement. Provision is made in the badge for the incorporation of a chemical dosimeter and a silver phosphate glass dosimeter for the measurement of gamma radiation. (auth)

4569 KAPL-1516
Knolls Atomic Power Lab., Schenectady, N. Y.
RESONANCE-THRESHOLD FOIL NEUTRON PERSONNEL DOSIMETER. J. J. Fitzgerald and C. G. Detwiler. June 8, 1956. 35p. Contract W-31-109-Eng-52. $0.30(OTS).

A resonance-threshold foil neutron personnel dosimeter is described. Some advantages which it offers in personnel monitoring are: (1) A neutron spectrum can be evaluated and an energy corrected total neutron dose can then be determined. (2) Direct thermal and slow neutron dose measurements as low as 25 mrem can be made on a routine basis. (3) It will be possible to interpret, in most cases, the total neutron dose regardless of the relative positions of the source, the body, and the detector. (auth)

INSTRUMENTS – Mixed Radiation 4.01.09.01.05

425
NUCLEAR INSTRUMENTATION. Denis Taylor (Plessey Nucleonics, Ltd.). Nucleonics 15, No. 9, 111-13(1957) Sept.

Recent developments in the design of radiation detection instruments are reviewed. The increasing use of transistors and ferrite loops is predicted, and the advantages and disadvantages of each is discussed. New production techniques, encapsulation, printed wiring, and expendable subassemblies are expected within the near future. It is expected that instrumentation will be simpler but more reliable, and will include more data processing. Small bench-type pulse-height analyzers, and instruments combining the functions of pulse-height analyzer and the time-of-flight spectrometer are predicted. It is also expected that whole-body counters will be an important health physics tool. (C.H.)

2636
A FILM DOSIMETER FOR RADIATION PROTECTION CONTROL IN CLOSE ASSOCIATION WITH RADIOACTIVE ISOTOPES. G. Böhler (Deutschen Akademie der Wissenschaften, Berlin-Buch). Kernenergie 1, 1045-51 (1958). (In German)

A film badge is described which is made up of 3 plates in a protective plastic envelope. The front (or back) plate is 1-mm thick Al 36 × 43 mm with 13-mm holes 0.5 mm deep. Two holes are inlaid with 1-mm Pb one of which is plated on the upper surface with 18 mg/cm^2 Al foil. Between the front and back plates an open frame of 1-mm Al is riveted so that the Al plating shows and the open space remains clear. The photo emulsion is placed between 7 mg/cm^2 specific surface weight black paper for protection. This surface weight is important because the film must be inserted in the slit between the plates. Radioactive contamination of the protective cover can be readily removed by exchanging it. The total weight of the plaque is 18 gm. By means of the two lead windows gamma dosimetry is accomplished, and the other two windows are for β dosimetry. The performance of this arrangement is demonstrated with curves of film darkening versus radiation energies. (T.R.H.)

333 WCAP-6029
Westinghouse Electric Corp. Atomic Power Dept., Pittsburgh.
NUCLEAR MATERIALS CONTROL SYSTEM. PHASE II. GENERAL ACTIVITY DETECTORS FOR SAFEGUARDS USE. F. J. Arsenault. Oct. 1, 1959. 14p. Contract AT(30-1)-2176, Task I. OTS.

The application of radioactivity monitors to the detection of SS material diversion is discussed. Slug counters on the dissolver slug chutes at chemical processing plants are currently in use and appear practical. Pipeline monitors, area monitors, and portable monitors to survey areas, personnel, and vehicles are considered. (auth)

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INSTRUMENTS – Mixed Radiation 4.01.09.01.05

15265 AD-211297
Controls for Radiation, Inc., Cambridge, Mass.
DEVELOPMENT OF A TACTICAL GAMMA NEUTRON DOSIMETER. Bi-Monthly Progress Report No. 2 [for] September 1, 1958–October 31, 1958. I. A. Berstein, R. C. Fix, J. E. Mayer, Jr., and P. F. Russo. Nov. 1, 1958. 8p. Contract DA-18-108-405-CML-198.

An 80% Pt–20% Rh alloy was investigated for sealing E-5 dosimeter ampoules. Very favorable results were obtained. A number of sealing units consisting of Pt–Rh alloy imbedded in cement were constructed and studied. It was concluded that with minor modifications automatic filling and sealing equipment can be assembled and put into use. The use of RF induction heating was also investigated. Several ampoules were successfully sealed by this method, and further investigation is proposed. (For preceding period see AD-211296.) (J.R.D.)

162 HW-56128
General Eletric Co. Hanford Atomic Products Operation, Richland, Wash.
AN AURAL ALPHA-BETA-GAMMA MONITOR. W. G. Spear and G. D. Crouch. June 1, 1958. 12p. Contract [W-31-109-Eng-52]. $3.30(ph OTS); $2.40(mf OTS).

A compact, aurally-indicating, alpha, beta, gamma monitor was developed to permit simultaneous monitoring for surface contamination. The probe incorporates a combination zinc sulfide and terphenyl-in-polystyrene crystal detector. The alpha background is less than three c/m and the alpha detector will easily detect and indicate above background a Pu^{239} source at normal surveying probe speeds. The beta-gamma portion will detect C^{14} and S^{35} betas of 154 and 167 kev. (W.D.M.)

6713 A/CONF.15/P/329
APPAREILS RECENTS ET METHODES NOUVELLES POUR LA MESURE DE LA CONCENTRATION DES PRODUITS RADIOACTIFS DANS L'ATMOSPHERE. (Recent Instruments for Measuring the Concentration of Radioactive Products in the Atmosphere).
C. Jehanno, A. Blanc, C. Lallemant, and G. Roux (Commissariat à l'Énergie Atomique, Paris). 61p.

Radioactive contamination of the atmosphere is a danger which is connected to the development of atomic industry. Six instruments which were developed and constructed in France for the detection of radiation in the vicinity of reactors and nuclear research centers are described. Four of the instruments are designed for measurement of radioactive aerosols, with sensitivities ranging from 10^{-11} to 10^{-1} c/m^3. A special aerosol detector is designed to measure plutonium concentrations. The SP-4 is designed to monitor the radiation produced on the ground by smoke from reactors. The A.D.I.R., an automatic and portable instrument, is designed for measurement of the radon content of the atmosphere. (J.S.R.)

7566
APPARATUS FOR MEASUREMENT OF RADIOACTIVITY OF HUMAN BODY. A. Lansiart and L. Jeanmaire (Commissariat a l'Énergie Atomique, Paris). J. phys. radium 20, Suppl. No. 12, 174A-6A(1959) Dec. (In French)

A whole-body counter is described. It employs both NaI crystals and liquid scintillators for maximum utility. (T.R.H.)

10265
RADIATION COUNTER. W. W. Goldsworthy (to U. S. Atomic Energy Commission). U. S. Patent 2,822,479. Feb. 4, 1958.

This patent relates to a radiation counter, and more particularly, to a scintillation counter having high uniform sensitivity over a wide area and capable of measuring alpha, beta, and gamma contamination over wide energy ranges, for use in quickly checking the contamination of personnel. Several photomultiplier tubes are disposed in parallel relationship within a light tight housing behind a wall of scintillation material. Mounted within the housing with the photomultipliers are circuit means for producing an audible sound for each pulse detected, and a range selector developing a voltage proportional to the repetition rate of the detected pulses and automatically altering its time constant when the voltage reaches a predetermined value, so that manual range adjustment of associated metering means is not required.

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9007

TRANSISTORIZED RADIATION SURVEY INSTRUMENTS. W. G. Spear (Hanford Atomic Products Operation, Richland, Wash.). Nucleonics 15, No. 6, 100, 102-3(1957) June.

An alpha scintillation meter, a G-M-tube meter, a combined alpha and G-M instrument, gamma and beta-gamma scintillation instruments, and a neutron-survey instrument are described. The power supply, amplifier and ratemeter circuits are all transistorized for light weight, compactness, and ease of maintenance of the 6 instruments. (T.R.H.)

14134

CHARGING DEVICE FOR POCKET DOSIMETERS. E. V. Utekhin (Central Research Inst. of Roentgen-Radiology, Ministry of Health, USSR). Med. Radiol. 3, 68-9(1958) May-June. (In Russian)

The scheme is presented for a pocket dosimeter recharge device. (R.V.J.)

1508 USNRDL-TR-178

Naval Radiological Defense Lab., San Francisco.

A FIELD BETA-GAMMA DOSE-RATE METER. Frank A. Devlin. May 1957. 14p. Project NS 088-001.

A thin polyethylene chamber ionization detector has shown remarkable β flux sensitivity. It was found that by adding a removable β flux discriminator to the chamber it was practicable to differentiate between the β component and the γ component of the flux coming from a contaminant field. Laboratory experiments and field data substantiate the practicability of the system described. The γ energy dependence of the detector was found to be a maximum of 17% high relative to Co^{60}. (auth)

1503 AF-SAM-57-90

California. Univ., Los Angeles.

DEVELOPMENT OF A GERMANIUM CRYSTAL DOSIMETER. Benedict Cassen, Valerie Burkig, and W. A. Selle. Jan. 29, 1957. 9p.

The most satisfactory material found for use as a fast neutron dosimeter has been made by purifying and crystallizing 30 ohm-cm germanium three times with 3 zones of a zone melt furnace and adding 0.026 mg of indium per kilogram of germanium. Good crystal structure is important and requires a good seed crystal and zone widths between 1 and 1.5 inches. Close temperature control appears to be required to make reliable cold bath resistance measurements with the consequent accuracy of ΔC calculations. (auth)

10259 ✓

QUARTZ FIBER ELECTROSCOPES. R. P. Henderson (to U. S. Atomic Energy Commission). U. S. Patent 2,742,577. Apr. 17, 1956.

This patent pertains to quartz fiber electroscopes of small size for use by personnel to monitor nuclear radiation. The invention resides in a novel way of charging the electroscope whereby the charging of the electroscope whereby the charging of the electroscope is carried out without obtaining contact with the fiber system or its support and the electroscope can therefore be constructed without a protective cap to prevent wrongful discharge. The electroscope is charged by placing a voltage between an electrode located in close proximity to the element to be charged and the electroscope metallic case.

3374 K-1277

Oak Ridge Gaseous Diffusion Plant, Tenn.

A HIGH SENSITIVITY BETA-GAMMA PROBE FOR USE WITH THE SAMSON SURVEY METER. T. J. Lewis. Apr. 13, 1956. 16p. Contract W-7405-eng-26. $0.20(OTS).

A high-sensitivity beta-gamma probe, which connects to the Samson Alpha Survey Meter by extension cable, has been developed. The probe was designed to operate in beta or gamma fields of strengths equivalent to 625 mr/hr. The complete instrument is suitable for general health physics survey work, and can be used to replace the separate GM-type and Cutie Pie instruments heretofore utilized. (auth)

3301 ✓ TID-8006

Technical Information Service, AEC.

GLASS DOSIMETERS FOR RADIATION MEASUREMENT. James H. Schulman, Naval Research Lab. Mar. 1956. 18p. $0.20(OTS).

One of Its monograph series "The Industrial Atom."

The principles and mechanisms involved in radiation

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detection with special Ag-bearing phosphate glass are discussed. Two detection devices are described which embody the principles of radiophotoluminescence. One is a personnel dosimeter for military and civilian defense use and the other is a dosimeter employing a small polished piece of glass for measuring high doses in food and drug sterilization. Other devices in the process of being developed are discussed briefly. (C.H.)

5077

POCKET RADIATION METER. P. R. Bell, Jr. (to U. S. Atomic Energy Commission). U. S. Patent 2,736,817, February 28, 1956.

A portable light weight radiation meter which is provided with a calibrated logarithmic indicator scale for covering ranges of intensities, permitting of direct reading on a single scale of the harmless to the disastrous ranges of radiation is described. The meter contains a battery operated vacuum tube and associated novel circuitry. (auth)

3090

RADIATION DETECTION DEVICE. G. Failla (to U. S. Atomic Energy Commission). U. S. Patent 2,731,568. January 17, 1956.

A small, low cost device that indicates the presence or degree of ambient radioactivity and does not depend upon an electrical source for operation is described. A number of identical glass or amber balls are contained in a dielectric container shaped so as to cause the balls normally to congregate. An atmosphere of a dry ionizable gas is present. Upon shaking the container the induced tribo-electric charges cause the balls to disassociate. If no radiation is present, this effect will continue, but a sufficiently high level of radiation will ionize the gas thereby permitting the tribo-electric charges to leak off and the balls to recongregate. The level of radiation necessary is determined by the size of the balls, the larger sized balls being more reluctant to disassociate and quicker to recongregate thus indicating a lower level of radiation. (auth)

2815 NRL-4680

Naval Research Lab., Washington, D. C.

A PORTABLE READER FOR DT-60 DOSIMETERS. J. C. Schaffert. Nov. 30, 1955. 11p. Projects NR-623-010 and NE 051-551.

3373 BNL-379

Brookhaven National Lab., Upton, N. Y.

BETA-GAMMA HAND AND FOOT MONITOR UTILIZING 10-DIGIT DEKATRONS. J. D. Chester and J. S. Handloser. Oct. 1955. 8p. $0.10(OTS).

A beta-gamma hand and foot monitor utilizing Dekatron type GC10B glow transfer counter tubes has been constructed. The number of channels has been reduced from the usual five to three and mechanical registers have been eliminated. The complete circuit is shown. (auth)

3214 AEC-tr-2399

RADIATION CONTROL BY PHOTOGRAPHIC RECORDING OF FLUORESCENCE. K. Sommermeyer and G. Heiner. Translated by D. E. Cardamone from Naturwissenschaften 42, 508(1955). 2p.

Radiation dosages and exposure times were estimated from the blackening of photographic plates due to fluorescence from exposed organic phosphors. In the range, 0.1 to 0.8r, doses were estimated with a ±20% error. (C.W.H.)

INSTRUMENTS – Calibration 4.01.09.01.06

4432 KAPL-A-HP-5

Knolls Atomic Power Lab., Schenectady, N. Y.

HEALTH PHYSICS MANUAL OF CALIBRATION PROCEDURES FOR PORTABLE AND FIXED SURVEY INSTRUMENTATION. M. R. Kennedy and H. Aceto. Nov. 27, 1959. 76p. Contract W-31-109-Eng-52. OTS.

A summary of the methods used by KAPL personnel to measure the accuracy with which radiation protection instruments respond to radiation standards is presented. Calibration facilities and radiation standards are described and a discussion of instrument operation and theory is included. (J.R.D.)

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3607 AD-212410
Mare Island Naval Shipyard. Industrial Lab., Calif.
DEVELOPMENT OF A PROCEDURE FOR CALIBRATING A WELL-TYPE SCINTILLATION DETECTOR FOR THE MEASUREMENT OF ABSOLUTE RADIOACTIVITY.
Paul T. Wagner and Louis R. Pollack. 1957. 23p.

A procedure is described for obtaining the relationship between counts per minute and disintegrations per minute, using a wall-type scintillation crystal which is considered, from a geometrical standpoint, as completely surrounding the radioactive sample in the test tube. Attenuation losses through the crystal wall are calculated using an empirical thickness which gives the correct result with standard samples. The decay schemes of the radionuclides must be known, and losses due to coincident attenuations, in the case of more than one photon emission per disintegration, must be taken into account. Conversion factors are listed for eleven radioisotopes, in addition to a mean conversion factor for obtaining an estimate of absolute radioactivity when the concentration and identities of the radioisotopes present are not known. The method is applicable to any radionuclide with a known decay scheme which emits a predominant gamma ray of 0.24 Mev or greater energy. (auth)

7607
RADIOACTIVE HOLLOW CYLINDER MAKES POSSIBLE SIMPLE STANDARDIZATION MEASUREMENTS OF LIQUID COUNTER TUBES. Martin Wenzel. German Patent DGM 1,774,919. Oct. 2, 1958. Atompraxis 5, 502(1959). (In German)

For the simple performance of standardization and calibration measurements in liquid counter tubes. it was proposed to introduce a sealed radioactive preparation in the form of a hollow cylinder into the measurement space of the counter instead of filling the counters with a radioactive solution. The hollow cylinder can be made from various materials, for example from a metallic plate, on which a radiometal is electrodeposited. By this innovation a decontamination of the counter after each calibration should be unnecessary. (J.S.R.)

7565
CONTRIBUTION TO THE STUDY OF THE AGING PHENOMENON OF SELF-LIMITING GEIGER-MUELLER COUNTERS. F. E. M. Lox and G. P. Van der Kelen (Faculteit der Wetenschappen, Ghent). J. phys. radium 20, Suppl. No. 12, 131A-38A(1959) Dec. (In French)

As an unambigous criterion for determining the deterioration of a GM counter tube, the value $(\Delta V_I/\Delta V_H)$, the change in pulse-height as a function of the applied high-voltage, has been defined. A study was made of the relative importance of the three main constituents of a GM counter on its characteristics. A systematic study was made of the influence of anode, cathode, and the gas-phase composition. It is shown that the aging of a counter can be ascribed to two different factors: changes of the gas phase that influence mainly the plateau characteristics and changes on the anode surface that cause a gradual decrease of the value $(\Delta V_I/\Delta V_H)$. This is taken as evidence that the changes of the anode surface influence the multiplication process (auth)

7544 WCAP-6038
Westinghouse Electric Corp. Atomic Power Dept., Pittsburgh.
NUCLEAR MATERIALS CONTROL SYSTEM (NMCS). PHASE II. A DOORWAY MONITOR FOR SAFEGUARDS USE. F. J. Arsenault. Feb. 1, 1960. 63p. Contract AT(30-1)-2176, Task I. OTS.

A doorway monitor was developed as part of a Nuclear Materials Control System (NMCS) to discourage the removal of source and special nuclear materials from a plant or work area by concealment on the person. Three methods of detection were considered: detection of the spontaneous fission neutrons from Pu^{240}, detection of the 90- and 184-kev gamma rays from U^{235}, and detection of metal shielding. (W.D.M.)

6728 A/CONF.15/P/1211
CONTRIBUTION A LA DETECTION DES RAYONNEMENTS EN VUE DU CONTROLE ET DE LA PROTECTION. (Radiation Detection for Control and Protection.)
Fuhrmann, [H]. Joffre, and Savouyaud (Commissariat à l'Énergie Atomique, Paris). 11p.

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The improvements made in the fields of gamma-ray dosimetry by photographic films, alpha dosimetry and spectrometry, standardization and autonomy of the electronic components of radiation detectors, and the dosimetry of pulsed radiations are described. The sensitivity of film to x rays and chemical reagents was studied so that a correction could be applied to gamma film dosimetry for these factors. Research on alpha dosimetry led to the improvement of ZnS scintillation counting. The construction of an alpha spectrometer is described. A description is given of improvements made in ionization chambers, counters, and scintillators. The measurement of pulsed radiation of very short periods is discussed. (J.S.R.)

328 WCAP-6024
Westinghouse Electric Corp. Atomic Power Dept., Pittsburgh.
NUCLEAR MATERIALS CONTROL SYSTEM (NMCS) PHASE II. MISCELLANEOUS DEVICES FOR SAFEGUARDING A FUEL REPROCESSING PLANT. W. E. Foster. Oct. 1, 1959. 22p. Contract AT(30-1)-2176, Task I. OTS.

Various anti-syphon devices, a temperature recorder, and a device to assure a constant rate of air flow in pneumatic instrument lines were evaluated for possible inclusion in a Nuclear Materials Control System (NMCS). The devices are intended for use in a fuels reprocessing plant as supplementary equipment for the prevention of unauthorized diversion of source and special (SS) material. The plant is assumed to be under stringent inventory control conditions. The design and application of each device is enumerated. Sufficiently detailed specifications are provided so that the equipment can be independently duplicated. Recommendations concerned with the application of the devices to a fuels reprocessing plant are presented. (auth)

8638
HEALTH PHYSICS INSTRUMENTATION. John S. Handloser. International Series of Monographs on Nuclear Energy. Division V. Health Physics. Volume I. New York, Pergamon Press, 1959. 190p. $6.50.

Health Physics Instrumentation contains descriptions, characteristics, and uses of the common types of radiation detectors used by health physicists. The book is primarily designed for those beginning to use radiation and who wish information concerning the basic health physics instrumentation procedures. A bibliography follows every chapter, and a general bibliography is included giving some general works on health physics. (C.H.)

6710 A/CONF.15/P/248
BASIC REQUIREMENTS FOR CONTINUOUS RADIOACTIVE CONTAMINATION MONITORS. A. Stebler and P. Schranz (Landis & Gyr S. A., Zug, Switzerland). 9p.

An atmosphere monitor is described and illustrated which issues a warning as soon as the product of time and radioactivity concentration reaches a pre-determined level. The instrument consists of a moving filter band with a system of detectors. (C.H.)

10331
THE LITERATURE OF INSTRUMENTATION FOR RADIOLOGICAL STUDIES. Marjorie Comstock (Brookhaven National Lab., Upton N. Y.). I.R.E. Trans. Nuclear Sci. NS-3, 15-17(1956) June.

Instrumentation for radiological studies is interpreted as relating to device or tools for measurement purposes or for implementing research studies in which radioactive material is used. In radiological studies, instrumentation plays a vital part due to the hazards involved in handling radioactive material, and due to the necessity for accurate measurements. The varied fields of research include use of the nuclear reactor, hot laboratory installations, accelerators, cloud chambers, and many other pieces of apparatus. All of these require accessory instruments in order to use them successfully. The list of instruments is lengthy

6681 A/CONF.15/P/261
CONTRÔLE CONTINU DE LA PROTECTION CONTRE LES RADIATIONS IONISANTES. (Continuous Control of the Protection Against Ionizing Radiations). Pierre Wenger and Beryl Renard (Inst. du Radium, Geneva). 3p.

For personnel monitoring at the Geneva Institut du Radium film badges are used. The films used are sensitive to doses from 10 mr to 20 r. The film is enclosed

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between lead foils 1 mm thick containing a central circular hole 1.4 mm in diameter. The photographic density was determined as a function of the radiation. (J.S.R.)

GENERAL HANDBOOK FOR RADIATION MONITORING. Jerome E. Dummer, Jr. Washington, D. C., U. S. Atomic Energy Commission, 1958. 185p. $0.60(GPO).

Basic data on radiation monitoring are presented as the third edition of the handbook. The most up-to-date data for permissible exposures and body burdens are included as well as descriptions of monitoring instruments and techniques, dosimetry, and protective equipment. (J.R.D.)

5360

THE INFLUENCE OF THE EMISSION PROPERTIES OF AN ANODE ON THE CHARACTERISTICS OF GM-COUNTERS. Radko Seidl (Inst. of Technical Physics, Czechoslovak Academy of Sciences, Prague). Czechoslov. J. Phys. 9, 517-23(1959). (In Russian).

The hitherto unknown mechanism of the production of false pulses is investigated, and its influence on the characteristics of counters is discussed. (auth)

509

DIE BERUFLICHE STRAHLENBELASTUNG. (The Occupational Radiation Burden). Hans Dresel. No. 11 of "Schriftenreihe des Bundesministers für Atomkernenergie und Wasserwirtschaft. Strahlenschutz." Brunswick, Gersbach and Sohn Verlag GmbH, 1959. DM 4.

The results obtained from the evaluation of 26,129 film badges sent out from Freiburg in 1957 to medical clinics, industries, and research institutions using radiation sources or radioisotopes are presented. The method of evaluation is described. The results are tabulated and arranged according to the size of the operation using radiation, position of person in the operation, age, sex, and family status of personnel, and total length of time in occupational exposure to radiation. (J.S.R.)

6734 A/CONF.15/P/1358

U-SCOPE, AN ELECTRONIC LOCATOR OF RADIOACTIVE SOURCES APPLYING THE PRINCIPLE OF RADAR. Kikuo Takahashi, Nobuo Katayama, and Moto-o Sato (Japan). 12p.

The U-Scope, a device for the rapid detection of radioactive sources in a field survey, is constructed of a rotating collimator or scanner and a radar tube on which complete information concerning the direction and occurrences of the radioactive sources is given. The collimator and the electronic system are discussed in detail. Typical images are given and analyzed. A field survey made in Okayama and Tottori Prefectures proved the value of the instruments. (J.S.R.)

6710 ✓ A/CONF.15/P/248

BASIC REQUIREMENTS FOR CONTINUOUS RADIOACTIVE CONTAMINATION MONITORS. A. Stebler and P. Schranz (Landis & Gyr S. A., Zug, Switzerland). 9p.

An atmosphere monitor is described and illustrated which issues a warning as soon as the product of time and radioactivity concentration reaches a pre-determined level. The instrument consists of a moving filter band with a system of detectors. (C.H.)

11265

ELECTRONICS IN PROTECTION AGAINST NUCLEAR RADIATIONS. Jacques Labeyrie (CEA). Ind. Atom. 2, No. 5-6, 79-88(1958). (In French)

Radiation hazards and electronic means of detecting and measuring them are discussed in two categories: radiations from accelerators, reactors, and research sources, and radiations from fission product contamination of persons, objects, or environs. Dose tolerances are tabulated and discussed, and instruments for detection and measurement of x and gamma radiation, neutron flux measurement, hand monitoring, atmosphere monitoring, and radon determination are described. (T.R.H.)

United Kingdom Atomic Energy Authority. Industrial Group H.Q., Risley, Lancs, England.

HEALTH PHYSICS MONITORING INSTRUMENTS AND METHODS. Information Bibliography. Sept. 1957. 20p. (IGRL-IB/R-26).

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This is a selection of 131 report, book, and journal references to publications issued up to December, 1956. Sources used were U. K., Canadian, and U. S. report abstracts, *Nuclear Science Abstracts, Geneva Conference* (1955) papers, *Engineering Index* (1950-1955), and *Industrial Arts Index* (1956).

5460
EQUIPMENT FOR PROSPECTION AND PROTECTION. J. Labeyrie (Centre d'Etudes Nucléaires, Saclay, France). p.121-36 of "Nuclear Electronics. II." (In French)
As the principles on which prospection and protection apparatus are based are essentially identical, the most recent developments of both are reviewed together. Typical apparatus are discussed. (J.S.R.)

2585
PERSONNEL RADIOACTIVITY MONITOR. Vladimiro Mandl (Centro Nazionale Richerche Nucleari, Ispra, 11-3-59pm Italy). Strumentazione e automazione No. 5, 225-7 (1959) May. (In Italian)
An apparatus is described which measures radioactive contamination on hands, shoes, and clothes. It consists of two photomultipliers with ZnS screens for alpha contamination of the hands, six Geiger counters to detect beta radiation from the shoes, and one probe for monitoring the clothes. The instrument is completely transistorized and automatic. Each measurement lasts 10 seconds and the results are indicated on two instruments. Dangerous contamination is signaled by acoustic and luminous alarms. (tr-auth)

1688
A METHOD OF MEASURING THE IONIZING ACTION OF RADIATION. Yu. M. Tolchenov, Yu. N. Sachkov, and V. G. Chaykovskii. U.S.S.R. Patent 118554. Byull. Izobret., 1959, No. 6.
To expand the measuring range of the Geiger counter, a sufficient voltage is applied to the electrodes of the counter to maintain a continuous corona discharge. The intensity of the radiation is determined by the amount of voltage drop on these electrodes. (TCO)

6475
RADIOACTIVE CONTAMINATION MONITOR FOR THE PERSONNEL OF THE METALLURGY PLANT OF THE CISE. G. Giannelli, A. Lucchini, A. Malvicini and M. Pernice. Energia nucleare (Milan) 4, 24-32(1957) Feb. (In Italian)

Whole-Body Counters -- A Literature Search, H.E. Voress, (USAEC-TISE) Jan 1960 (TID-3543).

MEASUREMENT AND CONTROL OF RADIOACTIVE PARTICULATE CONTAMINATION. Summary Report. Theodore F. Hatch. [nd]. Decl. with deletions Jan. 13, 1956. 22p. (AECD-4096)
The measurement and control of radioactive particulate matter by AEC installations are summarized. Accepted atmospheric tolerance levels are listed. The methods and requirements for sampling particulate contamination are surveyed. Devices such as the cascade impactor and the multi-stage impinger are described. Control requirements for particulate contamination are also listed.

13455 TID-3518
Technical Information Service, AEC.
RADIATION DETECTION. A Literature Search. J. A. McCormick, comp. Feb. 1959. 22p. $0.75(OTS)
This bibliography contains 335 selected references on detection and measurement of radiation from isotopes when used in physical and biological research. These references were selected from scientific journals published during 1948-1957. A list of journals from which the references were selected and an author index are included. (auth)

6674 A/CONF.15/P/60
SOME SPECIAL PROBLEMS IN HEALTH PHYSICS INSTRUMENTATION. Denis Taylor (Plessey Nucleonics Ltd., Northampton, Eng.). 7p.
The problems of measuring body radioactivity and the monitoring of the liquid and gaseous effluents from reactor plants are discussed. The measurement of body radioactivity can be important in the event of the accidental inhalation, ingestion, or absorption of alpha-active materials. In the case of Pu it is possible to take advantage of the 17-kev x-ray emissions, and the sort

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of sensitivity which may be achieved for the detection of Pu^{239} by this means and the possibility of producing a worth-while health physics instrument based on this technique are indicated. The measurement of the low activities (α,β,γ) in effluent streams is discussed with an indication of how some of the practical problems encountered in using these methods under factory conditions are solved. (auth)

21065 ✓ Y-A2-195
Union Carbide Nuclear Co. Y-12 Plant, Oak Ridge, Tenn.
A STUDY OF Y-12 AREA MONITORING FOR CRITICAL BURSTS. J. W. Wachter. Dec. 3, 1956. Decl. June 24, 1959. 24p. Contract W-7405-eng-26. $4.80(ph), $2.70(mf) OTS.

The problems of production area monitoring for nuclear accidents were studied. The characteristics of a criticality burst including estimates of the resulting neutron and gamma radiation are discussed. Recommendations as to the criteria which might be applied in the design of a suitable monitor are listed. It is concluded that ion chambers, possibly containing dose-integrating foils, are the most suitable of existing radiation detectors for area monitoring at Y-12. (auth)

6689 ✓ A/CONF.15/P/577
HEALTH PHYSICS WORK AND EXPERIENCE IN A SMALL ATOMIC ENERGY ESTABLISHMENT. Gudbrand Jenssen (Joint Establishment for Nuclear Energy Research, Kjeller, Norway). 7p.

The health physics organization, responsibility, and work at the Joint Establishment for Nuclear Energy Research is outlined. Around 200 persons are controlled in addition to monitoring around the reactor, in the laboratories, and surroundings. (auth)

7920 ✓ KAPL-1313
Knolls Atomic Power Lab., Schenectady, N. Y.
RADIOLOGICAL DEVELOPMENT ACTIVITIES IN THE HEALTH PHYSICS UNIT. Semiannual Progress Report [for] July–December 1954. Changed from OFFICIAL USE ONLY June 3, 1957. 26p. Contract W-31-109-Eng-52. $4.80(ph OTS); $2.70(mf OTS).

Data are presented from studies on the efficiency of air-cleaning filter materials and air-cleaning equipment. An illustrative schematic is presented of an extrapolation chamber and auxiliary components constructed for use in the determination of surface dose-rates from β sources. A radioactive gas counting system for the detection of A^{39} was calibrated. Resonance and threshold detector foils of In and S were tested for use in personnel neutron dosimetry under both normal and emergency conditions in reactor areas. The preparation of β sources is described. A method is outlined for the determination of Ra^{226} in urine. Liquid waste studies were confined to an analysis of P^{32} activity collected on suspended Mohawk River sediment. (C.H.)

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7633 ✓ AD-218530
Army Medical Research Unit No. 1, Landstuhl Army Medical Center, Germany.
INITIAL CALIBRATION OF LANDSTUHL HUMAN RADIOACTIVITY DETECTOR (BODY COUNTER). Progress Report. Charles O. Onstead, Frank V. Keary, Jack E. Redding, and John R. Appert. June 30, 1959. 10p.

Calibration of the Landstuhl human radioactivity detector is described. The method proved adequate for measuring the cesium-137 and potassium-40 present within the normal human. (C.H.)

8547 HW-61194
General Electric Co. Hanford Atomic Products Operation, Richland, Wash.
STACK EFFLUENT MONITOR OPERATION AND MAINTENANCE. R. A. Harvey and G. D. Crouch. July 21, 1959. 29p.

The operation, calibration, and maintenance procedures for an instrument which continuously measures and records several isotopes in the Redox facility stack effluent are presented. (C.J.G.)

12173 NP-7365(Vol. 1)(Paper 10)
Lockheed Nuclear Products, Marietta, Ga.
AREA MONITORING FOR RADIOACTIVITY. Roy Shipp. Paper 10 [of] THIRD SEMI-ANNUAL RADIATION EFFECTS SYMPOSIUM [HELD IN ATLANTA], OCTO-

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BER 28-30, 1958. VOLUME 1. GENERAL SESSION PAPERS. 8p.

To ensure the safety of people in the general vicinity of the Radiation Effects Reactor, monitor stations are situated around the exclusion fence to provide readings for use in controlling radiological hazards. Factors monitored include concentration of Ar^{41}, as well as fast neutrons and gamma intensities. Development of detectors and certain aspects of the Ar^{41} problem are covered. (W.D.M.)

12588 ✓ IGD-R-1

United Kingdom Atomic Energy Authority. Industrial Group. Dounreay Experimental Reactor Establishment, Caithness, Scotland.

COUNTING PRACTICE: A GUIDE TO BASIC TECHNIQUES. W. R. Diggle and A. E. Shaw. 1958. 48p. $0.84(BIS).

A concise account is given of the nature and sources of radioactivity and the theory of the interaction of radiation with matter. The various types of radiation detectors and the principles of their operation are described in some detail, together with a discussion of some more specialized techniques. A section on counting-errors and corrections is followed by a brief survey of commercial equipment available. (auth)

13338 ✓

CHEMICAL METHODS IN DOSIMETRY OF IONIZING RADIATION. A. M. Kabakchi and V. A. Gramolin. Uspekhi Khim. 27, 459-80(1958) Apr. (In Russian)

A review is given of methods for the determination of x ray, γ ray, and fast electron doses (produced by radioactive decay or generated in special apparatus) up to 10^5r. (R.V.J.)

37 IGRL-IB/R-26

United Kingdom Atomic Energy Authority. Industrial Group H. Q., Risley, Lancs, England.

HEALTH PHYSICS MONITORING INSTRUMENTS AND METHODS. Information Bibliography. Sept. 1957. 20p.

This is a selection of report, book, and journal references to publications issued up to December, 1956. Sources used were U.K., Canadian, and U.S. report abstracts, Nuclear Science Abstracts, Geneva Conference (1955) papers, Engineering Index (1950-1955), and Industrial Arts Index (1956). (auth)

2634

THE DECREASE OF THE PERSONAL DOSE BY AN INDIVIDUAL RADIATION-WARNING APPARATUS. Dietrich Frost (Städt, Rudolf-Virchow-Krankenhaus, Berlin and Entwicklungsabteilung der Dr. H. Stamm KG., Berlin). Atompraxis 5, 310-13(1959). (In German)

The possibilities of individual radiation warning are discussed. The best solution proved to be an alarm sound, the frequency of which increases in proportion to the dose. A battery-run pocket warning device and its use in clinical work are described. (auth)

6538 ✓ AERE-R-3112

United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England.

PROPOSALS FOR IMPROVING THE EFFICIENCY OF CERTAIN ROUTINE RADIOACTIVITY MONITORING OPERATIONS BY INTRODUCING A RAPID SORTING PROCESS. R. C. M. Barnes. Oct. 1959. 15p. BIS.

A two-stage counting procedure is recommended for some routine monitoring operations in which many weak radioactive samples are inspected although an accurate quantitative measurement is required on only the more active samples. In the proposed method all samples are first inspected by a rapid sorting test which rejects the weaker samples. The remainder, which may only be a small proportion, are then counted for a longer, fixed time to determine their activity accurately. Routine counting of α-active samples with the Sample Changer Type 1331 is taken as an example. At present all samples are counted for the same time, but it is shown that the introduction of a preliminary sorting operation would produce at least a six-fold increase in the sample-handling rate. The principles of the sequential test used for rapid sorting are summarized, and practical rules are suggested for selecting the operating parameters of the test. (auth)

5367 ✓

INSTRUMENT FOR RAPIDLY COUNTING EXTENDED RADIATION SOURCES. K. H. Lauterjung and W. Gruhle (Max-Planck-Institut für Kernphysik, Heidelberg, Ger.). Nuclear Instr. and Methods 5, 323-6(1959) Nov. (In German)

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There are two possibilities of recording the distribution of radiation intensity in an extended area. The first has a good resolution of space, but requires a recording time too long for rapid changes, while the second records with good resolution of time but with a restricted one of space. The new method has a good resolution both of time and of space. The main feature is the use of the propagation speed of GM-counter discharge. The area under inspection is covered by ten counters, each of which is sensitive for 1 msec. The primary pulse of radiation hitting the sensitive counter starts the recording device and the arrival of the discharge in a short probe counter triggers a CRO display which gives a mapping of the radiation. (auth)

6480 A/CONF.15/P/1956
LES MESURES DE LA RADIOACTIVITÉ ATMOSPHERIQUE PAR LES MÉTHODES CHIMIQUES ET RADIOMÉTRIQUES. (Identification of the Components of the Atmospheric Radioactivity through Chemical and Radiometric Methods.) L. Argiero, S. Manfredini, A. Olivi, and G. Palmas (C. A. M. E. N., Leghorn). 5p.
The methods used for the measurement of the radioactivity of rain and fall-out are described. An outline is given of the method used for chemical separation and radiometric determination of Sr^{90} in fall-out and rain. (J.S.R.)

AUTOMATION IN A GENERAL PURPOSE NUCLEAR COUNTING ROOM. D. G. Egan (Convair, Fort Worth, Tex.). p.29-37 in "Proceedings of the 1959 Biannual National Nuclear Instrumentation Symposium."
The Nuclear Aircraft Research Facility automatic counting room system provides computed dose measurements from irradiated samples with a practical minimum of manual handling. The major portion of the equipment used in former manual counting channels has been incorporated in the automatic channels. Raw data from the counting room proper is reduced by a digital computer using a program designed as a part of the over-all system. (auth)

CONTROL OF RADIOACTIVE CONTAMINATIONS. A. Malvicini and C. Polvani. Energia nucleare (Milan) 4, 363-74(1957) Oct. (In Italian)
The methods for control of radioactive contaminants (solid, liquid, and gaseous) are summarized. Among the instruments diagramed are devices for the measurement of the radon in air, for absorption of radon from air and measuring it with a Geiger counter, for the electrostatic precipitation of atmospheric dust and an ionization chamber for the measurement of atmospheric tritium. (M.H.R.)

8337 IDO-14378
Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho.
MONITORING THE LIQUID WASTES DISCHARGED FROM THE IDAHO CHEMICAL PROCESSING PLANT. William C. King. June 12, 1956. 29p. Contract AT(10-1)-205. $0.25(OTS).
A continuous liquid waste monitor which has been in operation for 24 months at the Idaho Chemical Processing Plant is described. By detecting the γ activity, the monitoring system provides a method of measuring the activity in large volumes of liquid wastes which are discharged from the ICPP. The monitoring system, as described, provides a permanent record of the flow-rate and instantaneous concentration of gamma activity in the discharged waste independent of background activity. It will integrate the product of the flow-rate and count-rate to give the total activity discharged over any given period of time. The monitor activates alarms if the concentration of activity in the discharge stream becomes too great. It also collects a continuous proportional sample of the discharged liquids which can be submitted for radiochemical analyses. (auth)

12651 KAPL-1831
Knolls Atomic Power Lab., Schenectady, N. Y.
HEALTH PHYSICS REPORT FOR JANUARY, FEBRUARY, MARCH 1957. 32p. Contract W-31-109-Eng-52. $0.25 (OTS).
Personnel, in-plant, and environmental radiation monitoring procedures engaged in during the period are summarized. (For preceding period see KAPL-1699.) (C.H.)

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Argonne National Lab., Lemont, Ill.
INTERPRETATION OF COUNTING DATA. Ellis P. Steinberg. Sept. 26, 1956. 66p. Contract W-31-109-eng-38. (ANL-5622).

This report is a convenient guide for interpretation of counting data. Some of the problems involved and techniques generally employed are reviewed. Over 150 references to pertinent report and published literature are included.

Monitoring of Material of Low U^{235} Assay through Gamma Radiation Energy Separation.

GAT - 254 (1958)

(Goodyear Atomic)

13455 TID-3518
Technical Information Service, AEC.
RADIATION DETECTION. A Literature Search. J. A. McCormick, comp. Feb. 1959. 22p. $0.75(OTS)

This bibliography contains 335 selected references on detection and measurement of radiation from isotopes when used in physical and biological research. These references were selected from scientific journals published during 1948-1957. A list of journals from which the references were selected and an author index are included. (auth)

7636 HASL-50
New York Operations Office. Health and Safety Lab., AEC.
RADIATION SURVEY, COLUMBIA UNIVERSITY VAN DE GRAAFF. Nov. 7, 1958. 16p. OTS.

A radiation survey was performed at the Van de Graaff electrostatic generator at Columbia University. Radiation levels are reported and recommendations regarding radiation safety are made. (auth)

6875 A/CONF.15/P/1467
BODY RADIOACTIVITY MEASUREMENT AS AN AID IN ASSESSING CONTAMINATION BY RADIO-NUCLIDES.
J. Rundo (Atomic Energy Research Establishment, Harwell, Berks, Eng.). 28p.

Methods which have been used to measure radioactive materials within the human body are briefly surveyed. Because of the high efficiency of sodium iodide as a detector of γ-rays, and its powers of energy resolution, an apparatus using crystals of this material was built at AERE, Harwell. The apparatus consists of a substantial lead shield, and the subject lies on a stretcher for the measurement. Four counters (NaI(Tl) crystals, 4-inches in diameter by 2-inches thick) are disposed about the body in such a way as to minimize the effects on sensitivity of different subject weights, and of distribution of the activity in the body. The energy spectrum of the amplified pulses from the counters is determined with a multichannel pulse amplitude analyzer. The natural γ-ray activity of the body limits the sensitivity of measurements of contaminants within the body. This activity is due to potassium-40 and the current contamination with the fission product cesium-137. The mean potassium content of sixteen adult males was 0.21% of body weight with a standard deviation of 0.023%. The mean cesium-137 content of these subjects, measured between June 1956 and July 1957, was 34.0 $\mu\mu c$ per g potassium, with a standard deviation of 7.6 $\mu\mu c$ per g potassium. For the assessment of internal contamination with a γ-ray emitter at about the same level as this natural activity, or with a pure β-particle emitter via its bremsstrahlung, the background activity must be known or be determinable. Measurements with a phantom have demonstrated the practicability of constructing the shape of the spectrum of the body radiation in particular at low energies. (auth)

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20078
HOW TO USE PYROPHORIC MATERIALS SAFELY.
L. H. Peer and J. T. Reichling (Knolls Atomic Power Lab., Schenectady, N. Y.). Mill & Factory 65, No. 2, 79-83(1959) Aug.

Pyrophoric materials include such things as finely divided zirconium, titanium, hafnium, uranium, and thorium. Safe handling, use, storage, disposal, and fire-fighting techniques for these pyrophoric materials are discussed. Safety hazards in the drilling, grinding, turning, milling, tapping, and shaping of uranium and thorium are presented. (C.J.G.)

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8609 AERE-C/R-2692
United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England.
THE REACTIONS OF ZIRCONIUM AND ZIRCONIUM BASED ALLOYS WITH NITRIC AND NITRIC-HYDROFLUORIC ACIDS. PART I. HAZARDOUS ASPECTS. PART II. DISSOLUTION RATES. F. S. Martin and B. O. Field. Dec. 1958. 16p.

Hazardous aspects of the dissolution of zirconium–uranium alloys in nitric acid were studied. It is concluded that when nitric acid constitutes the major part of the dissolving solution (i.e., if fluoride concentrations are low), the safe dissolving of such alloys cannot be guaranteed. The explosive reactions observed are not of the detonation type, but appear to involve a rapid oxidative reaction between adsorbed or precipitated nitrates and finely divided metal (or metal in a low oxidation state) on the alloy surfaces. Some dissolution rates are reported for 5% U–Zircaloy-2 and for Zircaloy-2 in nitric acid–fluoride mixtures, in sulfuric acid catalyzed by ferric ion, and in anhydrous dinitrogen tetroxide in tributyl phosphate. (auth)

3526 AECD-3851
Massachusetts Inst. of Tech., Cambridge.
URANIUM–ZIRCONIUM EXPLOSIONS IN NITRIC ACID. R. B. Russell. May 11, 1953. 5p. Decl. Dec. 5, 1955. Contract [W-7405-eng-175]. (MIT-RBR-4). $1.80(ph OTS); $1.80(mf OTS).

An investigation of explosions between a U–Zr alloy (80 wt. % U) and HNO_3 indicates that the explosion is a result of surface shock. The mechanism of the explosion is unknown. (C.W.H.)

2662 HW-62109
General Electric Co. Hanford Atomic Products Operation, Richland, Wash.
AN ESTIMATION OF THE EXPLOSION HAZARD DURING REPROCESSING OF METALLIC URANIUM FUEL ELEMENTS METALLURGICALLY BONDED TO ZIRCALOY CLADDING. J. L. Swanson. Sept. 30, 1959. 10p. Contract AT(45-1)-1350. OTS.

Experimental studies were performed to define the behavior in ammonium fluoride solutions of uranium-zirconium alloys and of explosive residues isolated from such alloys. The results indicate that once the diffusion layer existing between the uranium core and the Zircaloy cladding is exposed to such solutions, it will readily and completely dissolve, thus eliminating the possibility of this portion of the diffusion layer entering into an explosive reaction with nitric acid. Because of the probability that the Zircaloy cladding (and, therefore, the diffusion layer) will not be completely removed from the uranium prior to the nitric acid core dissolution step, consideration was also given to the magnitude of a possible explosive reaction resulting from the exposure of the diffusion layer to nitric acid. It is concluded that the probability of an explosive reaction of sufficient magnitude to pressurize a dissolver during normal plant operations is very remote. (auth)

15236 TID-7569(p.33-9)
General Electric Co. Hanford Atomic Products Operation, Richland, Wash.
SPONTANEOUS IGNITION. William R. DeHollander. p.33-9 [of] PROCEEDINGS OF THE 1958 ATOMIC ENERGY COMMISSION AND CONTRACTOR SAFETY AND FIRE PROTECTION CONFERENCE, HELD AT ATOMIC ENERGY COMMISSION HEADQUARTERS BUILDING, GERMANTOWN, MARYLAND, JUNE 24-25, 1958. May 15, 1959. 7p.

The mechanisms of spontaneous ignition are discussed. The oxidation of zirconium in air and oxygen is described. Derived expressions are given for ignition temperatures of oxidizing systems. (W.L.H.)

11596 AECU-4092
Stanford Research Inst., Menlo Park, Calif.
REACTIONS OF METALS WITH OXYGEN AND STEAM. Final Report [for] June 15, 1958 to February 15, 1959. Fred E. Littman and Frank M. Church. Feb. 15, 1959. 25p. [For Oak Ridge National Lab.]. Contract W-7405-eng-26. Subcontract 1088. SRI Project SD-2116. $4.80(ph), $2.70(mf) OTS.

Titanium, zirconium, and Zircaloy can spontaneously ignite under relatively mild conditions. The effect of temperature, oxygen concentration and pressure, and the nature of the diluent on the spontaneous ignition of titanium, zirconium, and Zircaloy were investigated.

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1101 CF-58-10-43
Oak Ridge National Lab., Tenn.
EXPLOSION OF EBWR ALLOY IN BOILING CONCENTRATED NITRIC ACID. F. G. Baird, T. A. Gens, and L. M. Ferris. Oct. 9, 1958. 3p. Contract [W-7405-eng-26]. $1.80(ph OTS); $1.80(mf OTS).

An explosion which occurred while dissolving EBWR core alloy (93.5% U–5.07% Zr–1.5% Nb) in boiling concentrated nitric acid is described. (auth)

15237 TID-7569(p.40-3)
Argonne National Lab., Lemont, Ill.
METAL FIRE AND EXPLOSION RESEARCH. J. Glenn Schnizlein. p.40-3 [of] PROCEEDINGS OF THE 1958 ATOMIC ENERGY COMMISSION AND CONTRACTOR SAFETY AND FIRE PROTECTION CONFERENCE, HELD AT ATOMIC ENERGY COMMISSION HEADQUARTERS BUILDING, GERMANTOWN, MARYLAND, JUNE 24-25, 1958. 4p.

A discussion is presented of a program directed toward determining the factors involved in the susceptibility of ignition of U, Zr, Th, and Pu. (W.L.H.)

16176 AECU-3825
Stanford Research Inst., Menlo Park, Calif.
REACTIONS OF TITANIUM WITH WATER AND AQUEOUS SOLUTIONS. Final Report [for] March 15, 1957 to June 15, 1958. Fred E. Littman and Frank M. Church. June 15, 1958. 42p. SRI Project No. SD-2116. For Oak Ridge National Lab. Contract W-7405-eng-26, Subcontract No. 1088.

The work described delineates the engineering conditions under which it is safe to use titanium as a material of construction in the presence of oxygen. These conditions apply not only to the atomic energy industry but to chemical processing as well. The results indicate that there may be several separate conditions which must be met before a self-sustaining reaction can occur. Obviously, a favorable heat balance must exist—that is, the rate of heat produced by the reaction must exceed the rate of heat dissipation by radiation, conduction, and convection. For the reaction to remain self-sustaining, another condition has to be met: an unprotected surface must be continuously exposed. It is postulated that this happens when the surface temperature reaches the melting point of the metal, the metal oxide, or a eutectic between the two and also when the metal and its oxide are mutually soluble. These conditions probably restrict the occurrence of autoignition of massive shapes of metals to a relatively small number of metals. Although zirconium appears to burn with more intense heat than titanium, it is much more resistant to spontaneous ignition. This may be due to its higher heat conductivity (0.04 vs. 0.014 cal/cm^2/cm/°C/sec) compared with titanium, which would allow it to dissipate the heat of the initial reaction more readily. The exact range of conditions leading to the autoignition of zirconium and possibly other metals will be the subject of another study. (auth)

8434 AECU-3682
Bureau of Mines. Div. of Explosives Technology, Pittsburgh.
ZIRCONIUM HAZARDS RESEARCH. Progress Report No 2 [for] September 1, 1957 to February 28, 1958. J. A. Herickes, P. A. Richardson, M. Weiss, and G. Gelernter. Feb. 28, 1958. 31p. Contract AT(11-1)-473. $4.80(ph OTS); $2.70(mf OTS).

The study of the sensitivity characteristics of Zr samples such as sponge, scrap, foil, and powder was continued. Of particular interest was the determination of the relative sensitivity of these materials to such stimuli as electrostatic discharge and an induced shock wave. The investigation of the zirconium–water reaction and zirconium–gas reactions at relatively low temperatures was continued. (For preceding period see AECU-3554.) (W.L.H.)

5330 AGC-AE-35
Aerojet General Corp., Azusa, Calif.
THE REACTION OF MOLTEN METAL WITH WATER. Monthly Progress Report [for] February 1 through February 28, 1957. Mar. 29, 1957. 6p. Contract AT(04-3)-44. (AGC-L2914-24). $1.80(ph OTS); $1.80(mf OTS).

Six explosion dynamometer tests were performed on molten Zr using 10 and 20g samples. The study of burning rates of Mg ribbon under 1 cm/sec O_2 flow at one atmosphere pressure continued. (For preceding period see AGC-AE-34). (W.L.H.)

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2934
PYROPHORICITY—A TECHNICAL MYSTERY UNDER VIGOROUS ATTACK. Richard B. Smith (Safety and Fire Protection Branch, AEC, Washington, D. C.). Nucleonics 14, No. 12, 28-33(1956) Dec.

The pyrophoricity of Pu, U, Th, Zr, and Hf are discussed. Some of the phenomena observed and some possible mechanisms of the various fires and explosions resulting from storage and handling of the above metals are presented. (W.L.H.)

10886 AGC-AE-28
Aerojet General Corp., Azusa, Calif.
THE REACTION OF MOLTEN METAL WITH WATER. Monthly Progress Report [for] October 1 through October 31, 1956. Nov. 23, 1956. Decl. Jan. 15, 1957. 12p. Contract AT(04-3)-44. $3.30(ph OTS); $2.40(mf OTS).

Tests have been performed to determine the reactivity of molten Al spray with degassed, deionized water at 725 to 2260°C. High-pressure corrosion-rate tests have been initiated on Zircaloy-2. The rate of propagation of burning of Mg in dry O_2 as a function of O_2 concentration has been determined. (For preceding period see AGC-AE-26.) (W.L.H.)

10885 AGC-AE-26
Aerojet General Corp., Azusa, Calif.
THE REACTION OF MOLTEN METAL WITH WATER. Progress Report [for] August 1 through September 30, 1956. Oct. 26, 1956. Decl. Jan. 15, 1957. 10p. Contract AT(04-3)-44. $1.80(ph OTS); $1.80(mf OTS).

A study was made of the effects of the sudden mixing of molten metals, used in reactor fuel elements, with H_2O. Some data from explosion dynamometer tests are included. (B.J.H.)

10884 AGC-AE-22
Aerojet General Corp., Azusa, Calif.
THE REACTION OF MOLTEN METAL WITH WATER. Monthly Progress Report [for] July 1 through July 31, 1956. Sept. 14, 1956. Decl. Jan. 15, 1957. 9p. Contract AT(04-3)-44. $1.80(ph OTS); $1.80(mf OTS).

A discussion of previous and future work on molten metal drop tests, molten spray tests, high-pressure corrosion-rate tests, burning rates of metals in various atmospheres and transition-state theory of linear oxidation rates is presented. (W.L.H.)

272 HW-44837
[Hanford Atomic Products Operation, Richland, Wash.].
SAFE CONDITIONS FOR APPLYING TITANIUM IN H.A.P.O. PROCESS EQUIPMENT. R. E. Smith. Aug. 6, 1956. 7p. Contract [W-31-109-Eng-52]. $1.80(ph OTS); $1.80(mf OTS).

Laboratory investigations and industrial experience indicate HNO_3–Ti systems are not explosive if the HNO_3 contains more than 2% H_2O. (D.E.B.)

13574 AGC-AE-19(Pt. I)
Aerojet General Corp., Azusa, Calif.
THE REACTION OF MOLTEN METAL WITH WATER. Progress Report [for] May 1 through June 30, 1956. July 23, 1956. Decl. Jan. 15, 1957. 13p. Contract AT(04-3)-44. (AGC-L2914-17(Pt.I)). $3.30(ph OTS); $2.40(mf OTS).

Experiments were initiated to determine the effect of sudden mixing of molten metal with water. Molten-metal drop tests and corrosion tests were carried out on Zr, Zircaloy-2, and Zircaloy-B with 0.9% Be added. Oxide film thicknesses were determined and photomicrographs were made. Results are presented of molten-metal spray tests which were carried out on Al and Zr. (W.L.H.)

8916 AGC-AE-18
Aerojet General Corp., Azusa, Calif.
THE REACTION OF MOLTEN METAL WITH WATER. Progress Report [for] March 1 through April 30, 1956. June 6, 1956. Decl. Jan. 15, 1957. 6p. Contract AT(04-3)-44. (AGC-L2914-16). $1.80(ph OTS); $1.80(mf OTS).

Experiments were performed to determine the reactivity of molten pure Al and Zircaloy-B with water. Oxidation tests were also performed on molten droplets of Zr, Zircaloy-2 and Zircaloy-B. Photographs of the representative droplets are included. (W.L.H.)

HANDLING ALPHA-ACTIVE, PYROPHORIC MATERIALS. PART 1. WHAT IS THE BEST APPROACH? Nucleonics 14, No. 3, 61-5(1956) Mar. PART 2. GLOVEBOX DESIGN AND CONSTRUCTION. Nucleonics 14, No. 4, 65-71(1956) Apr. PART 3. GLOVEBOX-ATMOSPHERE CONTROL. Nucleonics 14, No. 5, 77-82(1956) May. L. R. Kelman, W. D. Wilkinson, A. B. Shuck, and R. C. Goertz (Argonne National Lab., Lemont, Ill.).

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A comprehensive discussion is given of the handling of α-active, pyrophoric materials. Part 1 includes discussions on the philosophy and rules of handling α emitters and descriptions of fuel element handling facilities. Part 2 surveys the design and construction of gloveboxes. The survey includes such topics as materials used, tightness, visibility, glove problems, and working with gloves. Part 3 discusses the atmospheric control in glove boxes. Included are topics such as the selection of an inert atmosphere, auxiliary equipment, and emergency ventilation. (B.J.H.)

7684 NMI-1145
Nuclear Metals, Inc., Cambridge, Mass.
THE URANIUM–SILICON EPSILON PHASE. S. Isserow. Apr. 20, 1956. Decl. Feb. 27, 1957. 65p. Contract AT(30-1)-1565. $0.50(OTS).

The U–Si epsilon phase was investigated for fuel element application in a water environment. The corrosion behavior was emphasized. Bare samples were tested in 500 and 650°F water and in 750°F steam. Evidence is presented that the corrosion resistance depends on the absence of phases other than epsilon and that the desired epsilon phase has a Si content in the range of 3.9 to 4.0 wt. %, rather than the 3.78 wt. % of stoichiometric U_3Si. It was necessary to develop an analytical method to overcome the apparently low Si content found in this system under certain conditions. The epsilon alloy was clad by coextrusion with Zircaloy-2. At 1560°F, reductions of 40X were readily achieved. Samples from such coextrusions, notably simulated fuel

4575 TID-8011
Technical Information Service, AEC.
THE FIRE PROPERTIES OF METALLIC URANIUM. R. B. Smith, Safety and Fire Protection Branch, Div. of Organization and Personnel, AEC. Apr. 12, 1956. 12p. $0.20 (OTS).

One of Its Monograph Series "The Industrial Atom."

Under suitable conditions, uranium is capable of self-sustaining combustion in air, N_2, O_2, and CO_2; the reaction is accompanied by emission of very intense but localized heat and light. Factors contributing to uranium pyrophoricity are discussed and a reaction mechanism involving surface hydride formation is outlined. Uranium–water reactions were also investigated. (auth)

17440 TID-2508(Del.)(p.513-15)
Argonne National Lab., [Lemont, Ill.]
SPONTANEOUS IGNITION OF HIGHLY IRRADIATED FUEL. J. H. Kittel. p.513-15 [of] NUCLEAR SCIENCE AND TECHNOLOGY. VOL. 1A, ISSUE 3, DECEMBER 1955. 3p.

Several instances of highly irradiated fuel specimens igniting spontaneously and burning to oxide are described. All of the 5 specimens which ignited had had their surface to mass ratios greatly increased by extensive roughening. There appears to be a critical time after exposure to air when a specimen is most apt to ignite. If the specimen survives this period, it will then slowly oxidize in the same manner as unirradiated fuel. (W.L.H.)

59 CCC-1024-TR-141
West Virginia. Univ., Morgantown.
THE EXPLOSIVE REACTION OF DIBORANE IN DRY AND WATER-SATURATED AIR. H. P. Simons and E. L. Poling. Oct. 10, 1955. 128p.

The explosive oxidation of diborane in air was studied by measuring the rate of flame propagation in a tube, the pressure-time characteristics of the reaction in a closed vessel, and the effect of water vapor in the air on each of these characteristics. Product gases from the closed vessel reaction were analyzed and the results correlated with possible paths. (auth)

4465 TML-63
Battelle Memorial Inst. Titanium Metallurgical Lab., Columbus, Ohio.
HAZARDS AND SAFETY PRECAUTIONS IN THE FABRICATION AND USE OF TITANIUM. F. D. Peterseim. Jan. 25, 1957. 22p. Contract AF18(600)-1375.

Pertinent information of the health and safety hazards encountered in production, fabrication, and use of Ti has been reported. The survey indicated that under certain conditions Ti is combustible and explosive; thin chips and fires can ignite and burn with intense combustion and even

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explode when dispersed in the air. Under some conditions Ti sponge would ignite too, however massive ingots or sheets do not ignite easily. Explosive reactions were observed during stress-corrosion studies of Ti in red fuming nitric acid. Though Ti itself has not been found to be toxic, some Ti compounds, alloying ingredients, and chemicals used in Ti processing are. To date no effective means for extinguishing Ti fires have been found, however, the experience showed that Ti fires can be controlled by the use of conventional powders. (R.V.J.)

Picatinny Arsenal. Samuel Feltman Ammunition Labs., Dover, N. J.
A SURVEY OF AVAILABLE LITERATURE ON THE RAPID COMBUSTION OF METALS IN AIR. Saul Haffner. Sept. 1954. 20p. (AD-44543).

A literature search of available information covering experimental techniques, theories, and information concerning the rapid combustion of metals in air. It is summarized and documented by 25 references to published literature.

HEAT TRANSFER AND FLUID FLOW

12443 CU-11-53-At-dP-Ch.E.(Rev.)
Columbia Univ., New York.
REVIEW OF UNDERWATER BURNOUTS OF 2S ALUMINUM ELECTRICALLY OVERHEATED. A. J. Bendler. May 15, 1953. Decl. Mar. 18, 1957. 14p. [For] Du Pont [De Nemours (E. I.) & Co., Savannah River Lab.]. Contract AT(07-2)-1, Subcontract AX-294. $0.30(OTS).

Underwater arcing and melting failures of electrically overheated 2S aluminum, which have occurred during tests at Columbia University, are discussed with reference to phenomena accompanying the failures, in search of evidence indicating the chemical reactivity between high temperature aluminum and water. Discussion of the evidence, which includes macro- and micro-graphs, leads to the conclusion that even at temperatures as high as the melting and arcing points and in the presence of liquid water or steam, aluminum does not react readily with water. (auth)

1766 MIT-1105
Massachusetts Inst. of Tech., Cambridge. Metallurgical Project.
EXPLOSIONS OCCURRING DURING CHEMICAL ETCHING OR PICKLING OF URANIUM–ZIRCONIUM ALLOYS. H. P. Roth. Dec. 19, 1952. Decl. Oct. 7, 1955. 16p. Contract AT(30-1)-981.

Descriptions of five explosions involving the chemical etching of cast and extruded U–Zr alloys of high U content in HNO_3 baths are presented. It is recommended that all U–Zr alloys containing >75 wt.% U be kept out of HNO_3. (C.W.H.)

2511 NAA-SR-Memo-75
North American Aviation, Inc., [Downey, Calif.].
METAL–WATER EXPLOSIONS. W. C. Ruebsamen and J. B. Chrisney. July 10, 1951. Changed from OFFICIAL USE ONLY June 22, 1956. 8p. $1.80(ph OTS); $1.80(mf OTS).

The following were tested for explosive reactions with water: Al; Al–U alloys; Cu; Ni; U; U–Zr alloys; and Zr. Procedures followed included: furnace and induction heating of samples with water in sealed pyrex tubes; electrical (variable voltage a-c) heating of wires and foils under water; and condenser discharges through wires and foils. (T.W.S.)

9753 ANL-5040
Argonne National Lab., Lemont, Ill.
REACTIONS PRODUCED BY THE ELECTRICAL EXPLOSION OF A METAL IMMERSED IN A FLUID. Robert F. Plott. Dec. 8, 1950. Decl. Feb. 12, 1957. 35p. Contract W-31-109-eng-38. $0.30(OTS).

Calorimetric data are presented from an exploratory experimental study of electrically exploded metal ribbons in water, air, He, and O_2 at several pressures. The metal ribbons so exploded were Al, Au, and U. Electrically controlled exploding equipment made it possible to completely vaporize 20 to 30 mg of Al in air in a blue-white explosion. A two-valve Parr Pressure Bomb and associated calorimeter were used as a means of confining the explosions and measuring the energy exchange. A schematic sketch illustrates the calorimetry of electrically exploded materials. No direct evidence was found of a chemical chain reaction between Al and water during the electrical explosions. (C.H.)

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20911✓ NP-tr-278
ON THE SURFACE ACTIVITY OF CHARCOAL. B. G. Šimek and R. Kassler. Translated by J. B. Sykes (U.K.A.E.A. Atomic Energy Research Establishment from Mitt. Kohlenforsch. Insts. Prag 2, 142-9(1935). 10p. $1.80(ph), $1.80(mf) JCL.

The properties of charcoal which might cause or affect spontaneous ignition were investigated. The test samples did not change appreciably during 2 to 7 days in air, and moist adsorbed gases did not greatly affect their spontaneous inflammability. The heat of adsorption liberated in adsorption of air moisture is insufficient to raise cold charcoal to the ignition point. Data on the heat of wetting and surface activity are included. (J.R.D.)

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See also, under PROCESS CHEMISTRY AND ENGINEERING, RADIATION EFFECTS--Surveys and Theory (6.15.11).

FUEL ELEMENTS 4.02.01.01

11725 KAPL-M-BBB-2
Knolls Atomic Power Lab., Schenectady, N. Y.
DESIGN CRITERIA FOR THE TYPE M-130 STANDARDIZED SHIELDED SHIPPING CONTAINER. B. B. Biggs. Jan. 17, 1958. 10p. Contract W-31-109-Eng-52. $3.30(ph), $2.40(mf) OTS.

The design objectives and criteria for the Type M-130 shielded shipping container are presented. The information is presented to ensure compatibility with spent fuel modules. (auth)

6334 ✓ TID-7583(p.174-86)
Du Pont de Nemours (E. I.) & Co., Wilmington, Del.
MECHANICAL HANDLING OF CHALK RIVER AND PRDC FUEL. J. W. Langhaar. 13p.

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FUEL ELEMENTS 4.02.01.01

NRU and NRX fuel from the reactors at Chalk River, Ontario, is shipped to the Savannah River Plant in a finned, externally air-cooled cask provided for this purpose. The cask has an internal length of 11 feet to accommodate full-length elements. At SRP the elements are placed in a dissolvable frame or "bundle," about 25 per bundle, for storage and subsequent handling. Two bundles at a time are shipped from storage to the separations plant in an available 70-ton cask which has been equipped with a suitable internal rack. It is planned to ship at least the first two charges of PRDC fuel to the Savannah River Plant. The blanket element end sections of the fuel assembly will have been removed at the reactor site. Criticality hazards will probably limit handling operations to four fuel assemblies in any basket or bundle. The shipping cask design has not yet been specified. The possible need for removing the stainless steel housing tube before processing is to be determined by studies of dissolver operation. (auth)

21822
SHIPPING CASE FOR IRRADIATED FUEL ELEMENTS. A. Alonso Santos and A. Sevilla Benito. Energia nuclear (Madrid) 3, No. 10, 73-80(1959) Apr.-June. (In Spanish)

In the shipping of irradiated fuel elements special attention must be given to protection against radiation and to the elimination of the heat produced. The shipping case designed for the Junta de Energía Nuclear is described. It consists of an inner aluminum container in which are placed the fuel elements. The outer case is made of two steel cylinders with a lead shield between them. The tank has water pipes through it to remove the heat produced. The calculations to determine the thickness of the lead shield are given. (J.S.R.)

CARRIER FOR NUCLEAR FUEL ELEMENTS. (to Babcock and Wilcox, Ltd.). German Patent DAS 1 036 409. Aug. 14, 1958. Atompraxis 5, 247(1959) June. (In German)

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A carrier for fuel elements removed from a reactor is described. The principal part of the carrier consists of a chute for the transportation of the fuel element from a higher to a lower level by the use of gravity. This chute is so arranged that a slowing down of the fuel element can be controlled at the discharge end of the chute.

6320 HW-61076
General Electric Co. Hanford Atomic Products Operation, Richland, Wash.
PROJECT CGC-830, PLANT MODIFICATIONS FOR REPROCESSING NON-PRODUCTION REACTOR FUELS. DESIGN CRITERIA FOR BUILDING 213-U CASK TRANSFER FACILITY. M. E. Yates. July 15, 1959. 9p. OTS.
A cask transfer facility for receiving common-carrier rail cars containing casks loaded with spent fuel elements and transferring these casks to captive cars for unloading is described. After unloading by remote control, the casks are decontaminated and returned to the common carrier. The facility design includes an area for final decontamination, and a storage area for casks and special tools. (J.R.D.)

7730 IDO-16441
Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho.
GAMMA DAMAGE TO ETHYLENE GLYCOL IN MTR 90-DAY COOLED FUEL ELEMENT SHIPMENT. F. R. Keller. Feb. 20, 1958. 3p. Contract AT(10-1)-205. $0.50(OTS).
A shipment of 90-day old spent MTR fuel elements was made in late November 1957 using ethylene glycol as an anti-freeze agent in the water surrounding the four elements within the shipping cask. Radiation damage to the ethylene glycol was apparent after five days in the cask. An oil phase and an aqueous phase were present in the liquid drained from the cask, and some gelatinous material was observed on the fuel elements and the cask walls. As a consequence of this experience, the use of ethylene glycol as an anti-freeze has been discontinued in shipments of MTR fuel elements. (auth)

METHOD AND APPARATUS FOR HANDLING RADIOACTIVE PRODUCTS. D. Nicoll (to U. S. Atomic Energy Commission). U. S. Patent 2,875,345. Feb. 24, 1959.
A device is described for handling fuel elements being discharged from a nuclear reactor. The device is adapted to be disposed beneath a reactor within the storage canal for spent fuel elements. The device is comprised essentially of a cylinder pivotally mounted to a base for rotational motion between a vertical position, where the mouth of the cylinder is in the top portion of the container for receiving a fuel element discharged from a reactor into the cylinder, and a horizontal position where the mouth of the cylinder is remote from the top portion of the container and the fuel element is discharged from the cylinder into the storage canal. The device is operated by hydraulic pressure means and is provided with a means to prevent contaminated primary liquid coolant in the reactor system from entering the storage canal with the spent fuel element.

GENERAL 4.02.01.02

20066
HYGIENIC PROBLEMS IN TRANSPORTATION OF RADIOACTIVE ISOTOPES. R. S. Kalinova. Gigiena i Sanit. 23, No. 10, 41-5(1958) Oct. (In Russian)
The results of investigations of various types of transport containers with respect to the sanitary-hygienic requirements and the data of individual dosimetric examinations of a group of workmen employed in the transportation of radioactive isotopes are reported. Various defects were noted in some types of containers used at present. The data obtained show that it is necessary to improve the system of transportation of radioactive isotopes and to construct containers in accordance with the sanitary-hygienic requirements. (auth)

273 SCTM-9-55(12)
Sandia Corp., Albuquerque, N. Mex.
CONTROLLED VENTING OF STORAGE AND SHIPPING CONTAINERS. G. V. Lemmon. Jan. 31, 1955. Changed from OFFICIAL USE ONLY Oct. 21, 1959. 14p. OTS.

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A recommendation is made that future containers designed by Sandia Corporation for the protection of large ordnance items be provided with open vents for controlling the moist air "breathed," to an amount which can be economically controlled by the inclusion of a desiccating agent. A group of six tests are cited, with their results, as evidence upon which this recommendation is made. A formula is presented for calculating the amount of desiccant necessary to maintain the relative humidity below 30% (considered to be a safe value from the standpoint of corrosion) for one and one-half years' storage under severe storage conditions. (auth)

DP-357
Du Pont de Nemours (E. I.) & Co. Engineering Dept., Wilmington, Del. and Du Pont de Nemours (E. I.) & Co. Atomic Energy Div., Wilmington, Del.
70-TON SHIPPING CASK FOR THE SAVANNAH RIVER PLANT—DESIGN AND FABRICATION. William H. Piper and John W. Langhaar. Jan. 1959. 71p. Contract AT(07-2)-1. $2.00(OTS).

Several casks externally finned for heat dissipation, with an internal length of 15 feet and weighing about 70 tons, were constructed for off-plant shipment of radioactive material. Basic safety considerations leading to the selection of this type of cask are discussed. Unusual design and fabrication problems, and operating experience with the casks, are described. The principal fabrication difficulties were maintaining the required dimensional tolerances in view of the large amount of welding and producing the desired degree of metallurgi-

494
SEMI-TRACTOR FOR TRANSPORTING IRRADIATED U. R. Haguet (Etudes Générales aux Services Nucléaires, St. Gobain, France). Inds. atomiques 3, No. 7-8, 95-6 (1959). (In French)

A semi-tractor arrangement for hauling irradiated U to the processing plant at Marcoule is described. Load positioning, shielding, and other safety factors are discussed. (T.R.H.)

THE MEASUREMENT OF RADIATION SAFE ISOTOPE CONTAINERS. Rolf Plesch (Siemens and Halske AG, Karlsruhe, Ger.). Atompraxis 5, 49-53(1959) Feb. (In German)

A previously described method of calculating radiation shield thicknesses in an extended gamma-radiation field (Atompraxis 4, 402(1958)) is modified in this study so that it can also be used for calculating the wall thicknesses of isotopc containers. For this purpose a container number K_b is defined, with which the calculation is possible by means of generally valid diagrams. By taking into consideration the predetermined distance of the source from the inner side of the wall, it is possible, in cases where this distance is important, to reduce the thickness of the shield. The necessary correction factors are given in diagrams. In conclusion, the case of complex gamma-emitters is discussed. (auth)

15126
METHOD OF TESTING HERMETIC CONTAINERS. L. B. Borst (to U. S. Atomic Energy Commission). U. S. Patent 2,873,603. Feb. 17, 1959.

A method is presented for testing hermetic containers enclosing a material capable of chemically combining with a fluid at elevated temperatures. In accordance with the invention, the container to be tested is weighed together with the material therein. The container and its contents are then immersed in the fluid and heated to a temperature sufficiently high to cause a reaction to take place between the contents and the fluid and maintained under such conditions for a definite period of time. The container and its contents are then cooled and re-weighed. The rate of change in weight is determined and utilized as an index to determine the possibility of container failure.

8097
LOW WEIGHT CONTAINER FOR RADIOACTIVE MATERIALS. H. J. Browne and N. B. Garden (to U. S. Atomic Energy Commission). U. S. Patent No. 2,743,372, Apr. 24, 1956.

A light-weight portable container for radioactive materials of minimum weight and dimensions having a relatively constant and safe level of radiation on all surfaces is described. This container made of U or W consists of a rela-

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tively thick inner container, supported centrally by webs and fittings, shaped so that its thickness is inversely proportional as the radius from the center to the cubical surface of the outer container. For example, since one corner of the outer cubical container is farther from the radiation source the thickness of the inner container at the corresponding point would be less in order to achieve a constant radiation level on the outer surface. The container by reason of this design may safely carry radioactive materials under such limitations as would be imposed by the use of air freight. (auth)

8231 ✓ APAE-Memo-98
Alco Products, Inc., Schenectady, N. Y.
SHIELDING CALCULATIONS FOR APPR-1 DEMINERALIZER SHIPPING CONTAINERS. R. C. DeYoung. Apr. 26, 1957. 7p. Contract [AT(11-1)-318]. $1.80(ph OTS); $1.80(mf OTS).

Calculations were performed which indicate the required lead thickness to adequately shield an APPR-1 demineralizer during transfer in 3.5 inches. (D.E.B.)

4375 ✓ TID-7581(p.215-23)
Westinghouse Electric Corp. Bettis Atomic Power Div., Pittsburgh.
METAL SPACE FRAME SHIPPING CONTAINERS. C. W. Hughes. 9p.

The development of inside and outside shipping containers are reported. One container was built out of welded steel angle. The cost and length of time for construction of this container showed that another method was needed. A container built of pre-slotted steel angle proved to be inexpensive, quickly assembled, and light in weight. A series of drop and vibration tests was performed on the pre-slotted steel angle containers. They were found to perform satisfactorily. Three different types of inner containers are discussed. (W.L.H.)

SOURCES 4.02.01.03

6541 ✓ CWLSP-3-8
Chemical Warfare Labs., Army Chemical Center, Md.
A PORTABLE REMOTELY OPERATED DEVICE FOR PRODUCING A GAMMA RADIATION FIELD. Ralph E. Rexroad and Murray A. Schmoke. Dec. 1958. 21p.

A portable field device is described for use in lifting a high-intensity gamma radiation source from its shield without exposing the personnel. The device is remotely operated. (C.H.)

10951 ✓ CF-56-11-58
Oak Ridge National Lab., Tenn.
HRT SOURCE HANDLING FACILITIES. C. A. Burchsted and C. L. Segaser. Nov. 15, 1956. 5p. Contract [W-7405-Eng-26]. $1.80(ph OTS); $1.80(mf OTS).

A portable shield is described which may be used to transport the HRT antimony-beryllium source from the LITR to the HRT reactor site, and to store the source during critical experiments preliminary to bringing the reactor to power. The shield consists of a 16-in. diam. lead pig (the existing HRT fluid sample carrier) centered in a 50-in. diam. × 42-in. deep steel tank filled with borated water. (auth)

7396 ✓
PORTABLE SHIELDED CONTAINER FOR A RADIOACTIVE SOURCE OF RADIATION. S. Untermeyer (U.S.A.). British Patent 766,856. Nuclear Eng. 2, 224 (1957) May.

A radioactive capsule is arranged in a crooked or curved passage (stainless steel) in a shielding container (lead) and can be moved by a wire rod from an inactive position deep within the container to an operative position near the front of it. The capsule consists of an active core and a casing formed of a cup and a plug (both of aluminum). (auth)

12042 ✓
CONTAINERS FOR Co^{60}. Z. Frynta and J. Langmajer (Inst. of Materials and Tech., Prague). Jaderna Energie 4, 98-102(1958) Apr. (In Czech)

Data are given for the determination of the wall thickness in the design of lead containers encased in thick iron encasements. The performance and practical factors of such lead-iron containers for high activity Co^{60} are discussed. (tr-auth)

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13022

MODERN TECHNIQUES USED IN THE PREPARATION AND SHIPMENT OF RADIOACTIVE Co-60 SOURCES. A. B. Lilli. pp. 563-78 in "Dozimetriya ioniziruyshchikh izlucheniy." Moscow, Gostekhteoretizdat, 1956. (Translated from Referat. Zhur. Khim. No. 1, 1957, Abstract No. 1322).

A detailed discussion is given of the design of capsules (C) for the irradiation of Co in the reactor, containers for the therapeutic sources (CT), and a hot cell (HC) rated at several thousand curies, for the preparation of the sources. A description is given of a container used in a shipment of the sources and of a device for the removal of C from the reactor. A C of length 4.5 cm and diameter 1.9 cm is prepared from high-purity Al. A reduction in the screening of the Co tablets from the neutron flux is achieved by the formation of an Al jacket inside the C. The CT consists of a thin (0.5 mm) stainless steel cup encased in a tungsten alloy block. Lead packings are inserted between the cup and

7491

NEW CONTAINER FOR HIGHLY RADIOACTIVE MATERIALS. V. Sinitsyn, N. Leshchinskiĭ, and A. Gusev. Atomnaya Energ. 7, 399-400(1959) Oct. (In Russian)

Descriptions are given of a new container designed for transporting and handling highly radioactive sources. The container holds up to four standard cobalt sources of 700 g eqv. Ra, which can be transferred directly from the container into the loading channels of an installation. The radioactivity from the container at 0.5 m does not exceed 2.5 μr/sec. The weight of the container is 1 ton. (R.V.J.)

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13043 BNL-211(Del.)

Brookhaven National Lab., Upton, N. Y.

PROGRESS REPORT ON FISSION PRODUCTS UTILIZATION. IV. PROPOSALS FOR CONCENTRATING HIGH-LEVEL WASTES. PART 2. F. V. Caccavo, R. J. Isler, and B. Manowitz. Apr. 1, 1953. Decl. with deletions March 6. 1957. 16p. $3.30(ph OTS); $2.40(mf OTS).

Concepts for design of containers for concentrated Savannah River reactor fission-product wastes are presented. The capacities of containers of various designs, calculations of the specific heat generation of dried fission-product solids in these containers, and radiation distribution in the various containers are discussed. Preliminary results are presented from laboratory studies of the physical constants of waste solids and the viscosity of waste slurries. (C.H.)

COSTS 4.02.02

See also, under SURVEYS (GENERAL), COSTS (7.02).

ECONOMICS OF SHIPPING SPENT NUCLEAR FUEL ELEMENTS. Charles E. Dryden (General Electric Co., Schenectady, N. Y.). Nucleonics 14, No. 7, 77-80(1956) July.

Regulations for shipping, shipping cost estimates, design of shipping containers, shielding requirements and transportation for the shipping of spent nuclear fuel elements are discussed. (W.L.H.)

2289 CF-57-5-24

Oak Ridge National Lab., Tenn.

COMMENTS ON THE TRANSPORTATION OF IRRADIATED FUEL AND RADIOACTIVE WASTES FOR M. LOUIS ARMAND, EURATOM GROUP. F. L. Culler. May 6, 1957. 32p. Contract [W-7405-eng-26]. $6.30(ph OTS); $3.00(mf OTS).

General considerations involving the transportation of irradiated fuel and radioactive wastes are reviewed. It is assumed that many reactors will supply feed to a few large multipurpose chemical plants which ultimately send radioactive waste to a few disposal sites. General economic considerations of irradiated fuel reprocessing, economic aspects of the nuclear economy complex, growth predictions of the nuclear power economy in the U.S., general requirements for the shipment of fuel and waste, regulations applicable to fuel shipments, and permissible radiation levels are discussed. (C.H.)

8362 IGE-R-13

United Kingdom Atomic Energy Authority. Industrial Group H. Q., Risley, Lancs, England.

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PRELIMINARY REPORT ON SHIELDING ECONOMICS. E. W. Sidebotham and T. Standen. Feb. 24, 1956. 23p. (IGC-EMC/P-52; IGC-SWP/P-29)

Some of the more recent works on shielding economics are reviewed. Prices of materials which may be of use in shielding are quoted, and a collection of published shielding data is presented. The relative merits of different materials as shields are investigated, and a program of work to be done is proposed. (auth)

3244 KAPL-1443
Knolls Atomic Power Lab., Schenectady, N. Y.
PROBLEMS AND COSTS ENCOUNTERED IN THE HANDLING OF IRRADIATED FUELS. L. O. Sullivan. Sept. 1, 1955. 35p. Contract W-31-109-Eng-52. $0.25(OTS).

Operating experience in the Radioactive Materials Laboratory is described, with emphasis on problems and costs encountered in the handling of irradiated fuels. (auth)

4911 AECU-3254
Division of Civilian Application, AEC.
TRANSPORTATION COSTS FOR IRRADIATED MTR FUEL ELEMENTS. 6p. $0.10(OTS).

6007 ✓ A/CONF.15/P/1093
THE DESIGN AND CONSTRUCTION OF RESEARCH FACILITIES FOR A POWER DEVELOPMENT PROGRAMME. G. L. Miles and C. N. Watson-Munro (Australia). 19p.

Some of the problems met in establishing, in a country of limited financial and technological resources, atomic energy research facilities capable of supporting a power development program are outlined. In addition to discussing the general policy underlying the selection of the site, and the type of research program to be undertaken, technical and cost details of the irradiation and active handling facilities found necessary for a limited power research project are given. (auth)

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5502 ✓ HASL-66
New York Operations Office. Health and Safety Lab., AEC.
NUCLEAR SAFETY IN MANUFACTURING PLANTS. James E. McLaughlin. Nov. 3, 1959. 24p. OTS.

Presented at the 1959 Industrial Health Conference, Chicago, Illinois, April 30, 1959.

Criticality control in the processing of fissionable materials is discussed. Several fundamental criteria are desirable in criticality control. Safety of a configuration should depend on the occurrence of at least two unlikely events. Configurations should be nuclear safe even if totally flooded with water or, if this possibility can be included, account should be taken of other incidental reflectors. In the case of mass control, the possibility of double-batching should be considered. The intentional use of neutron poisons should not be necessary to achieve subcriticality in manufacturing processes. (W.L.H.)

11037 ✓
NUCLEAR SAFETY CONSIDERATIONS IN THE HANDLING AND STORAGE OF REACTOR FUELS. Presented at Nuclear Engineering and Science Conference, held at Chicago, March 17 to 21, 1958. Preprint 29, Session 32. Norman Ketzlach (General Electric Co., Richland, Wash.). New York, American Institute of Chemical Engineers, 1958. 23p.

Methods of calculation to determine design criteria for nuclear safety specifications in the handling and storage of slightly enriched fuels are presented. Examples for fuel elements of 1.60% and approximately 90% U-235 enrichment are given. The importance of understanding the reactor theory involved in interpreting results of calculation so that they can safely be applied to plant process conditions cannot be overemphasized. The importance of standardization of transportation specifications for shipping large quantities of these fuels is also indicated. (auth)

823 ✓
CRITICALITY PROBLEMS IN CHEMICAL PLANT DESIGN. G. R. Hall (Imperial Coll., London). Nuclear Power 4, No. 42, 97-9(1959) Oct.

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A review is given of criticality problems encountered in handling fissionable material, i. e., critical dimensions for mass and neutron leakage and reflection, control factors to reduce criticality hazard are discussed. (C.J.G.)

6586 A/CONF.15/P/88
CRITICAL ASSEMBLY EXPERIMENTS AT DOUNREAY.
G. W. K. Ford and J. G. Walford (United Kingdom Atomic Energy Authority, [Caithness, Scotland]). 23p.
A laboratory was constructed at the Dounreay U.K.A.E.A. research station for critical assembly experiments upon a wide variety of systems. The immediate object was the investigation of certain safety problems associated with the Authority's fissile material processing factories. Three different types of critical experiments are described which were carried out in order to assist with the safety problems which arise in fissile material processing plants handling aqueous and organic solutions of highly enriched U. (W.D.M.)

22151 NP-7894
European Company for the Chemical Processing of Irradiated Fuels, Mol, Belgium.
PRELIMINARY CRITICALITY STUDY. Technical Report No. 52, Chapter 260. G. Calleri, M. Lung, and M. Zifferero. [1959]. 74p. $12.30(ph), $4.50(mf) OTS.
A brief study is presented of criticality control and parameters for the proposed 100 ton per year Eurochemic radiochemical processing plant. (W.L.H.)

495
HEALTH PHYSICS ASPECTS OF CRITICALITY. H. J. Dunster (United Kingdom Atomic Energy Authority, Risley, Lancs, Eng.). Nuclear Eng. 4, 343-6(1959) Oct.
The methods of detecting the release of radiation, the identification of exposed personnel, and an estimation of the dose received are reviewed. (C.J.G.)

11702 DP-312
Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Augusta, Ga.
INTERACTION OF SUBCRITICAL COMPONENTS.
Hugh K. Clark. Nov. 1958. 48p. Contract AT(07-2)-1. $1.50(OTS).
A simple, generally conservative, and reasonably accurate method is developed for computing safe spacings of vessels containing fissile material, such as those encountered in separations process equipment. Simplifying assumptions are made to permit the fraction of the neutrons escaping from one component that enters another to be obtained by a purely geometric calculation. independent of the details of the flux distribution. For each component the albedo and the effective reflector saving provided by the other components are expressed in terms of these fractions. Interactions between slabs (both parallel and perpendicular), between cylinders, interactions with reflectors, and self-interactions in the case of annuli are considered. Comparisons with experiments are made. (auth)

5774 HW-61931
General Electric Co. Hanford Atomic Products Operation, Richland, Wash.
MINUTES OF CRITICALITY INSTRUMENTATION MEETING, HANFORD ATOMIC PRODUCTS OPERATION, AUGUST 17 AND 18, 1959. C. L. Brown. Sept. 16, 1959. 13p. Contract W-31-109-Eng-52. OTS.
A criticality instrumentation meeting was held at Hanford on August 17 and 18, 1959. The meeting was attended by instrumentation and criticality specialists from the primary AEC sites. The talks presented served to acquaint those present with the efforts and problems associated with criticality alarm systems now in use at each site and the development work being directed toward perfecting more adequate systems. A brief résumé of each talk is given. (W.D.M.)

11001 CF-58-9-77
Oak Ridge National Lab., Tenn.
REQUEST FOR PRELIMINARY CRITICALITY REVIEW OF REACTOR FUEL REPROCESSING SCHEMES. A. R. Irvine, J. M. Holmes, J. P. Nichols, and A. C. Schafer, Jr. Sept. 24, 1958. 39p. Contract [W-7405-eng-26]. $7.80(ph), $3.30(mf) OTS.

SHIPPING AND HANDLING OF RADIOACTIVE MATERIALS 4.02

CRITICALITY 4.02.03

GENERAL 4.02.03.01

Reprocessing schemes for Consolidated Edison Thorium Reactor, Special Stainless Steel, and Foreign Research Reactor Fuels are described for purpose of examination by Criticality Review Board. (auth)

✓702 APAE-36
Alco Products, Inc., Schenectady, N. Y.
THE ALCO PRODUCTS, INC. CRITICALITY FACILITY. DESCRIPTION AND OPERATION. John W. Noaks. July 16, 1958. 62p. $9.30(ph OTS); $3.60(mf OTS).
The Alco Products Criticality Facility, site location, and operating procedures are described in detail, including the handling of fissionable material and the operating procedures for the safe performance of critical experiments. (auth)

NUCLEAR SAFETY GUIDE. A. D. Callihan, W. J. Ozeroff, H. C. Paxton, and C. L. Schuske. [1958]. 29p. (TID-7016)
Regulations for the prevention of neutron chain reaction in fissionable materials being processed, stored, or transported on an industrial scale are presented. Nuclear safety operating rules are formulated in detail, and an administrative system is set up to enforce them.

15176✓ A/CONF.15/P/427
Oak Ridge Gaseous Diffusion Plant, Tenn. and Union Carbide Nuclear Co. Y-12 Plant, Oak Ridge, Tenn.
NUCLEAR SAFETY IN THE UNIRRADIATED PROCESSING PHASES OF ENRICHED URANIUM FUEL CYCLES. J. D. McLendon, J. W. Wachter, and H. F. Henry. 14p. $0.50(OTS).
Prepared for the Second U. N. International Conference on the Peaceful Uses of Atomic Energy, 1958.
Strict limitations must be imposed on the design and operation of industrial facilities processing fissionable material in order to prevent accidental nuclear chain reactions. Freedom from such criticality hazards can be attained by a program of nuclear safety incorporating geometric, administrative, and operational controls. This paper discusses briefly the fundamental nuclear safety methods common to all uranium processing and considers how, with changing emphasis, these basic rules can be applied to the divergent problems encountered in the unirradiated processing phases of a each nuclear variable are presented. The reduction of uranium tetrafluoride to metal and the subsequent handling and processing of enriched metal requires the strict isolation of individual pieces. Means, both mechanical and administrative, of effecting this are discussed. Alloy fuel elements possess the advantages of poorly moderated systems, but require special care in storage and shipping. The treatment of scrap for recycling incorporates all the above problems and presents added difficulties arising from the exceedingly small uranium concentrations. Shipping container designs are discussed which allow a wide range of types and concentrations of enriched uranium materials to be handled safely and economically. (auth)

5775✓ HW-62031
General Electric Co. Hanford Atomic Products Operation, Richland, Wash.
A COMPARISON OF PCTR AND CRITICAL EXPERIMENT DETERMINATIONS OF k_∞ FOR TWO WEIGHT PER CENT URANIUM-235 ENRICHED UF_4 IN PARAFFIN. V. L. Neeley. Sept. 22, 1959. 28p. Contract AT(45-1)-1350. OTS.
The value of k_∞ for 2 wt.% U^{235} enriched UF_4 paraffin moderated at a H/U^{235} atomic ratio of 195 was determined in the PCTR. This material was returned to ORNL in order that critical experiments might be conducted to determine k_∞. The two values of k_∞ were then compared. The value of k_∞ as determined in the PCTR was dependent upon the cross-section values which were chosen. In this experiment "effective" cross-section values obtained by averaging the cross section over the Wigner-Wilkens spectrum of a similar type of mixture were used. The value of k_∞ determined in the PCTR was 1.216 ± 0.013. The value obtained from the work carried out at ORNL was 1.200 ± 0.011 from a one-group treatment of the critical experiments and 1.202 ± 0.012 from a two-group treatment of the work. A theoretical calculation of k_∞ gives a value of 1.23. This is in good agreement with the experimental value. Critical experiments done on this material at ORNL show that the minimum critical mass for a bare "square" cylinder contains approximately 28 kg of U^{235}. A calculated value of the amount of U^{235} in a just critical bare square cylinder was obtained using the experimental k_∞ value. Again there was good agreement with the experimental results. (auth)

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9073
EFFECT OF NEUTRON INTERACTION ON CRITICALITY. II. G. W. Stuart (General Electric Co., Richland. Wash.). J. Appl. Phys. 28, 677-9(1957) June.

A method for calculating the criticality conditions for spatially disconnected fissile regions based on the multiplication constant k is presented. To illustrate the method, the case of two interacting infinite water-tamped fissile slabs containing solutions of pure U^{235} in water is considered. (auth)

4675 AEC-tr-3122
MAXIMUM PERMISSIBLE CONCENTRATIONS OF RADIOACTIVE ISOTOPES. (Zur Frage der Maximal Zulässigen Konzentrationen Radioaktiver Isotope). A. Catsch. Translated from Atomkern-Energie 2, 181-6(1957). 23p.

This paper was previously abstracted from the original language and appears in Nuclear Science Abstracts, Vol. 11, as abstract No. 12653.

13496 WAPD-T-445
Westinghouse Electric Corp. Bettis Plant, Pittsburgh.
CRITICALITY CONSIDERATIONS IN MANUFACTURE OF REACTOR FUELS. J. C. Clark. [1957]. 12p. $3.30(ph OTS); $2.40(mf OTS).

Prepared for presentation at the 18th Annual Meeting American Industrial Hygiene Association Radiation Session, St. Louis, April 22-26, 1957.

Whenever fissionable materials are processed, there is a possibility of accumulating a critical mass. This will be determined by several factors which include the enrichment of the fissionable material, the effect of reflectors, the effect of moderators, the shape of the process vessels, the density of fissionable material in the system, the effect of non-hydrogenous diluents, and neutron interaction between process vessels. Control of criticality hazards in the manufacture of reactor fuels is based upon the appropriate combination of these factors which provides a balance between adequate safety and minimum costs and which insures safety with a minimum of rules. (auth)

193
EVALUATION OF PROCESS VARIABLES IN THE RECOVERY OF SPENT REACTOR FUEL. Frank P. Vance and Fred H. Tingey (Phillips Petroleum Co., Idaho Falls, Idaho). Chem. Eng. Progr. 52, 375-80(1956) Sept.

The application of the mathematical theory of the "analysis of variance" to general problems in plant material balance calculation is discussed here. Also given is the derivation of a graphic plot which includes an empirical operating line indicating the safe number of batches which can be charged to a spent enriched uranium reactor fuel dissolver. (auth)

12509 TID-5451
Dow Chemical Co. Rocky Flats Plant, Denver.
AN EMPIRICAL METHOD FOR CALCULATING SUBCRITICAL PIPE INTERSECTIONS. C. L. Schuske. July 17, 1956. Decl. Mar. 14, 1957. 4p. Contract AT(29-1)-1106. (TG-7.1). $1.80(ph OTS); $1.80(mf OTS).

THE CALCULATION OF MAXIMUM PERMISSIBLE CONCENTRATIONS FOR LONG-LIVED RADIOISOTOPES. J. W. Healy (General Electric Co., Richland, Wash.). Radiation Research 4. 367-72(1956) May.

5776 NP-8168
Iowa State Univ. of Science and Technology, Ames.
CHARACTERISTICS OF A SUBCRITICAL ASSEMBLY EVALUATED BY NEUTRON WAVES (thesis). Frank Peter Mertes. 1959. 56p.

A new and more effective method of studying the phase angle and amplitude of the neutron waves in a subcritical assembly by a completely analytical method, with no dependence upon visual interpretation of graphs, was developed. The phase and amplitude of the neutron wave was determined as a function of vertical position in the assembly for two frequencies of oscillation. Phase and amplitude determinations were also made along a horizontal plane in the assembly. (W.D.M.)

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822 Y-A2-104(Del.)
Carbide and Carbon Chemicals Co. Y-12 Plant, Oak Ridge, Tenn.
CRITICALITY REVIEW OF PROCESS FOR FABRICATION OF FUEL RODS. J. D. McLendon and J. W. Morfitt. Jan. 28, 1953. Decl. with deletions May 7, 1957. 6p. Contract W-7405-eng-26. OTS.
Suggestions are given for maintaining nuclear safety during the fabrication of fuel rods. Included are brief comments on storage, handling, and area problems. (W.D.M.)

POISONS AND MODERATORS 4.02.03.02

13859 ✓ Y-B23-22
Oak Ridge National Lab., Y-12 Area, Tenn.
RING TAMPING. Dixon Callihan and Frank Cronin. Nov. 5, 1952. Decl. Mar. 21, 1957. 7p. Contract [W-7405-eng-26]. $1.80(ph OTS); $1.80(mf OTS).
In a potential nuclear chain reacting system with two or more volumes of fissionable material surrounded by, but not separated by, a hydrogeneous neutron reflecting medium reliance is placed on neutron absorption by the H separating the components. The fissionable material used was U_3O_8 enriched to 5% in U^{235} mixed with glycerol tristearate for moderation. The H content of glycerol tristearate is 96% that of H_2O by volume and 111% by weight. The change in reactivity incurred by removal of the reflector material from between the components was determined. (F.S.)

2792 ✓ CF-58-12-23
Oak Ridge National Lab., Tenn.
CHEMICAL FEASIBILITY OF HOMOGENEOUS NEUTRON POISONS FOR CRITICALITY CONTROL IN FUEL REPROCESSING. J. G. Moore and R. H. Rainey. Dec. 1, 1958. 8p. Contract W-7405-eng-26. $1.80(ph OTS); $1.80(mf OTS).
A preliminary examination has demonstrated the apparent chemical feasibility of the nuclear poisons boron, cadmium, and rare earth elements in the proposed flowsheet for reprocessing Consolidated Edison thorium fuels.

2858 ✓ CF-58-8-5
Oak Ridge National Lab., Tenn.
CRITICAL PARAMETERS FOR POISONED ANNULAR CYLINDERS CONTAINING AQUEOUS SOLUTIONS OF U^{235}. J. K. Fox and L. W. Gilley. Aug. 1, 1958. 7p. Contract [W-7405-eng-26]. $1.80(ph OTS); $1.80(mf OTS).
Experiments were performed to determine the critical parameters of aqueous solutions of 93.2% U^{235}-enriched uranyl fluoride contained in cylindrical annuli formed by various combinations of aluminum cylinders varying in diameter from 2 to 30 in. In all of the experiments the inside cylinder was lined with a 20-mil-thick cadmium sheet and filled with water to a height of 48 in., and in some experiments a water reflector was used on the sides and bottom of the outside cylinder. The data indicate that for the solution having an $H:U^{235}$ atomic ratio of 50.4 the critical infinitely high reflected annulus would have a minimum thickness between 2.5 and 3 in., while the unreflected annulus would have a thickness between 3.75 and 4.5 in. The corresponding thicknesses for the solution having an $H:U^{235}$ atomic ratio of 309 would be between 3.5 and 4 in. for the reflected annulus and between 4.5 and 5.5 in. for the unreflected annulus. (auth)

15205 ✓ AECU-4180
Combustion Engineering, Inc. Reactor Development Div., Windsor, Conn.
ANALYTICAL EVALUATION OF THE REACTIVITY WORTH OF A LUMPED ABSORBER. J. M. Stein and H. A. Vieweg. Dec. 11, 1956. 17p. (S1C/RP/56-104). $3.30(ph), $2.40(mf) OTS.
Period measurements were obtained for the removal of a lumped absorber from two different locations in a critical assembly. A two-group analytical evaluation, developed in the report, resulted in a value of 30.6 cents for boron steel strips removed from the center of core regions, as compared to a measured worth of 31.0 cents. A calculated worth of 42.9 cents was obtained for boron steel strips removed from near water gaps; the measured value was 36.6 cents. The difference between measured and calculated values for the water gap is greater due to inability to account for some local details with two group diffusion theory. The agreement noted between measured and calculated reactivity worths and consideration of the qualifications mentioned lends confidence to the application of the method involved to similar experiments with lumped absorbers. (auth)

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CRITICALITY 4.02.03

POISONS AND MODERATORS 4.02.03.02

11007 ✓ K-643
Carbide and Carbon Chemicals Div. K-25 [Plant], Oak Ridge, Tenn.
CRITICAL MASS STUDIES. PART V. Dixon Callihan, D. F. Cronin, J. K Fox, and J. W. Morfitt. June 30, 1950. Decl. Mar. 19, 1957. 57p. Contract W-7405-eng-26. $0.40(OTS).

An investigation has been made of the conditions under which aqueous solutions of enriched uranyl nitrate become critical in right cylindrical reactors. A comparison was made of the neutron reflectivity of stainless steel, bismuth subcarbonate both dry and as a water slurry, aqueous solutions of natural uranyl nitrate and phosphoric acid. The materials tested, with the exception of dry bismuth subcarbonate, were about as effective reflectors as water. Dry bismuth subcarbonate was considerably less effective. The free nitrogen content of the nitrate solution and the addition of phosphoric acid and metallic bismuth to the reactor core were among the variables studied. Nitric and phosphoric acid when introduced into the core material were effectively mild poisons when compared with aqueous solutions at the same hydrogen to U^{235} ratio. Bismuth was introduced into the core as an array of aluminum clad bismuth rods. The critical mass of this array was only slightly less than that measured when the bismuth was replaced by a similar array of voids. (auth)

511 ✓ GAT-T-673
Goodyear Atomic Corp., Portsmouth, Ohio.
MODERATING RATIOS AND POISONING RATIOS OF THE ELEMENTS AND SOME COMPOUNDS. J. L. Feuerbacher. Sept. 1, 1959. 12p. Contract AT(33-2)-1. OTS.

Moderating ratio and poisoning ratio are defined and their significance is explained. Best values of moderating ratio and (where applicable) poisoning ratio are given in tabular form, first for materials most likely to be used at the Portsmouth Gaseous Diffusion Plant, and then for all elements and some compounds. These values are then illustrated in graphical form. Apparent anomalies are discussed with reference to extrapolation distances for unreflected and reflected aluminum and steel containers, as well as a number of other observations of interest. Methods of calculation are outlined and all terms are defined. (auth)

SOLUTIONS – GENERAL 4.02.03.03

14685 ✓ A/CONF.15/P/518
Du Pont de Nemours (E.I.) & Co. Savannah River Lab., Augusta, Ga.
CRITICALLY SAFE EQUIPMENT FOR AQUEOUS SEPARATIONS PROCESSES. T. J. Colven. 13p. $0.50 (OTS).

Prepared for the Second U. N. International Conference on the Peaceful Uses of Atomic Energy, 1958.

The operating characteristics of critically-safe "slab" mixer-settlers and continuous solvent washers are described. The effectiveness of some experimental units of each type was evaluated for a number of tributyl phosphate-kerosene and uranyl nitrate-nitric acid-aluminum nitrate systems. The units described are prototypes of equipment that could be used in a full scale solvent extraction plant. The mixer-settlers are of the "pump-mix" type and are shaped in the form of slabs, three inches high. When positioned in an operating area

✓**9812** CF-55-11-104
Oak Ridge National Lab., Tenn.
LIMITING CONCENTRATIONS FOR FISSILE ISOTOPES. J. T. Thomas. Nov. 17, 1955. 7p. Contract [W-7405-eng-26]. $1.80(ph OTS); $1.80(mf OTS).

The limiting critical concentrations of aqueous solutions of the fissile isotopes are of particular interest to the chemical processing groups in the matter of nuclear safety. The purpose of this paper is to define the concentration regions wherein criticality is not possible. The method utilized defines safe concentrations with a rather wide but comforting margin. (auth)

10547
NUCLEAR SAFETY IN PROCESSING REACTOR FUEL SOLUTIONS. Dixon Callihan (Oak Ridge National Lab., Tenn.). Nucleonics 14, No. 7, 38-41(1956) July.

Safety factors have been presented in the processing of reactor fuel solutions. The effects of neutron leakage, moderation and density along with the design of storage vessels have been discussed. (W.L.H.)

SHIPPING AND HANDLING OF RADIOACTIVE MATERIALS 4.02

CRITICALITY 4.02.03

SOLUTIONS - PLUTONIUM 4.02.03.04

22208 CF-59-9-3
Oak Ridge National Lab., Tenn.
EUROCHEMIC ASSISTANCE: ANSWERS TO QUESTIONS ON CRITICALITY. E. D. Clayton. Sept. 11, 1959. 4p. $1.80(ph), $1.80(mf) OTS.
Answers to questions on the criticality of Pu and Pu solutions are presented. (W.L.H.)

7622 ✓ HW-53618
General Electric Co. Hanford Atomic Products Operation, Richland, Wash.
NUCLEAR CRITICALITY IN HANDLING AND PROCESSING PLUTONIUM. Norman Ketzlach. Nov. 14, 1957. Decl. Jan. 13, 1959. 21p. Contract W-31-109-Eng-52. $4.80(ph), $2.70(mf) OTS.
Some of the nuclear safety considerations in the handling and processing of plutonium solutions as well as slurries of plutonium oxides in water whose bulk density is less than about 3.5 grams plutonium per cubic centimeter are presented. The dissolution of plutonium metal is mentioned briefly to illustrate some of the effects of surrounding metal by a solution of the same material. Criticality conditions for plutonium–aluminum alloys are not discussed at this time. (auth)

4471 ✓ CP-400
[Chicago. Univ. Metallurgical Lab.]
CHAIN REACTION OF PURE FISSIONABLE MATERIALS IN SOLUTION. Robert F. Christy and John A. Wheeler. Jan. 1, 1943. Decl. Dec. 15, 1955. 16p. Contract [W-7401-eng-37]. (A-451). $3.30(ph OTS); $2.40(mf OTS).
The critical mass of Pu^{239} and the corresponding critical dimensions of homogeneous mixtures of Pu^{239} with various moderating media have been calculated as a function of the concentration of Pu. A simple transformation makes the figures applicable to U^{235}. The problem of the stability of a chain reaction in solution and questions of protection are discussed. (auth)

SOLUTIONS - URANIUM 4.02.03.05

See also, this section,

VESSELS AND FUEL ELEMENTS (4.02.03.07).

16104 ✓ CF-59-6-45
Oak Ridge National Lab., Tenn.
A COMPARISON OF ELEMENTARY CRITICALITY CALCULATIONS WITH EXPERIMENTAL RESULTS. C. W. Nestor, Jr. June 11, 1959. 15p. $3.30(ph), $2.40(mf) OTS.
Several experiments have been performed at ORNL with light water solutions of uranyl nitrate (highly enriched in either U^{233} or U^{235}) in an essentially bare sphere 27 inches in diameter. Results are presented of several calculations with elementary bare reactor theory and a discussion of the observed discrepancies between the calculated and experimental results. If the observed critical concentration is used in the calculations, the calculated effective multiplication constant is less than unity; thus a higher critical concentration would be predicted than is actually observed. (auth)

16107 ✓ KY-294
Union Carbide Nuclear Co. Paducah Plant, Ky.
A GENERALIZED AND CONSISTENT METHOD FOR CALCULATING THE CRITICAL MASS OF HOMOGENEOUS AQUEOUS URANYL FLUORIDE SOLUTIONS. O. W. Hermann. June 8, 1959. 22p. Contract W-7405-eng-26. $0.75(OTS).
A more encompassing, yet consistent and practical, method of calculating the critical mass of aqueous uranyl fluoride solutions was developed. Comparison of calculated results with experimentation gave a maximum of only 2.3% error in the effective multiplication factor and 9% error in the critical mass, with absolute averages of 0.7% and 3.4%, respectively, through the ranges from high moderation down to an H/U of 25 for 90% U^{235} assays or an H/U of 4 for 2% U^{235} assays. (auth)

12332 ✓ AERE-CE/R-2052
United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England.
CRITICAL ASSEMBLIES OF AQUEOUS URANYL

SHIPPING AND HANDLING OF RADIOACTIVE MATERIALS 4.02

CRITICALITY 4.02.03

SOLUTIONS – URANIUM 4.02.03.05

FLUORIDE SOLUTIONS. PART II. PREPARATION AND HANDLING OF SOLUTIONS. J. E. Cunningham, G. P. Wall, and I. Wells. Apr. 1958. 28p. $1.08(BIS).

Light-water solutions of U^{235} and U^{238} in the form of uranyl fluoride have been prepared and dispensed to the Zero Energy Thermal Reactor. The development of the process, equipment, and handling techniques are described along with experimental criticality test techniques, results, and an analysis of the results. (auth)

17333

8226 UCRL-4975
California. Univ., Livermore. Radiation Lab.
CRITICAL MASSES OF SPHERICAL SYSTEMS OF ORALLOY REFLECTED IN BERYLLIUM. H. Robert Ralston. Oct. 10, 1957. Decl. Feb. 26, 1958. 7p. Contract W-7405-eng-48. $1.80(ph OTS); $1.80(mf OTS).

The critical thickness of beryllium reflector was determined for oralloy (uranium, enriched to 93.17% U^{235}) spheres ranging from 10.765 kg to 32.654 kg. Four points which were determined by other experimenters were normalized to the data and are included in the curves. (auth)

1803 HW-51364
General Electric Co. Hanford Atomic Products Operation, Richland, Wash.
NUCLEAR SAFETY IN PROCESSING URANIUM SOLUTIONS OF ALL ENRICHMENTS. N. Ketzlach. July 15, 1957. 18p. Contract W-31-109-Eng-52. $3.30(ph OTS); $2.40(mf OTS).

A set of relatively simple formulas has been presented to calculate the critical parameters for homogeneous solutions of uranium of all enrichments in water. Comparison of calculated values has been made with experimental ones where available. Rules for the use of the calculated data have also been presented. (auth)

12653 ✓
MAXIMUM PERMISSIBLE CONCENTRATION OF RADIOISOTOPES. A. Catsch. Atomkern Energie 2, 181-6(1957) May. (In German)

11489 AECD-4243
Los Alamos Scientific Lab., N. Mex.
ESTIMATED CRITICAL MASSES OF DILUTED ORALLOY. Hugh C. Paxton. June 1956. Decl. Aug. 30, 1956. 4p. Contract W-7405-Eng-36. $1.80(ph OTS); $1.80(mf OTS).

8755 IDO-16296
Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho.
CRITICALITY OF UNREFLECTED, INFINITELY-LONG CYLINDERS OF URANYL NITRATE SOLUTION. J. W. Webster, G. A. Cazier, and M. A. Wahlgren. Oct. 13, 1955. Decl. June 4, 1956. 4p. Contract AT(10-1)-205. (PTR-8). $1.80(ph OTS); $1.80(mf OTS).

9897 AECD-4190
Tennessee Eastman Corp., Oak Ridge, Tenn.
CRITICALITY IN UNTAMPED URANIUM SOLUTIONS. Raymond Murray and George W. Schmidt. Feb. 4, 1947. Decl. Feb. 15, 1956. (A-7.390.24). $3.30(ph OTS); $2.40(mf OTS).

A new conservative method of determining critical concentrations and masses of pure U^{235} in water solutions is described. An experimentally determined source function involving diffusion length characteristic to several neutron energies is used instead of the simpler Fermi age theory source. (F.S.)

14039 ✓ A-7.390.27
[Tennessee Eastman Corp., Oak Ridge, Tenn.]
CRITICAL CONDITIONS IN PYREX VESSELS. George W. Schmidt and John W. Morfitt. [1947?]. Decl. Feb. 12, 1957. 13p. $3.30(ph OTS); $2.40(mf OTS).

A method is described for estimating the effect of Pyrex shielding upon the critical mass of aqueous solutions of uranium salts. The method finds particular application in estimating the minimum critical masses of compact arrays of Pyrex carboys. Certain elements of conservatism have been made an integral part of the method, which simplify the mathematical treatment and provide an inherent safety factor. The method follows directly from the so-called "untamped" theory outlined below. (auth)

SHIPPING AND HANDLING OF RADIOACTIVE MATERIALS 4.02

CRITICALITY 4.02.03

URANIUM METAL 4.02.03.06

15208 Y-1248
Union Carbide Nuclear Co. Y-12 Plant, Oak Ridge, Tenn.
CRITICAL ASSEMBLIES OF URANIUM METAL. R. Gwin and W. T. Mee. Mar. 26, 1959. 17p. Contract W-7405-eng-26. $0.75(OTS).
Data on critical assemblies of fissionable uranium metals are summarized. Empirical studies are made for specific reflectors and geometries to determine the feasibility of extrapolating these data for conditions concerning nuclear safety problems. Also included are the influences on critical systems by various reflectors, U-235 isotopic enrichment, density, and small metal pieces homogeneously distributed in water. (auth)

13634 TID-5345
Carbide and Carbon Chemicals Co. [K-25 Plant], Oak Ridge, Tenn.
VARIATION OF CERTAIN CRITICAL PARAMETERS WITH ASSAY. L. Geller. Nov. 20, 1952. Decl. June 3, 1958. 9p. Contract [W-7405-eng-26]. (KS-336). $1.80(ph OTS); $1.80(mf OTS).
New data from the 5% critical experiments were used to determine the variation of certain minimum critical parameters with the U^{235} assay. Curves are presented showing the minimum mass, volume, and cylinder diameter of U^{235} as functions of the assay. (W.D.M.)

2191 HKF-1492D-39
Ferguson (H. K.) Co., New York.
CRITICALITY HAZARDS IN PROCESSING 1% ENRICHED URANIUM. Kenneth C. Cooper. Sept. 24, 1951. Decl. Mar. 14, 1957. 4p. $1.80(ph OTS); $1.80(mf OTS).
Possible hazards involved in the Mallinckrodt procedures for processing 1%-enriched U are analyzed, and necessary precautions are specified. No danger is possible in handling any amount of nominally 1% U in the reduction of UF_4 to metal, cooling, or remelting. Critical amounts might conceivably be accumulated during the rolling to ¾" rod, in which case an "always safe" amount is indicated. (B.J.H.)

11008 KS-219
Carbide and Carbon Chemicals Co. [K-25 Plant], Oak Ridge, Tenn.
MINIMUM CRITICAL MASS OF U-235 FOR SEVERAL VALUES OF THE U-235 ASSAY. R. Gwin and H. F. Henry. Aug. 17, 1951. Decl. Mar. 14, 1957. 5p. Contract [W-7405-eng-26]. $1.80(ph OTS); $1.80(mf OTS).

VESSELS AND FUEL ELEMENTS 4.02.03.07

820 RFP-149
Dow Chemical Co. Rocky Flats Plant, Denver.
AN EMPIRICAL INTERPRETATION OF ANNULI CRITICAL MASS DATA. C. L. Schuske and G. H. Bidinger. Oct. 26, 1959. 26p. Contract AT(29-1)-1106. OTS.
Simple empirical equations were found which relate the inside and outside diameters of annular vessels to the critical heights. From these equations, annuli of infinite length can be obtained. The interaction of 6-in. and 8-in. diameter cylinders in annular or circular arrays is discussed. (auth)

15206 CF-59-4-120
Oak Ridge National Lab., Tenn.
PRELIMINARY REPORT ON 2% U^{235}-ENRICHED UF_4-$C_{25}H_{52}$ CRITICAL ASSEMBLIES. J. T. Mihalczo, J. J. Lynn, Dunlap Scott, and W. C. Connolly. Apr. 22, 1959. 42p. $7.80(ph), $3.30(mf) OTS.
A series of critical experiments with blocks of 2% U^{235}-enriched UF_4-$C_{25}H_{52}$ was initiated at the ORNL Critical Experiments Facility. Thus far assemblies with $H:U^{235}$ atomic ratios of 195 and 294 were built in parallelepipedal and simulated cylindrical geometries, both reflected and unreflected. From the results the minimum critical masses for reflected spheres were determined to be 16.3 and 8.5 kg of U^{235} for fuel mixtures with $H:U^{235}$ atomic ratios of 195 and 294, respectively. The minimum critical masses for unreflected spheres of these two fuel mixtures are 24.3 and 12.7 kg of U^{235}, respectively. (auth)

7845 HW-59301
General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

SHIPPING AND HANDLING OF RADIOACTIVE MATERIALS 4.02

CRITICALITY 4.02.03

VESSELS AND FUEL ELEMENTS 4.02.03.07

RANDOM LOADING OF E-METAL DISSOLVER. N. Ketzlach. Feb. 25, 1959. 26p. Contract W-31-109-Eng-52. $4.80(ph), $2.70(mf) OTS.

Nuclear safety in the dissolution of irradiated 0.95% U^{235} enriched fuel was investigated. Critical conditions of fuel of this enrichment in a 52-in.-diam. dissolver crib were studied. The processing of I and E fuel elements in a 52-in.-diam. dissolver crib can be based on random loading of the dissolver. The maximum safe dissolver charge depends on the assumptions that can be made regarding the distribution of fuel in the dissolver. It depends on whether the fuel can be loaded into a cylindrical pile whose diameter is less than 52-in.-diam. dissolver crib. The dissolver limits calculated require complete dissolution before a new dissolver charge is added. (W.L.H.)

Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Augusta, Ga.
INTERACTION OF SUBCRITICAL COMPONENTS. Hugh K. Clark. Nov. 1958. 48p. Contract AT(07-2)-1. $1.50(OTS).

A simple, generally conservative, and reasonably accurate method is developed for computing safe spacings of vessels containing fissile material, such as those encountered in separations process equipment. Simplifying assumptions are made to permit the fraction of the neutrons escaping from one component that enters another to be obtained by a purely geometric calculation, independent of the details of the flux distribution. For each component the albedo and the effective reflector saving provided by the other components are expressed in terms of these fractions. Interactions between slabs (both parallel and perpendicular), between cylinders, interactions with reflectors, and self-interactions in the case of annuli are considered. Comparisons with experiments are made. (auth)

16919 HW-57853
General Electric Co. Hanford Atomic Products Operation, Richland, Wash.
BUCKLING MEASUREMENTS OF FUEL ELEMENTS IN RANDOM ARRAYS. R. C. Lloyd. Oct. 21, 1958. 8p. Contract W-31-109-Eng-52. $1.80(ph), $1.80(mf) OTS.

The buckling was measured for three different fuel element types in random arrays. The average value of the buckling was less than the buckling of uniform arrays in all three cases, but in view of the 95% confidence limit, it is not considered advisable to increase the safe critical limits of random arrays above those of uniform arrays. (D.E.B.)

2859 CF-58-9-40
Oak Ridge National Lab., Tenn.
CRITICAL EXPERIMENTS WITH ARRAYS OF ORR AND BSR FUEL ELEMENTS. J. K. Fox and L. W. Gilley. Oct. 2, 1958. 6p. Contract [W-7405-eng-26]. $1.80 (ph OTS); $1.80(mf OTS).

Critical experiments were performed with ORR and BSR fuel elements to determine safe arrays in which the elements could be handled and stored. The data indicate that the optimum spacing for criticality of 168-g ORR elements in water is 0.2 in. between locating bosses and that an infinite array of vertically placed elements one element high would probably be subcritical with a $1\frac{1}{2}$-in. spacing between locating bosses. For uniform arrays of adjacent elements in water, variation in the fuel loading per element between 140 and 200 g made very little difference in the critical mass. When 132 elements with an average loading of 160 g per element were closely packed in water in an 11 by 12 element array in which

126 HW-56423
General Electric Co. Hanford Atomic Products Operation, Richland, Wash.
NUCLEAR SAFETY OF IRON-ENCASED FUEL ELEMENTS. N. Ketzlach. June 17, 1958. 13p. Contract W-31-109-Eng-52. $3.30(ph OTS); $2.40(mf OTS).

A study was made of the reactivity of water flooded arrays of 0.95% enriched U^{235} fuel elements encased in aluminum and iron pipes. The feasibility of making large arrays of low U^{235} enrichment safe for shipping and storing was determined. Lattice calculations for solid and I and E fuel elements when bare, and encased in $\frac{1}{8}$ and $\frac{1}{4}$ inch pipe were made. Buckling measurements were made on 1.34 in. diam. solid rods in 0.049 in. thick iron pipe. (W.D.M.)

SHIPPING AND HANDLING OF RADIOACTIVE MATERIALS 4.02

CRITICALITY 4.02.03

VESSELS AND FUEL ELEMENTS 4.02.03.07

2087 UCRL-5255
California. Univ., Livermore. Radiation Lab.
CRITICAL-MASS DETERMINATIONS OF LEAD-REFLECTED SYSTEMS. Robert E. Donaldson and Wilbur K. Brown. June 9, 1958. Decl. Sept. 22, 1958. 10p. Contract W-7405-eng-48. $0.50(OTS).

A series of experimentally determined critical masses of cylindrical and spherical lead-reflected oralloy systems are presented. Critical masses are given for two oralloy core sizes in both cases and also for reflected and unreflected ends in the cylindrical case. Experimental methods are described and a photograph of the assembly machine is included. (auth)

13469 HW-55173
General Electric Co. Hanford Atomic Products Operation, Richland, Wash.
PLUTONIUM-ALUMINUM ALLOY CRITICALITY. Norman Ketzlach. Feb. 28, 1958. Decl. Apr. 25, 1958. 17p. Contract [W-31-109-Eng-52]. $3.30(ph OTS); $2.40(mf OTS).

Critical conditions were determined theoretically for water-moderated and unmoderated systems of plutonium oxides and fluorides as well as those of plutonium-aluminum alloy materials. Since there are no experimental data available, the results presented should be considered as estimates until their validity is verified by experiment. (auth)

14042 KAPL-M-CVL-4(Del.)
Knolls Atomic Power Lab., Schenectady, N. Y.
SOME CRITERIA FOR SAFE STORAGE OF U-235 FUEL. C. V. Larrick. Jan. 19, 1956. Decl. Mar. 14, 1957. 12p. Contract W-31-109-eng-52. $0.30(OTS).

Criteria are derived for safe storage of U^{235} in arrays that approximate a portion of an infinite slab. This includes storage on the four walls of room. Criteria are also given for safe shipping boxes. (auth)

12803 K-1345
Oak Ridge Gaseous Diffusion Plant, Tenn.
A SPECIAL PURPOSE SLIDE RULE FOR COMPUTING SOLID ANGLES. J. R. Knight. Sept. 19, 1957. 15p. Contract W-7405-eng-26. $0.50(OTS).

The design and construction of a slide rule for calculating the solid angle subtended by a rectangle at a point located on a line perpendicular to the center of the rectangle are described. The application of the solid angle to the evaluation of safe spacing between individually subcritical containers of fissionable material is discussed, and a complete derivation of the solid-angle equation and a table of values used in marking the slide rule scales are given. (auth)

9185
CRITICAL MASSES OF ORALLOY ASSEMBLIES. Glen A. Graves and H. C. Paxton (Los Alamos Scientific Lab., N. Mex.). Nucleonics 15, No. 6, 90-2(1957) June.

A summary of empirical data on critical configurations of fissionable metals is presented in a form that emphasizes the influence of conditions commonly of concern in nuclear safety questions. (T.R.H.)

THE STORAGE OF FISSILE MATERIAL. A. J. Mayne (Atomic Energy Research Establishment, Harwell, Berks, England). J. Nuclear Energy 2, 77-84(1955) Dec.

Estimates are obtained for the safe spacing between a given number of similar fissile spheres arranged in a linear, square, or cubic array. These estimates give upper bounds, so that they overestimate the size of the least spacing that is safe. Estimates are also obtained for the number of fissile spheres that may be stored safely in a regular linear, square, or cubic array, with given spacing between spheres. These estimates give lower bounds, so that they underestimate the maximum number that can be stored safely. The assumptions used in these calculations are stated, the chief one being that the probability of direct neutron passage from one sphere to another decreases at least as fast as the reciprocal of the distance between them. Some numerical examples are calculated. General arrays of fissile bodies are also considered briefly. (auth)

SHIPPING AND HANDLING OF RADIOACTIVE MATERIALS 4.02

CRITICALITY 4.02.03

VESSELS AND FUEL ELEMENTS 4.02.03.07

12632 CF-54-8-221
Oak Ridge National Lab., Tenn.
A REPORT ON CRITICAL DIMENSIONS OF CYLINDERS. Richard C. Keen. Aug. 31, 1954. Decl. Apr. 1, 1957. 18p. Contract [W-7405-eng-26]. $0.30(OTS).

Curves showing the relationship between the critical heights and critical diameters of stainless steel cylinders having wall thicknesses of $^1/_{16}$ in. and containing aqueous solutions of UO_2F_2 and enriched U have been plotted for several values of H to U^{235} atomic ratios. A critical size nomograph is presented for simple geometries. If the dimensions of one critical shape are known, then the dimensions for a series of similar shapes using the same assay material may be determined from the nomograph. Criticality relationships are also considered for cylindrical annuli and cylinders with small axial poison rods. (M.P.G.)

11828 K-1141
Carbide and Carbon Chemicals Co. K-25 Plant, Oak Ridge, Tenn.
WATER BOILER CALCULATIONS OF CRITICAL PARAMETERS. H. F. Henry and C. E. Newlon. Aug. 13, 1954. Decl. Feb. 23, 1957. 23p. Contract W-7405-eng-26. $0.25(OTS).

The U^{235} assay variation of the minimum critical U^{235} mass, volume, cylinder diameter, and slab height have been calculated for the water reflected case by use of the water boiler theory and using the current best values of the several nuclear constants of the water boiler equations. With respect to empirical criticality data reduced from experiments at 4.9% and 93.4% assays, the theoretic minimum U^{235} critical masses are considered to be slightly nonconservative and the calculated geometric parameters are considered to be conservative at the lower assay only. (auth)

11827 IDO-16172
Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho.
MISCELLANEOUS SAFEGUARD CALCULATIONS. J. W. Webster and B. J. Garrick. May 26, 1954. Decl. Jan. 17, 1957. 10p. Contract AT(10-1)-205. $1.80(ph OTS); $1.80 (mf OTS).

Critical mass measurements were made for cylinders of U^{235} where the cylinder was bare, H_2O reflected, H_2O reflected with a Cd interface, and bare with a concentric Cd shell. The method of two-group, spherical geometry was used. (D.E.B.)

12633 KS-317(Del.)
Carbide and Carbon Chemicals Co. [K-25 Plant], Oak Ridge, Tenn.
THE INTERACTION OF BARE SYSTEMS OF CONTAINERS. PART I. L. Geller. Sept. 26, 1952. Decl. with deletions Feb. 28, 1957. 32p. Contract [W-7405-eng-26]. $6.30 (ph OTS); $3.00(mf OTS).

A theoretical solution of the problem of interaction between containers filled with fissile materials in the ORGDP is given, based on a macroscopic, multigroup diffusion model in which a dual coupling matrix is the fundamental interaction parameter, and which is essentially a modified first order perturbation. (M.H.R.)

13855 K-343
Carbide and Carbon Chemicals Corp. K-25 Plant, Oak Ridge, Tenn.
CRITICAL MASS STUDIES. PART III. C. K. Beck, Dixon Callihan, J. W. Morfitt, and Raymond L. Murray. Apr. 19, 1949. Decl. Jan. 30, 1957. 77p. Contract [W-7405-eng-26]. $0.45(OTS).

The conditions under which U^{235} (93.4%), contained in aqueous solutions of UO_2F_2, becomes critical in cylindrical aluminum and stainless steel reactors were examined. (L.M.T.)

9898 AECD-4191
Tennessee Eastman Corp., Oak Ridge, Tenn.
CRITICAL CONDITIONS IN CYLINDRICAL VESSELS. John W. Morfitt, Raymond Murray, and George W. Schmidt. Jan. 22, 1947. Decl. Feb. 15, 1956. 16p. (A-7.390.22). $4.80(ph OTS); $2.70(mf OTS).

A rapid method of calculating the critical masses of aqueous solutions of enriched U compounds in cylindrical containers is developed. Results involve an inherent safety factor and as such are conservative. (F.S.)

SHIPPING AND HANDLING OF RADIOACTIVE MATERIALS 4.02

CRITICALITY 4.02.03

VESSELS AND FUEL ELEMENTS 4.02.03.07

3754 ✓ AECD-3909
[Tennessee Eastman Corp., Oak Ridge, Tenn.]
INTERACTION OF SOLUTIONS OF URANIUM SALTS.
Raymond Murray and George W. Schmidt. Jan. 2, 1947. Decl. Dec. 13, 1955. 12p. (A-7.390.20). $3.30(ph OTS); $2.40(mf OTS).

Criticality studies on vessels containing U solutions in proximity with other containers are reported. Sample calculations are included. (C.W.H.)

HISTORY (INCIDENTS) 4.02.04

CRITICAL REACTIONS 4.02.04.01

15207 HW-51828
General Electric Co. Hanford Atomic Products Operation, Richland, Wash.
BURST MAGNITUDES AND RADIATION LEVELS FOR THE PROPOSED CRITICAL MASS LABORATORY.
J. A. Berberet. Aug. 14, 1957. Decl. Mar. 3, 1959. 9p. Contract W-31-109-eng-52. $1.80(ph), $1.80(mf) OTS.

Of the twelve unintentional "bursts" that have taken place in assemblies for making critical mass studies, the number of fissions in the largest was 1.67×10^{17}. The average number of fissions is 4.7×10^{16}. Both fast and thermal systems as well as homogeneous and non-homogeneous systems were involved in these bursts. Using the history of these bursts together with a study of the proposed critical mass work as a basis, a burst of 3×10^{17} fissions is set as the maximum expected. For design purposes it is recommended that a much more conservative value of 10^{18} fissions be used for determining radiation limits. (auth)

7657 LAMS-2293
Los Alamos Scientific Lab., N. Mex.
NUCLEAR-CRITICAL ACCIDENT AT THE LOS ALAMOS SCIENTIFIC LABORATORY ON DECEMBER 30, 1958. H. C. Paxton, R. D. Baker, W. J. Maraman, and Roy Reider. Feb. 1959. 34p. Contract W-7405-eng-36. $0.50(OTS).

The nuclear-critical accident that occurred in the plutonium processing plant at the Los Alamos Scientific Laboratory on December 30, 1958, resulted from an unusual and complex set of circumstances. Reconstruction of the steps that preceded the accident and analysis of the materials involved give a reasonably specific picture of the conditions at the time of the radiation burst. (auth)

ACCIDENTAL RADIATION EXCURSION AT THE OAK RIDGE Y-12 PLANT. I. DESCRIPTION AND PHYSICS OF THE ACCIDENT. Dixon Callihan and Joseph T. Thomas (Oak Ridge National Lab., Tenn.). Health Phys. 1, 363-72(1959) Mar.

An aqueous solution of enriched uranium inadvertently flowed into a 55 gal drum in a process area in Oak Ridge in June 1958, establishing a prompt-critical neutron chain reaction in which about 10^{18} fissions occurred before the system finally became subcritical by the addition of water. The solution contained about 2.5 kg of U^{235}. Records of the radiation field show the power excursion to have continued about 20 min during which the reaction oscillated a number of times. This paper describes the accident and presents a reactor-physics analysis yielding reactivities in an unperturbed system as great as 1.3 per cent which were above zero for a time consistent with observations. A plausible sequence of events during the excursion is enumerated. The emergency and health physics procedures and the medical observations of exposed personnel will be given in subsequent papers of this series. (auth)

2021 LA-1289
Los Alamos Scientific Lab., N. Mex.
A STUDY OF AN ACCIDENTAL RADIATION BURST.
R. W. Paine, Jr., R. S. Dike, J. D. Orndoff, and D. P. Wood. Mar. 20, 1951. Decl. Mar. 26, 1957. 33p. Contract W-7405-eng-36. $6.30(ph OTS); $3.00(mf OTS).

An accidental burst of radiation occurred at the laboratory on 1 February 1951 during remote control operation of a critical experiment. There was no personnel hazard. Normal operations were resumed within 24 hr, and the active material involved in the burst returned to service within three weeks. An unforeseen brief excursion into the prompt critical region was engendered in the act of scramming the assembly at the end of a series of measurements. This report describes the effects of the burst and analyzes the probable causes in some detail. (W.L.H.)

SHIPPING AND HANDLING OF RADIOACTIVE MATERIALS 4.02

HISTORY (INCIDENTS) 4.02.04

EXPLOSIONS 4.02.04.02

TNX EVAPORATION INCIDENT JANUARY 12, 1953. Interim Technical Report. T. J. Colven, Jr., G. M. Nichols, and T. H. Siddall. May 15, 1953. Decl. Feb. 16, 1957. 35p. (DP-25)

The circumstances are described pertaining to an explosion in a TNX evaporator during the concentration of a $UO_2(NO_3)_2-HNO_3$ solution. TBP and Amsco diluent were probably present in the evaporator charge. A laboratory program involving small-scale atmospheric and closed-vessel distillations of various mixtures of UNH, HNO_3, Amsco, TBP, and water indicate that an exothermic reaction between TBP and UNH, or between TBP and HNO_3, or both, was responsible for the explosion. The danger areas of temperature, TBP concentration, pressure, and heating rate are defined and recommendations are made for safe evaporator operation.

7727 BNL-3641
Brookhaven National Lab., Upton, N. Y.
SOME SAFETY RECOMMENDATIONS PERTINENT TO HOT LABORATORIES. L. C. Stang, Jr. [Mar. 1958]. 14p. Contract [AT-30-2-GEN-16]. $3.30(ph OTS); $2.40(mf OTS).

Presented at the Sixth Conference on Hot Laboratories and Equipment, Chicago, March 1958.

The explosions that occurred at the Brookhaven National Laboratory on May 15, 1957, are described. A detailed description is given of the behavior of the personnel during and following the explosion. An outline of the safety devices employed in the plant prior to the explosion, their location, and additional safety devices that were placed in the plant after the accident is given in detail. (W.L.H.)

15238 TID-7569(p.44-53)
General Electric Co. Hanford Atomic Products Operation, Richland, Wash.
SEPARATIONS PLANT SILVER REACTOR INCIDENT. E. R. Irish. p.44-53 [of] PROCEEDINGS OF THE 1958 ATOMIC ENERGY COMMISSION AND CONTRACTOR SAFETY AND FIRE PROTECTION CONFERENCE, HELD AT ATOMIC ENERGY COMMISSION HEADQUARTERS BUILDING, GERMANTOWN, MARYLAND, JUNE 24-25, 1958. 10p. (HW-57048).

A description of the dissolver cell equipment in the Purex Plant is given. Some of the chemical reactions occurring in the silver reactor are given. The operating experience of the silver reactor that exploded is traced. A detailed description is presented of the incident. (W.L.H.)

10184 CF-54-6-248
Oak Ridge National Lab., Tenn.
[ATTACHED RÉSUME OF "INCIDENTS."] E. G. Bohlmann. June 29, 1954. 1p. $1.80(ph OTS); $1.80(mf OTS).

With this is bound, with separate paging: Mathieson Chemical Corp., Baltimore. CA-96—TITANIUM IN NITRIC ACID: "EXPLOSIONS." B. J. Philibert. Apr. 7, 1954. 3p.

A brief review is given of reports available on explosions caused by the reaction of Ti in HNO_3. (J.E.D.)

1287 BNL-470
Brookhaven National Lab., Upton, N. Y.
ACCIDENT IN CONTINUOUS-DISSOLVER PILOT PLANT OF FLUORIDE VOLATILITY PROJECT ON MAY 15, 1957. Gerald Strickland, F. L. Horn, Richard Johnson, and O. E. Dwyer. July 10, 1957. Revised Aug. 20, 1957. 44p. $9.30(ph OTS); $3.60(mf OTS).

A series of explosions, estimated at five, occurred over a period of ten seconds within the continuous dissolver pilot plant, of the Fluoride Volatility Project on May 15, 1957. The explosive reactions occurred in the dissolver vessels as a result of violent chemical reactions between uranium and an interhalogen mixture. Just what the conditions were which triggered the explosions, ~~have~~ not been definitely established. Nevertheless, based upon the evidence which has been collected, several possible explanations, listed according to probability, are presented. A number of recommendations are included to be followed before operation of the pilot plant is resumed. These recommendations relate to additional laboratory research, equipment design, facility design, and use of a review committee. Safety rules for handling BrF_3, BrF_5, ClF_3, and Br_2 are appended. (C.H.)

SHIPPING AND HANDLING OF RADIOACTIVE MATERIALS 4.02

HISTORY (INCIDENTS) 4.02.04

RADIOACTIVITY RELEASES 4.02.04.03

M. W. KELLOGG CO. RADIATION INCIDENT ON MARCH 13, 1957. Nucleonics 15, No. 12, 42-3(1957) Dec.

This statement by the General Manager of the AEC concerns the background and facts relating to an incident involving the uncontrolled release of radioactive Ir^{192} at the South Houston plant of the Nuclear Products Div. of the M. W. Kellogg Co. in March 1957. (L.T.W.)

2266 ✓ WASH-1023(p.46-58)
Oak Ridge National Lab., Tenn. and Union Carbide Nuclear Co. Y-12 Plant, Oak Ridge, Tenn.
AN INHALATION EXPOSURE TO U_3O_8. R. R. Fish and G. R. Patterson, Jr. 13p.

An industrial worker accidentally received an inhalation exposure to enriched uranium fume during October 1957. This case has been studied by several methods in an effort to estimate the magnitude of the lung burden. A description of the accident illustrates the difficulty in detecting this type of exposure through the use of air sampling alone. Samples of urine were analyzed fluorometrically and by two different electrodeposition procedures. Blood samples and specimens of feces were analyzed also to aid in estimating the inhaled dose. Five separate estimates of the initial lung burden, based upon the bioassay data and in vivo counting, agree that the dose was in the range 1 to 10 mg, and was probably close to 4 mg. (auth)

11708 AECU-4089
Union Carbide Nuclear Co. Y-12 Plant, Oak Ridge, Tenn.
A URANIUM INHALATION EXPOSURE CASE HISTORY. [nd]. 4p. $1.80(ph), $1.80(mf) OTS.

Condensed version of Y-B94-54.

A machinist in a U shop was found to have inhaled dust from his work. The exposure resulted from the worker's keeping his face close to the work thereby interfering with the exhaust provided. Also, at some time during the period some cleansing tissues were drawn into the exhaust duct and lodged there. An initial lung burden of 3 to 5 mg was found with no evidence of kidney loading. Excretion was primarily in the urine, 2.33 mg being detected in urinalyses for 2.54 mg being eliminated from the deposit. The employee suffered no deleterious effects, felt well, and had no complaints. (T.R.H.)

5504 ✓ UCRL-8919
California. Univ., Berkeley. Lawrence Radiation Lab.
HIGH-LEVEL SPILL AT THE HILAC. Nelson B. Garden and Carroll Dailey. Sept. 24, 1959. 40p. Contract W-7405-eng-48. OTS.

On July 3, 1959, an incident occurred in the Hilac Building when the turning of the wrong valve resulted in pressurizing a helium cooling box, with a resultant blowout of a thin foil. The burst of He gas disintegrated experimental foils made up with 10^{11} dpm of Cm^{244}. The resultant activity was quickly dispersed as airborne particulates throughout the building. The 27 people in the building were evacuated within 10 minutes under surveillance of the Health Chemistry personnel; wherever clothing proved to be contaminated it was removed, and in cases where nose swipes were pertinent they were taken. Although an assumption of a combination of the worst conditions could conceivably have resulted in 1 man's inhaling between 2 and 4 times the calculated allowable inhalation for short bursts, evaluation from air analysis and medical tests indicate that it is unlikely that anyone actually did receive this amount. The building was closed during decontamination procedures, which required about 30 people for 3 weeks in direct decontamination work and 30 people for 3 weeks in indirect work. The cost of labor, material, and other charges related to the spill amounted to about $30,500 without overhead; equipment loss was held to less than $2000. The lost time of operation of the Hilac has been evaluated at $26,000, so that the total loss from the incident amounts to roughly $58,500. The primary cause of the accident was determined to be an error by the experimenter. Steps were taken to help insure against any recurrence of an uncontained radiation spill at the Hilac, and to decrease the danger of exposure to personnel in the event that a spill should occur in the future. (auth)

SURVEYS 4.02.04.04

RADIATION EXPOSURE AND SAFETY EXPERIENCE IN RADIOCHEMICAL PLANTS. G. S. Sadowski, T. W. Hungerford, R. E. Blanco, and F. L. Culler. May 1, 1957. p.1022-36 of SYMPOSIUM ON THE REPROCESSING OF IRRADIATED FUELS, HELD AT BRUSSELS, BELGIUM, MAY 20-25, 1957. BOOK III. (TID-7534)

A general comparison of the accident experience of the AEC and chemical industries in the United States is given. Other information includes maximum permissible exposure limits, radiation exposure experience in radiochemical separation plants, and whole body irradiation experience.

SHIPPING AND HANDLING OF RADIOACTIVE MATERIALS 4.02

HISTORY (INCIDENTS) 4.02.04

SURVEYS 4.02.04.04

6684 A/CONF.15/P/302
RADIATION EXPOSURE EXPERIENCE IN THE U.K. ATOMIC ENERGY AUTHORITY IN 1957. H. J. Dunster and A. S. McLean (United Kingdom Atomic Energy Authority, Risley, Lancs, Eng.), and W. G. Marley (Atomic Energy Research Establishment, Harwell, Berks, Eng.). 11p.

Radiation exposure data for the Industrial and Research Groups during 1957 are summarized. Data are compared with that from previous years, and a decrease in average exposure is noted. (C.H.)

7093 TID-5360(Suppl.)
Division of Organization and Personnel. Safety and Fire Protection Branch, AEC.
A SUMMARY OF INCIDENTS INVOLVING RADIOACTIVE MATERIAL IN ATOMIC ENERGY ACTIVITIES, JANUARY–DECEMBER 1956. Daniel F. Hayes. Aug. 1957. 28p. $1.00(OTS).

Pertinent details of the incidents are given. Some are illustrated with photographs or diagrams. (M.H.R.)

9967 TID-5360
Division of Organization and Personnel. Safety and Fire Protection Branch, AEC.
A SUMMARY OF ACCIDENTS AND INCIDENTS INVOLVING RADIATION IN ATOMIC ENERGY ACTIVITIES, JUNE 1945 THROUGH DECEMBER 1955. Daniel F. Hayes. Aug. 1956. 79p. $0.45(OTS).

Criticality incidents, reactor incidents, contamination incidents, fires and explosions involving radioactive material, and miscellaneous accidents involving radiation which occurred from June 1945 through Dec. 1955 are described. Safety measures resulting from review of the accidents are included. (C.H.)

14522 A/CONF.15/P/741
General Electric Co., Schenectady, N. Y.
RADIATION PROTECTION IN THE INDUSTRIAL USE OF RADIATION. W. A. McAdams. 8p. $0.50(OTS).

Prepared for the Second U. N. International Conference on the Peaceful Uses of Atomic Energy, 1958.

During the last few years the use of radiation and radioactive materials by American industry has begun to play a vital role in the development and improvement of commercial products and in the simplification and control of manufacturing processes. This is evidenced by the increase in AEC licenses for the use of reactor by-product materials, and also by the increase in the industrial use of x-ray equipment, particle accelerators, and radioactive materials not under AEC control. This increase in radiation work can have a serious effect on the health and safety of both the workers and the general public, if proper radiation practices are not observed. To illustrate how industry has learned to deal effectively with the hazards of radiation, both on a large and small scale, the radiation protection programs of the General Electric Company are described. General Electric has had a long experience in radiation and atomic energy fields and more than 70 of its departments are now engaged in radiation work of one kind or another. Since the Company is a highly diversified and decentralized organization, the radiation protection programs of the various branches are quite varied. Although the majority of radiation workers in General Electric are employed at AEC facilities, this paper gives most of its attention to other radiation work, including the manufacture of x-ray equipment; the production of electron tubes, starter switches, luminescent timepieces and other products containing radioactive materials; radiographic testing; activation analyses; production gaging and control; and radiation studies on the physical and chemical properties of materials. Radiation exposure records are summarized, monitoring and control procedures are described, and unique protection problems are analyzed. Special design techniques used for the protection of customers and the general public are also discussed. One section of the report deals with the radiation hazards of manufactured equipment, such as projection TV apparatus, and high power electronic devices. (auth)

14526 A/CONF.15/P/758
General Electric Co. Hanford Atomic Products Operation, Richland, Wash.
RADIATION PROTECTION RECORDS AT A MAJOR ATOMIC ENERGY FACILITY. A. R. Keene, J. W. Vanderbeek, and E. C. Watson. 9p. $0.50(OTS).

SHIPPING AND HANDLING OF RADIOACTIVE MATERIALS 4.02

HISTORY (INCIDENTS) 4.02.04

SURVEYS 4.02.04.04

Prepared for the Second U. N. International Conference on the Peaceful Uses of Atomic Energy, 1958.

A system is described whereby the radiological exposure status of some 9,000 individuals and their environment is determined, evaluated, and recorded. The facility involved has a full spectrum of atomic energy activities. Included are the fabrication of radioactive fuel elements, the utilizing of these fuel elements in several water cooled reactors, the processing of the fuel after irradiation, plus the many supporting activities such as radiation laboratories, Van de Graaff generators, x ray machines, and waste disposal. The radiological controls and records of these work locations, (particularly the Radiation Zones) is detailed. (auth)

ADMINISTRATIVE EXPERIENCE WITH OCCUPATIONAL OVEREXPOSURE TO RADIATION. Morris Kleinfeld and A. P. Abrahams (New York Dept. of Labor, New York). Am. Ind. Hyg. Assoc. J. 20, 294-8(1959) Aug.

Nineteen instances of radiation overexposure in excess of the limits prescribed by Industrial Code Rule 38 have been reported to the New York State Department of Labor since December, 1955. In eight instances, the reported excessive readings were found to be invalid and may be ascribed, on the whole, to faulty dosimetry technique. There were eleven instances of actual overexposure; four were chronic in nature, four were acute external overexposures, and three were acute internal overexposures. The acute overexposures resulted from accidents; the chronic overexposures were associated with routine everyday operations. Ten employees showed positive biological effects such as radiation burns and/or abnormal retention of radioactive material. Injury to the hands was the effect most frequently observed among the chronically as well as the acutely exposed. These accounted for seven of the ten reported instances. The causal factors most frequently involved in the overexposures were lack of supervision, lack of awareness of the hazard, and failure to provide or maintain appropriate protective devices. In general, the data indicate that the incidence of radiation overexposure (1.4 per cent) and injury (0.3 per cent) in New York State is extremely low when compared to other major industrial hazards. (auth)

12314 ORNL-2102
Oak Ridge National Lab., Tenn.
ANALYSIS OF THOREX PILOT PLANT RADIATION EXPOSURES DURING 1955. W. T. McCarley. Nov. 16, 1956. Decl. Mar. 2, 1957. 69p. Contract W-7405-eng-26. $0.55(OTS).

An analysis of radiation exposure received by Thorex pilot plant personnel during 1955 is given. The analysis reveals where and why the radiation was received and what shielding, modification, or technique could be used to reduce the 60 mrep man-week average. The information should be useful in new plant design. (T.R.H.)

13568 CF-56-10-88
Oak Ridge National Lab., Tenn.
PERSONNEL RADIATION EXPOSURES IN THE THOREX PILOT PLANT. PAPER PRESENTED AT CHEMICAL TECHNOLOGY DIVISION INFORMATION MEETING, OCTOBER 11-12, 1956. G. S. Sadowski. Oct. 19, 1956. Decl. Mar. 13, 1957. 8p. Contract [W-7406-eng-26]. $1.80(ph OTS); $1.80(mf OTS).

Radiation dosages received by operating personnel during 21 months of Thorex Pilot Plant operation are tabulated. Lower exposures may be obtained by extensive use of remote-operation equipment and additional shielding. (C.W.H.)

1188 AECD-3714
National Lead Co. of Ohio, Cincinnati.
INDUSTRIAL HYGIENE SURVEY OF THORIUM ROLLING AT SIMONDS SAW AND STEEL COMPANY. Charles E. Schumann. Dec. 14, 1953. Decl. with deletions Dec. 9, 1955. 18p. Contract AT(30-1)-1156.

Personnel exposures to the radioactive dust from a thorium rolling operation are tabulated. (B.J.H.)

8629
THE EXPERIENCE OF DOSIMETRIC CONTROL AND DISPENSARY REGISTRATION OF WORKERS OF THE LABORATORY OF NUCLEAR PROBLEMS OF THE UNITED INSTITUTE OF NUCLEAR RESEARCH. V. P. Afanasev,

SHIPPING AND HANDLING OF RADIOACTIVE MATERIALS 4.02

HISTORY (INCIDENTS) 4.02.04

SURVEYS 4.02.04.04

V. A. Golovina, M. M. Komochkov, V. N. Mekhedov, K. O. Oganesyan, V. E. Rozhkov, A. M. Rozanova, and M. N. Fateeva. Med. Radiol. 5, No. 1, 6-18(1960) Jan. (In Russian)

Data on dosimetric control of personnel working on a synchrocyclotron during a period of operation of eight years are analyzed. (auth)

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See also, under SURVEYS (GENERAL),
INTERNATIONAL CO-OPERATION (7.06),
and,
under WASTE TREATMENT AND DISPOSAL,
LAND, DISPOSAL ON--General (8.03.04.01),
LIQUID WASTES--General (8.03.05.01),
WATER, DISPOSAL IN--General (8.03.06.02).

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6704 A/CONF.15/P/2425
INTERNATIONAL ASPECTS OF RADIOACTIVE CONTAMINATION IN WESTERN EUROPE AND THE NECESSITY OF INTERNATIONAL CONTROL ARISING FROM IT. (Royal Netherlands Academy of Sciences.) 6p.

The need for international regulations governing the handling of radioactive materials is discussed. The problem is especially urgent for western Europe because, in addition to great industrial activity and dense population, the area is composed of a number of sovereign states. (C.H.)

6691 ✓ A/CONF.15/P/1138
DONNEES DE LA SURVEILLANCE ET REGLES QUI EN RESULTENT EN WATIERE DE PROTECTION CONTRE LES RAYONNEMENTS. (Regulations Concerning Radiation Protection and Survey). Duhamel, Lavie, and [L.] Fitoussi (Commissariat à l'Énergie Atomique, Paris). 74p.

A comparative study of the radiation hazards to which the people working in installations of the Commissariat à l'Énergie Atomique are exposed was made and the results reported. The few contamination and irradiation incidents were discussed. Contaminating sources are classified according to the recommendations of the International Commission on Radiologic Protection. The dangers of irradiated elements are discussed. The controls and regulations used for radiation protection are described. (J.S.R.)

6333 ✓ A/CONF.15/P/2510
LA MEDECINE INDUSTRIELLE DANS LE CENTRE D'ETUDE DE L'ENERGIE NUCLEAIRE DE MOL. (Industrial Medicine in the Nuclear Energy Study Center at Mol.) M. H. Faes (Centre d'Etude de l'Energie Nucléaire, Brussels). 13p.

The aim of an industrial medical service is to maintain the health of the personnel in normal conditions and to treat personnel in the case of accidents or illnesses caused by the work. The first objective of a medical service is one of control, in which a thorough clinical, radiological, and laboratory examination is given to all prospective employees. This examination is described in detail. The discovery of professional illnesses is as fully described. The legal safeguards for a person accidentally exposed to radiation are discussed.

1317 ✓
UNITED KINGDOM REGULATIONS COVERING SAFETY IN THE USE OF RADIATION SOURCES. S. Smith (H. M. Factory Inspectorate, London). Intern. J. Appl. Radiation and Isotopes 6, 269-73(1959) Oct.

Regulations concerning the use of radiation sources in the United Kingdom are reviewed. (C.H.)

16139
RADIATION PROTECTION. R. Jaeger. Atomwirtschaft 3, 314-16(1958) Aug.-Sept. (In German)

In the German Federal Republic there is still no federal statute controlling radiation protection, although the government has drafted instructions and guidance manuals. (J.S.R.)

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16082
THE DEVELOPMENT OF ATOMIC LAW. H. Fischerhof. Atomwirtschaft 3, 329-30(1958) Aug.-Sept. (In German)
Since a uniform federal statute has not been passed in the German Federal Republic, the development of atomic law has centered around the formation of the Federal Ministry for Atomic Affairs, appeal to the German Commission, and the enactment of temporary laws in several of the states. (J.S.R.)

11263
OCCUPATIONAL RADIATION PROTECTION: AN ETHICAL AND TECHNICAL PROBLEM. S. Balke. Atomwirtschaft 3, 189-91(1958) May. (In German)
The protection of the working man against ionizing radiations is not only a technical but also an ethical problem, because the anxiety of mankind would be greatly increased by thoughtlessness in this field. The principle to adapt safety measures to the greatest sources of danger will require considerable economic expense. All measures of occupational protection must be regarded as part of the manufacturing process and must be put on an equal footing with other technical and economical production factors. They must be separated from the whole volume of social measures which are intended to serve quite different objectives. (auth)

12906
NUCLEAR ENERGY: BIBLIOGRAPHY, 1946-1958. Nos. 13, 14. Luxemburg, Communaute Européenne du Charbon et de L'Acier, Haute Autorité, 1958. (In English, French, or German)
A bibliography on the problem of nuclear energy covering the years 1947 to March 1958 is presented. After the listing of some publications on some general aspects, the largest part is devoted to articles on the peaceful applications of nuclear energy in the different countries of the world. Separate sections are also devoted to the social, political, and legal aspects. International agreements and industrial applications both have a section. Articles concerned with the various organizations for the development of nuclear energy such as C.E.R.N. are listed in the last sections. (J.S.R.)

5132
THE ATOMIC RESEARCH CENTER-KARLSRUHE. Administrative Law Questions. E. Ziegler. Atomwirtschaft 2, 443-4(1957) Dec. (In German)

15247 CEA-tr-A-565
PROBLÈMES POSÉS PAR LA PROTECTION CONTRE LES RAYONNEMENTS DANS L'UTILISATION PACIFIQUE DE L'ÉNERGIE ATOMIQUE. (Problems Caused by Protection Against Radiation in the Peaceful Uses of Atomic Energy.) Robert G. Jaeger. Translated into French from Z. angew. Phys. 9, 467-8 (1957). 53p.
A review is presented of the problems posed by protection against radiation in the peaceful utilization of atomic energy. The establishment of admissible doses and units, limits of the admissible radiation level, particular problems caused by the exploitation of reactors, and the elimination of radioactive wastes are considered. An appendix lists recommendations, regulations, instructions, decrees, and laws relative to protection against radiation. 55 references. (J.S.R.)

STATUTE OF THE EUROPEAN NUCLEAR ENERGY AGENCY. CONVENTION ON THE ESTABLISHMENT OF A SECURITY CONTROL IN THE FIELD OF NUCLEAR ENERGY AND ANNEXED PROTOCOL ON THE TRIBUNAL ESTABLISHED BY THE SAID CONVENTION. CONVENTION ON THE CONSTITUTION OF THE EUROPEAN COMPANY FOR THE CHEMICAL PROCESSING OF IRRADIATED FUELS. Paris, Organisation for European Economic Co-Operation, 1957. 85p. (In French and English)

2775
MANAGEMENT, ECONOMICS AND TECHNOLOGY FOR THE ATOMIC INDUSTRY. Vol. I: MANAGEMENT AND INTERNATIONAL AFFAIRS. Vol. II: ECONOMICS AND TECHNOLOGY. William J. Smith, ed. New York, The Atomic Industrial Forum, Inc., 1956. Vol. I 282p., Vol. II 308p. $5.00 per Vol.
Problems relating to atomic energy in law, manpower needs and information needs in private industry are dis-

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cussed. Atomic energy programs in Japan, Netherlands, Switzerland, France, Sweden, and Germany are summarized. New power reactor concepts in liquid metal, organic moderated, gas turbine and sodium deuterium are reviewed. New reactor projects are explained and their costs are evaluated. Progress in reactor materials, reactor safety, research programs, and radiation utilization is reported. (F.S.)

56

PROCEEDINGS OF THE INTERNATIONAL CONFERENCE ON THE PEACEFUL USES OF ATOMIC ENERGY, HELD IN GENEVA, AUGUST 8-20, 1955. VOLUME 13. LEGAL, ADMINISTRATIVE, HEALTH AND SAFETY ASPECTS OF LARGE-SCALE USE OF NUCLEAR ENERGY. New York, United Nations, 1956. 393p. $7.00.

7651

THE NEW RULES FOR TRANSPORTING RADIOACTIVE MATERIALS. A. Shtan and N. Leshchinskiĭ. Atomnaya Energ. 7, 399(1959) Oct. (In Russian)

The new regulations and instructions of the USSR Atomic Energy Administration for handling and transporting radioactive materials are described. (R.V.J.)

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3714

SELECTED MATERIALS ON FEDERAL-STATE COOPERATION IN THE ATOMIC ENERGY FIELD. JOINT COMMITTEE ON ATOMIC ENERGY, CONGRESS OF THE UNITED STATES, MARCH 1959. Washington, D. C., Joint Committee on Atomic Energy, 1959. 526p. (GPO)

Excerpts from the Atomic Energy Act of 1954, and proposed amendments to this act are given. Reports are contained which summarize the activities of Federal, State, local agencies, and certain nongovernmental organizations in the field of atomic energy relative to regulation of radiation hazards and the Federal and State responsibilities for radiation protection. Articles, legal analyses, and a bibliography on Federal-State cooperation in atomic energy are included. (C.J.G.)

23015

STATUTORY RESPONSIBILITIES OF THE ICC WHICH PERTAIN TO THE TRANSPORTATION OF RADIOACTIVE WASTE MATERIALS. Kenneth H. Tuggle (Interstate Commerce Commission, Washington, D.C.). p.2646-54 of "Hearings on Industrial Radioactive Waste Disposal. Volume 4."

Under Federal statutes known as the Transportation of Explosives Act and section 204 of the Interstate Commerce Act, the Commission has prescribed regulations governing the safe transportation of radioactive materials in interstate commerce. The regulations are applicable to rail and motor carriers and to shippers using those service and the services of water carriers. (C.J.G.)

11765

REPORT TO THE SURGEON GENERAL, U. S. PUBLIC HEALTH SERVICE ON THE CONTROL OF RADIATION HAZARDS IN THE UNITED STATES. The National Advisory Committee on Radiation, 1959. 22p.

The conclusions reached by the National Advisory Committee on Radiation of the Surgeon General's Office, U. S. Public Health Service, are presented. The trends in dose received by the population, potential increase in dose received, and the downward trend of maximum permissible limits are cited and a radiation control program outlined. State versus Federal regulation is discussed. The need for individuals trained in radiation control methods is pointed out. Specific recommendations made are: primary responsibility for radiation control should be vested in a single federal agency; the agency should be authorized to do broad planning and develop a comprehensive program for all radiation sources. (T.R.H.)

21071

FEDERAL-STATE RELATIONSHIPS IN THE ATOMIC ENERGY FIELD. HEARINGS BEFORE THE JOINT COMMITTEE ON ATOMIC ENERGY, CONGRESS OF THE UNITED STATES, EIGHTY-SIXTH CONGRESS, FIRST SESSION ON FEDERAL-STATE RELATIONSHIPS IN THE ATOMIC ENERGY FIELD, MAY 19, 20, 21, 22, AND AUGUST 26, 1959. Washington D. C., Joint Committee on Atomic Energy, 1959. 509p. (GPO).

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Federal-state relationships are discussed relative to radiation protection standards, medical use of radioisotopes, transportation of nuclear materials, and waste disposal processes involving reactors and the uranium mining and milling industry. Legislation regarding the prevention of major disasters in mines is given. (C.T.G.)

23011
STATEMENT OF DAVID E. PRICE, M.D., CHIEF, BUREAU OF STATE SERVICES, U. S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE. p.2522-31 of "Hearings on Industrial Radioactive Waste Disposal. Volume 4."
Public health standards and laws governing these standards for the protection of the public from industrial radioactive waste disposal are discussed. (C.J.G.)

THE PRDC CASE. James L. Morrisson (Ginsburg, Leventhal, Brown and Morrisson, Washington, D. C.) and B. John Garrick (Holmes and Narver, Inc., Los Angeles). Nucleonics 17, No. 7, 60-3(1959) July.
Litigation of the PRDC case is reviewed. A construction permit for the PRDC Reactor was requested by the Power Reactor Development Company. A provisional construction permit was issued by AEC. Three labor unions filed petitions to intervene in the licensing proceeding and requested a hearing. The hearing demonstrated that reactor safety issues can be handled by traditional administrative processes. (A.C.)

6446 WCAP-6037
Westinghouse Electric Corp. Atomic Power Dept., Pittsburgh.
NUCLEAR MATERIALS CONTROL SYSTEM (NMCS). PHASE II. SUMMARY AND PROGRESS REPORT TO DECEMBER 31, 1959. Dec. 31, 1959. 91p. Contract AT(30-1)-2176. OTS.
Activities on a Nuclear Materials Control System are summarized. In June of 1959, the AEC undertook a critical re-evaluation of the over-all research and development needs of its safeguards program for source and special nuclear materials. This re-evaluation resulted in the termination of most work programs in the NMCR Project. Terminal reports on these programs have either been issued or are in preparation. Experimental work is continuing on a N^{16} monitor for measuring reactor power and coolant flow rate, and on the development of non-destructive assay techniques for reactor fuel elements. Chemistry and chemical engineering studies, nuclear studies, special devices, and security devices and techniques are discussed. (For preceding period see WCAP-6015.) (W.D.M.)

INTERPRETATION OF REGULATIONS GOVERNING THE SHIPMENT OF RADIOACTIVE MATERIAL. Carl W. Buckland, Jr. (Los Alamos Scientific Lab., N. Mex.). A.M.A. Arch. Ind. Health 19, 33-43(1959) Jan.
Regulations governing the shipment of radioactive material by common carrier within the United States are reviewed and interpreted. (C.H.)

1263 COO-212(Rev.)
Chicago Operations Office. Health and Safety Div., AEC.
HEALTH AND SAFETY CONSIDERATIONS FOR URANIUM FUEL FABRICATION FACILITIES. William A. Brobst. Aug. 1, 1958. 54p.
With the advent of the reactor power program, a large number of firms are becoming involved in the manufacture of reactor fuel elements. This publication has been prepared to insure that these firms are aware of the health and safety problems involved and to offer some solutions to these problems. The manual presents situations to be considered, lists pitfalls to be avoided, and states the minimum standards of the Chicago Operations Office regarding the handling of uranium. (auth)

LABELING OF MANUFACTURED PRODUCTS CONTAINING RADIOACTIVE MATERIALS. W. A. McAdams (General Electric Co., Schenectady, N. Y.). Am. Ind. Hyg. Assoc. J. 19, 26-30(1958) Feb.
Radioactive materials are now being used in a variety of commercial products which are readily available to both industry and the general public. Some of these products

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contain quantities of radioactive materials which can be hazardous to unsuspecting customers or to those persons who handle the products in large numbers. It is necessary that each item containing a hazardous amount of radioactive material be conspicuously marked with the conventional radiation symbol. It is equally important that such marking not be used on items which do not present a radiation hazard. Various radiation protection codes and standards now in effect or under development contain special provisions for labeling such products but these

2573 TID-7537(Pt. 1)
Division of Nuclear Materials Management, AEC and New York Operations Office, AEC.
CONTROL OVER SOURCE AND SPECIAL NUCLEAR MATERIAL. A Symposium Held at New York, March 5-7, 1957. 107p. $3.00(OTS).
Topics discussed include: AEC pricing policy and billing procedures for radioactive source and nuclear materials; material control procedures used during the Experimental Breeder Reactor fuel fabrication; application of in-line instrumentation for process control of uranium processes; accountability policy, practice, and organization at Mallinckrodt Chemical Works; accountability records and meas-

4481
A.E.C. POLICY ON THORIUM. Allan M. Labowitz (U. S. Atomic Energy Commission, Washington). Metal Progress 71, No. 2, 108(1957) Feb.

HANDBOOK OF FEDERAL REGULATIONS APPLYING TO TRANSPORTATION OF RADIOACTIVE MATERIALS. Washington, United States Atomic Energy Commission, 1955. 52p. Available for $0.25 from U. S. Government Printing Office, Washington.
Regulations are summarized which govern the transportation of radioactive materials within the United States. (C.H.)

ATOMIC ENERGY AND CONGRESS. Morgan Thomas, in collaboration with Robert M. Northrop. Ann Arbor, University of Michigan Press, 1956. 301 p. $4.75.
Researchers from the Institute of Public Administration at the University of Michigan interviewed government officials and congressmen concerned with atomic energy matters. This data, in addition to the usual documentary material, is the basis for a review of the political aspects of atomic energy in the United States.

GOVERNMENT CONTRACTING IN ATOMIC ENERGY. Richard A. Tybout. Ann Arbor, University of Michigan Press, 1956. 226 p. $4.50.
A thorough study of the relationship between public ownership and private operation in the atomic energy industry, with conclusions applicable to defense contracting in general.

THE NEW ATOMIC ENERGY LAW—WHAT IT MEANS TO INDUSTRY. Atomic Industrial Forum. New York, 1954. 181 p. $5.
Proceedings of a meeting for members and guests of the Atomic Industrial Forum, Inc., held September 27–28, 1954, New York. Contains 21 papers. Main topics considered are: The new law interpreted; investment problems and opportunities in atomic energy; what industry sees ahead; the new industry-government partnership; government implementation of the new law; the labor outlook; and insurance problems of the atomic industry.

ATOMIC ENERGY LAW REPORTS. Commerce Clearing House, Inc., 214 N. Michigan Ave., Chicago 1, Ill. Yearly subscription, $240.
A loose-leaf service, arranged by subject, covering statutes, regulations, decisions, and rulings, news, and developments.

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21824
ATOMIC ENERGY PATENTS. HEARINGS BEFORE THE SUBCOMMITTEE ON LEGISLATION OF THE JOINT COMMITTEE ON ATOMIC ENERGY, CONGRESS OF THE UNITED STATES, EIGHTY-SIXTH CONGRESS, FIRST SESSION ON ATOMIC ENERGY PATENTS, APRIL 21, 22, AND 23, 1959. Washington, D.C., Joint Committee on Atomic Energy, 1959. 233p. GPO.

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Details of hearings by the Subcommittee on Legislation concerning atomic energy patents are presented. Testimony by Atomic Energy Commission personnel is given as well as that given by Dept. of Commerce personnel and other witnesses. Additional material supplied for the record is included. (J.R.D.)

Radioactive Waste Problems Facing State Governments, E.C. Jensen, E.F. Eldridge, C.M. Everts, Jr., H.C. Clarke. Sewage and Indus Wastes 29, 6 June 1957, p 687-94.

Discussion of responsibilities and actions States should take in view of ever increasing danger of radiation due to growing use of radioactive materials; attitude of various States outlined.

492

REGULATING IONIZING RADIATION. Electronics 32, No. 44, 22-3(1959) Oct. 30.

Legislation governing ionizing radiation in New York State is discussed. The public safety program of Westchester County, New York, in relation to ionizing radiation is described. The results of a survey on faults with medical-dental x-ray equipment are presented. (C.J.G.)

THE CONTROL OF RADIATION HAZARDS IN INDUSTRY, 1957. New York State Department of Labor, 1957. 127p.

A compilation is given of the material presented at the first state Radiological Health Conference in Buffalo, Jan. 1956. The chapters are entitled: Fundamentals of Radiation Science; Biological Effects of Ionizing Radiation; Radiation in Industry; Principles of Radiation Hazard Control; Instruments for Detection and Measurement of Radiation; Specific Installations and Operations; Surveying Methods and Procedures; and Regulation of Radiation Hazards in New York State. (T.R.H.)

14868

CONTROL OF RADIOACTIVE LIQUID WASTES IN PENNSYLVANIA. Karl M. Mason. Public Health Repts. U. S. 73, 895-7(1958) Oct.

Public health authorities in Pennsylvania are administering a program of radioactive liquid waste control in the following manner: (1) Radioactive liquid wastes have been classified as industrial wastes and thus are subject to a permit from the Sanitary Water Board. (2) Since the treatment processes employed at such installations have not been subject to full-scale operation experience, the permits are granted on an experimental basis. (3) For the purpose of insuring protection of the public health and the retention of stream volumes for future discharges, the levels of radioactivity in liquid wastes must conform to more stringent standards than those generally accepted. (4) The conditions of the permit, including the maximum allowable concentrations, are subject to revision if altered conditions or the advance of science and technology so indicate. (5) The discharge of radioactivity shall be kept at the most practicable minimum, regardless of maximum amounts permissible. (6) Adequate analyses and operational reports must be submitted to the department of health. (7) Environmental monitoring programs shall be continued and, if necessary, expanded. (8) Immediate notification of the department is required in the event of accident or discharge in excess of tolerance. (auth)

RADIATION INSTALLATION REGISTRATION LAW. AN ACT OF THE GENERAL ASSEMBLY OF ILLINOIS. C. W. Klassen (Dept. of Public Health, Springfield, Ill.). Non-Destructive Testing 15, 352-4(1957) Nov.-Dec.

The complete text of a new law in Illinois to require the registration of radiation installations is presented. Radiation installation is defined as any location or facility where radiation machines are used or where radioactive material is produced, transported, stored, disposed, or used for any purpose. The Act includes no measures for controlling or restricting the use of radiation machines or radioactive materials. (L.T.W.)

5712

STATE ACTIVITIES IN ATOMIC ENERGY, THIRD EDITION, FEBRUARY 1957. Saul J. Harris, ed. New York, Atomic Industrial Forum, Inc., 1957. 45p. $0.50.

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A summary of the activities of the states to foster and control industrial utilization and development of atomic energy is presented. (auth)

23020
PROBLEMS OF RADIOACTIVE WASTE DISPOSAL IN NEW MEXICO. S. J. Leland (New Mexico Dept. of Public Health). p.2784-8 of "Hearings on Industrial Radioactive Waste Disposal. Volume 4."

The experiences of the public health department of New Mexico in relation to radioactive waste discharge to the ground are described. (C.J.G.)

4222
EXPERIENCE WITH THE MASSACHUSETTS CODE ON IONIZING RADIATION. Harold Bavley and Robert L. Devlin (Massachusetts Dept. of Labor and Industries, Boston). Am. Ind. Hyg. Assoc. J. 20, 473-7(1959) Dec.

Rules and regulations for the protection of employees exposed to ionizing radiation were adopted by the Massachusetts Legislature in December, 1957. Experiences with the code over a two-year period are reviewed. (C.H.)

23013
THE RESPONSIBILITY OF STATES IN THE DISPOSAL OF INDUSTRIAL RADIOACTIVE WASTES. Hollis S. Ingraham (New York State Department of Health). p.2547-78 of "Hearings on Industrial Radioactive Waste Disposal. Volume 4."

The responsibility of the state in public health protection from industrial waste disposal is outlined. The program of the New York State Department of Health is specifically outlined. (C.J.G.)

23012
STATEMENT OF CLARENCE W. KLASSEN, CHIEF SANITARY ENGINEER, ILLINOIS DEPARTMENT OF PUBLIC HEALTH AND TECHNICAL SECRETARY, ILLINOIS SANITARY WATER BOARD. p.2538-44 of "Hearings on Industrial Radioactive Waste Disposal. Volume 4."

Industrial radioactive waste disposal experiences in relation to public health in Illinois are discussed relative to water, food, air, shelter, wastes, and the control of natural and man-made hazards. (C.J.G.)

23023
ACTIVITIES OF TEXAS AGENCIES IN REGULATING DISPOSAL OF RADIOACTIVE WASTE. Henry A. Holle (Texas State Dept. of Health, Austin). p.2815-55 of "Hearings on Industrial Radioactive Waste Disposal. Volume 4."

The majority of wastes enter the environment via the public sewer. Analysis of this practice indicates that the present amount of radioactivity in sewage creates no hazard. Surveys are being conducted to determine the current concentrations of radioactivity in milk, air, and surface waters. Regulations governing radiation exposure as applied to industrial personnel, waste disposal, and in medical work are discussed. (C.J.G.)

23022
PENNSYLVANIA'S ROLE IN REGULATING THE DISPOSAL OF RADIOACTIVE WASTES. Karl M. Mason (Pennsylvania Dept. of Health). p. 2794-2814 of "Hearings on Industrial Radioactive Waste Disposal. Volume 4."

A program for regulating liquid, gas, and solid radioactive waste disposal in Pennsylvania is described. A discussion is contained on the proposed amendment to the Atomic Energy Act of 1954, Section 274. (C.J.G.)

23021
STATE REGULATION OF RADIOACTIVE WASTES. Daniel E. Lynch (Ohio Dept. of Health). p.2789-93 of "Hearings on Industrial Radioactive Waste Disposal. Volume 4."

Waste disposal regulations in Ohio and the origin of various radioactive wastes in the state are enumerated. (C.J.G.)

23019
THE DISPOSAL OF RADIOACTIVE WASTES. LeRoy W. Van Kleeck. p.2781-3 of "Hearings on Industrial Radioactive Waste Disposal. Volume 4."

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State regulations governing waste disposal in Connecticut are given, and radiation protection measurements are discussed. (C.J.G.)

23018
STATEMENT OF CALIFORNIA STATE DEPARTMENT OF PUBLIC HEALTH. Malcolm H. Merrill. p.2681-2711 of "Hearings on Industrial Radioactive Waste Disposal. Volume 4."

State regulations governing the disposal of radioactive wastes are stated, and the program of the Public Health Department for continuously monitoring the atmosphere, rainfall, and surface waters is reviewed. Maximum permissible activities are tabulated. (D.E.B.)

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2639
EMPLOYEE RADIATION HAZARDS AND WORKMEN'S COMPENSATION. HEARINGS BEFORE THE SUBCOMMITTEE ON RESEARCH AND DEVELOPMENT OF THE JOINT COMMITTEE ON ATOMIC ENERGY, CONGRESS OF THE UNITED STATES, EIGHTY-SIXTH CONGRESS, FIRST SESSION ON EMPLOYEE RADIATION HAZARDS AND WORKMEN'S COMPENSATION, MARCH 10, 11, 12, 17, 18, AND 19, 1959. Washington, D. C., Joint Committee on Atomic Energy, 1959. 864p.

The subcommittee on Research and Development, Joint Committee on Atomic Energy, met on March 10, 1959 to continue hearings begun in 1956 on employee radiation hazards and workmen's compensation. Subjects covered included the general background of the broad problem of industrial radiation hazards; examples of experience at individual installations; current Federal, State, and private activities with regard to prevention of radiation accidents to employees; application of workmen's compensation laws to radiation injuries; and proposed changes in laws. (C.H.)

4164
INSURANCE AND LIABILITY QUESTIONS IN THE FIELD OF NUCLEAR ENERGY. H. Hagmaier and E. Pohl. Atom u. Strom 5, No. 5, 33-40(1959) May. (In German)

The German insurance business is presently disturbed at the risk to be taken and the applications to be made of atomic energy, in offering the necessary insurance protection. It is shown that, from the problematics of nuclear fission and especially from the problem of liability insurance with the late-injury danger entering in, it is unreasonable that the insurance management be asked for premium quotations for such installations, the technical structure of which is still undergoing alteration, and for which there is absolutely no experience with the protection of the plants available. (T.R.H.)

7178
FINAL REPORT. FINANCIAL PROTECTION AGAINST ATOMIC HAZARDS, WITH SPECIAL REFERENCE TO THE PROTECTION OF THIRD PARTIES. Tokyo, Japan Atomic Industrial Forum, Inc., 1959. 24p. $1.00.

The need of providing State indemnity as a means of financial protection against atomic hazards is stressed. Financial protection laws or bills of the United States, West Germany, Great Britian, and Switzerland are discussed. The status of a Japanese system of financial protection against atomic hazards is reviewed. (C.H.)

A RELATIONSHIP OF INDETERMINACY APPEARS TO RULE THE INSURING OF NUCLEAR RISKS. Théodore C. Pontzen. Inds. atomiques 3, No. 1-2, 92-6(1959). (In French)

The uncertainties involved in the insuring of nuclear risks are discussed. These include third party responsibility, the possible wide consequences of nuclear accidents, the time interval apt to elapse between exposure and effects, and the lack of uniformity in the national laws governing the use of radioactive materials and the safety features to be employed. (J.S.R.)

12336
A RELATIONSHIP OF INDETERMINACY APPEARS TO RULE THE INSURING OF NUCLEAR RISKS. Théodore C. Pontzen. Inds. atomiques 3, No. 1-2, 92-6(1959). (In French)

The uncertainties involved in the insuring of nuclear risks are discussed. These include third party responsibility, the possible wide consequences of nuclear accidents, the time interval apt to elapse between ex-

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posure and effects, and the lack of uniformity in the national laws governing the use of radioactive materials and the safety features to be employed. (J.S.R.)

COMPARATIVE STUDY OF ATOMIC LEGISLATION IN EUROPE. Paris, Organisation for European Economic Co-Operation, 1959. 112p.

A comparative study of legislation pertaining to the use, handling, security regulations, transport, health aspects, and patents of nuclear fuels and nuclear equipment is discussed in relation to various European countries. (C.J.G.)

11522

INTERNATIONAL PROBLEMS OF FINANCIAL PROTECTION AGAINST NUCLEAR RISK. New York, Atomic Industrial Forum, Inc., 1959. 99p. $6.00.

A summary of the chief legal elements of financial protection against nuclear risk is presented. In addition, the questions peculiar to the international nature of nuclear risk are considered as well as what appear to be the most promising solutions to the associated problems. Following these, detailed examination of the involved legal questions is conducted. (J.R.D.)

15234 TID-7569(p.16-19)

Atomic Energy Commission, Washington, D. C.
IMPLICATIONS OF THE NEW LIABILITY REQUIREMENTS OF THE REVISED ATOMIC ENERGY ACT. Charles Eason. p.16-19 [of] PROCEEDINGS OF THE 1958 ATOMIC ENERGY COMMISSION AND CONTRACTOR SAFETY AND FIRE PROTECTION CONFERENCE, HELD AT ATOMIC ENERGY COMMISSION HEADQUARTERS BUILDING, GERMANTOWN, MARYLAND, JUNE 24-25, 1958. 4p.

The indemnity amendment is discussed. This amendment was designed as a means of limiting the liability of those engaged in atomic energy activities which are potentially hazardous and, at the same time, assuring that funds will be available to satisfy claims within limits specified in the same amendment. (W.L.H.)

3478 TID-7557(p.75-9)

Atomic Energy Commission, Washington, D. C.
THIRD-PARTY LIABILITY ASSOCIATED WITH NUCLEAR INSTALLATIONS. Edward Diamond. p.75-9 [of] FIFTH INTERNATIONAL CONGRESS AND EXHIBITION OF ELECTRONICS AND ATOMIC ENERGY, ROME, ITALY, JUNE 16-30, 1958. (U. S. Papers). 5p.

Any country, acting by itself and pending the consummation of regional or world-wide international arrangements, can make an effective and substantial contribution to the solution of the third-party liability problem as it affects both its domestic and foreign operators. It is not necessary for a government to delay remedial action until (1) representatives of its own country and of other countries have mutually agreed upon the exact mechanics and details of the solution and drafted them

INSURANCE POSSIBILITIES AGAINST ATOMIC HAZARDS. F. Cincotti. Energia nucleare (Milan) 5, 265-8(1958) Apr. (In Italian)

Insurance companies are at present most concerned with the problems connected with a suitable financial protection of atomic industries personnel. In this paper Francesco Cincotti, director of the Italian Assicurazioni Generali Insurance Company, states in detail the several insurance possibilities offered nowadays against the various kinds of atomic hazards. (auth)

14537 A/CONF.15/P/2352

Michigan. Univ., Ann Arbor. Law School.
LEGAL PROBLEMS OF LIABILITY AND FINANCIAL PROTECTION CONNECTED WITH RADIATION INJURIES. E. Blythe Stason. 28p. $0.50(OTS).

Prepared for the Second U. N. International Conference on the Peaceful Uses of Atomic Energy, 1958.

Industrialists, prospective reactor operators, and all others engaged in the peaceful applications of atomic energy are increasingly interested in the scope of the legal liabilities and the means of protecting themselves against loss. Answers are presented to the most commonly asked questions in this field. (C.H.)

4021

THIRD PARTY LIABILITY IN NUCLEAR INDUSTRY. P. Sacerdoti. Energia nucleare (Milan) 6, 495-511(1957) Dec. (In Italian)

SHIPPING AND HANDLING OF RADIOACTIVE MATERIALS 4.02

LEGAL ASPECTS 4.02.05

INSURANCE LIABILITY 4.02.05.04

Following a general review of the safety and hazards problems in nuclear industry and research, the problem is dealt with from an insurance point of view. All questions concerning limits and costs of coverages on behalf of private companies, limits of liability in time, legal limits of operators' liability are examined. (auth)

10410 CF-57-7-31
Oak Ridge National Lab., Tenn.
THE ECONOMICS AND HAZARD POTENTIAL OF WASTE DISPOSAL. E. D. Arnold. July 8, 1957. 19p. Contract [W-7405-eng-26]. $3.30(ph OTS); $2.40(mf OTS).
The two most important considerations in the disposal of radioactive wastes are safety and economy. All other steps in the waste disposal complex must be tuned to accomplish these two goals. In general, the hazardous waste in the nuclear power complex affect the cost of the nuclear power reactor fuel cycle, the general environment since disposal must exclude radioactivity from the environment for over 500 years, the costs and/or methods of waste treatment including fission product utilization, the methods of shipping, the location of chemical processing plants and waste disposal sites, the methods of disposal best suited for a particular type of waste or site location, and potential public damage and third-party liability.

GOVERNMENTAL INDEMNITY AND REACTOR SAFETY. Hearings before the Joint Committee on Atomic Energy. U. S. Congress. 85th Cong., 1st Sess. March 25, 26, and 27, 1957. Washington, Government Printing Office, 1957. 288 p. $0.70.

FINANCIAL PROTECTION AGAINST ATOMIC HAZARDS; Final Report, January 1957. Arthur W. Murphy and others. Atomic Insurance Project. New York, Atomic Industrial Forum, 1957. 65 p. $1.20.
A survey of the problem of providing financial protection against the risks of damage and public liability arising from the use of atomic energy for industrial purposes.

RADIATION PROTECTION—INSURANCE AND INDUSTRIAL RELATIONS ASPECTS. Charles R. Williams (Liberty Mutual Insurance Co., Boston). Am. Ind. Hyg. Assoc. Quart. 17, 214-20(1956) June.
The insurance phase of the reactor program is reviewed. (C.H.)

REPORT OF THE DEPARTMENT OF LABOR ATOMIC ENERGY STUDY GROUP ON LABOR IMPLICATIONS OF ATOMIC ENERGY. U. S. Department of Labor. Washington, 1956. 90 p.
Presents background information and suggestions regarding labor standards necessary for the atomic energy industry.

THIRD-PARTY RESPONSIBILITY TO THE USER OF NUCLEAR PLANTS. Giuseppe Belli. p. 607-19 in "5th International Electronic and Nuclear Review. Acta of the Scientific Congress. Volume I. Nuclear Section." (In Italian)
The problem of third party responsibility is a complex one, and one which must be solved by the legislatures of the various countries. The work of the Economic Organization of the European Community with respect to third-party liability is discussed on the basis of the nature of the responsibility, the responsibility of the state, the subject of the responsibility, limitations of the responsibility, duration of the responsibility, and the federal responsibility for the incidents. (J.S.R.)

PLUTONIUM 4.02.06

20054 TID-7577(p.83–101)
General Electric Co. Hanford Atomic Products Operation, Richland, Wash.
CONFINEMENT TECHNIQUES AND HANDLING OF PLUTONIUM IN RESEARCH LABORATORIES. A. R. Keene. p.83–101 of SYMPOSIUM ON TECHNICAL METHODS IN HEALTH PHYSICS, RISÖ, DENMARK, MAY 25–28, 1959. 19p.
Plutonium with its extremely low maximum permissible body burden requires that some degree of confinement be provided in order to handle the material safely in research laboratories. Dependent upon the quantity

SHIPPING AND HANDLING OF RADIOACTIVE MATERIALS 4.02

PLUTONIUM 4.02.06

and physical form of the material being handled, confinement techniques may range from complete physical isolation of the material from the research worker to nominal control through the use of standard survey procedures. Confinement and handling methods must consider the plutonium both as a source of external radiation and as a bone-seeker, potentially most likely to enter the body through accidental inhalation or skin injury. Other factors to be considered in establishing safe handling procedures include pyrophoricity of plutonium metal, required ventilation, use of strippable coatings, and survey techniques. A review of problems likely to be encountered when handling plutonium in research laboratories is made. (auth)

3377
PHYSIOLOGY AND TOXICOLOGY OF PLUTONIUM-239 AND ITS INDUSTRIAL MEDICAL CONTROL. W. H. Langham (Los Alamos Scientific Lab., N. Mex.). Health Phys. 2, 172-85(1959) Oct.

When taken into the systemic circulation, Pu^{239} deposits predominantly in the skeleton, where it may produce bone disease (including cancer) many years later. Its absorption rate from the gastrointestinal tract is only about 0.003%. A small amount may be absorbed through the intact skin and through contaminated cuts and puncture wounds. Absorption from the lung may be from 1 to 10% of the inhaled dose, depending on particle size, solubility, chemical form, etc. Inhalation of contaminated air is potentially the most important mode of exposure, and its control is largely responsible for the rigorous closed-systems and other industrial hygiene and engineering practices employed in plutonium processing. Once in the body, Pu^{239} is excreted extremely slowly (about 200 years being required to eliminate one-half the body burden). An individual who has reached the maximum permissible body burden technically should be removed from further plutonium contact for the rest of his life. The maximum permissible body burden of Pu^{239} (0.04 μc) is established by comparison with Ra^{226} and is that amount which has the same improbability of producing harm to any person at any time during his natural life as does 0.1 μc of fixed Ra^{226}. Control of the industrial hazards of Pu^{239} processing is based on the premise that exposure of personnel should be as nearly zero as possible. If presently recommended practices are maintained, there is little reason to feel that the health of a person working with Pu^{239} will be subject to any greater absolute risk than if he were engaged in any other chemical or industrial occupation. (auth)

20023 AERE-R-2970
United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England.
STUDIES OF THE TOXICOLOGY OF PLUTONIUM. Katharine Williams. June 1959. 25p. $0.5¢(BIS).

Data are summarized from a survey of the literature covering the toxicity, retention, pathological effects, maximum permissible body burden, and maximum permissible values in air and water for plutonium. Fifty-six references. (C.H.)

16120 ANL-6021
Argonne National Lab., Lemont, Ill.
COMMENTS OF THE HANDLING OF PLUTONIUM. M. J. Steindler. June 1959. 27p. Contract W-31-109-eng-38. $0.75(OTS).

Many of the features of plutonium facilities have been covered, and a number of them have been omitted. A great variety of safety equipment is available, together with trained personnel to operate it. All of these devices, however, do not assure a contamination-free operation. Basically, the careful design of enclosures, experimental equipment, and procedures when handled by trained personnel represents the only approach to the problem of plutonium handling. (auth)

SAFETY ASPECTS OF WORKING WITH PLUTONIUM. Arthur B. Shuck (Argonne National Lab., Lemont, Ill.). Nuclear Energy Engr. 13, 411-14(1959) Apr.

Hazards of working with plutonium are discussed relative to four properties of the element; it can become critical, it emits alpha particles, it can constitute a radiation hazard, and in certain forms it is pyrophoric. Safe handling methods, storage methods, and fire fighting techniques are discussed. (C.J.G.)

2268 WASH-1023(p.71-83)
General Electric Co. Hanford Atomic Products Operation, Richland, Wash.
A REVIEW OF SIGNIFICANT HANFORD PLUTONIUM DEPOSITION CASES. R. H. Wilson. 13p.

SHIPPING AND HANDLING OF RADIOACTIVE MATERIALS 4.02

PLUTONIUM 4.02.06

This paper reviews several incidents of plutonium exposure which occurred at the Hanford production plant. A brief description is given of the circumstances that resulted in internal deposition of plutonium and the treatment given each employee. Biological data collected in each case are presented along with interpretation of these data in terms of body burden. (auth)

PLUTONIUM HANDLING HAZARDS. T. S. Chapman (Dow Chemical Co., Denver). p.284-91 in "Proceedings of the Seventh Hot Laboratories and Equipment Conference."

The philosophy and practices of protection from hazards accompanying plutonium processing and fabrication are described. Topics discussed are alpha and penetrating radiation and difficulties associated with the presence of fire or water. (auth)

THE DEVELOPMENT OF HANDLING TECHNIQUES FOR THE STUDY OF PLUTONIUM METAL. W. B. H. Lord (Atomic Weapons Research Establishment, Aldermaston, Berks, Eng.) and M. B. Waldron (Atomic Energy Research Establishment, Harwell, Berks, Eng.). J. Inst. Metals 86, 385-92(1958) Apr.

Metallurgical studies of plutonium are complicated by its fissionable nature, its extreme radioactive toxicity, and its ready oxidation to form a fine powder. Since 1951, when plutonium first became available in Great Britain there has been a steady development in the methods of handling it. The first installations were based on the use of fixed cells, which were operated through gloves from one face, and to which access could be gained by men in pressurized suits for maintenance. With increasing experience, island cells, operated from two opposite faces, and free-standing glove-boxes, with all-round glove-access, were developed. The relative merits of the various arrangements are discussed. Special features of the ancillary equipment are outlined. (auth)

16900 **WASH-1002(Pt. II and Suppl.)**
Division of Biology and Medicine, AEC.
A SELECTED LIST OF REFERENCES OF PLUTONIUM HAZARDS. PART II. Alfred W. Klement, Jr., comp. Feb. 25, 1958. 6p. SUPPLEMENT. Mar. 17, 1958. 4p. $3.30(ph OTS); $2.40(mf OTS).

A bibliography of 140 references to books, technical reports, and journal articles on the hazards of Pu is presented. (T.R.H.)

14722 A/CONF.15/P/760
Los Alamos Scientific Lab., N. Mex.
CONTROL OF HEALTH HAZARDS IN HANDLING PLUTONIUM. RESULTS OF 14 YEARS EXPERIENCE. H. F. Schulte and D. D. Meyer. 9p. $0.50(OTS).

Prepared for the Second U. N. International Conference on the Peaceful Uses of Atomic Energy, 1958.

As a result of 14 years of experience in handling plutonium in large batch sizes practical techniques for the control of health hazards have been developed. The health hazards involved, including both external and internal radiation, will be outlined and a brief historical review will be made of the Los Alamos experience in developing methods of handling plutonium safely. Remote handling equipment has made possible the isolation of the operators from the direct environment of the plutonium for many operations. Completely interlinked groups of ventilated dry boxes have proven most advantageous for other operations. Enclosure of parts in special containers has permitted some opera-

9246
SOME FACILITIES FOR THE STUDY OF PLUTONIUM AND ITS ALLOYS. G. K. Williamson, D. M. Poole, and J. A. C. Marples (Atomic Energy Research Establishment, Harwell, Berks). J. Inst. Metals 85, 431-6(1957) June.

Five glove-boxes for the safe handling of the highly toxic and reactive metal plutonium and its alloys are described. Facilities are provided for alloy preparation, x-ray examination, heat treatment, and metallography. The apparatus is simple, is easy to use, requires little maintenance, and can readily be modified and extended whenever necessary. (auth)

A SENSITIVE CONTINUAL MONITOR FOR THE DETECTION OF AIRBORNE PLUTONIUM. Alwyn C. Lapsley. Feb. 1957. 13p. (DP-201)

A continual monitor that detects airborne Pu dust has been built. An air impactor is used to collect the Pu and to reject the background alpha activity in the air. The threshold for detection is between one-half and twice the maximum permissible biological concentration of Pu. Such a

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PLUTONIUM 4.02.06

concentration is detected within ten minutes of its appearance in the atmosphere. The operation of the monitor is completely automatic.

A CONTINUOUS MONITOR FOR AIRBORNE PLUTONIUM. Dowdey C. Collins. Nov. 1956. 16p. (DP-188)
A continuous monitor has been developed that can detect one MPC (maximum permissible concentration) of Pu in air within ten minutes. Application details are described to assist other groups in adapting the equipment to their needs.

110 ✓
THE HANDLING OF PLUTONIUM IN LABORATORIES: PRECAUTIONS. H. J. Dunster and E. J. Bennellick (Atomic Energy Research Establishment, Harwell, Berks, England). Atomics 6, 312-20(1955) Oct.
Laboratory facilities and procedures for handling Pu at levels up to 10 curies are outlined. Glove box operation and maintenance are discussed. A procedure for the determination of Pu in urine is described. Emergency measures are suggested. (C.W.H.)

19072 ✓ LAMS-596
Los Alamos Scientific Lab., N. Mex.
PROBLEMS OF AIR-BORNE CONTAMINATION IN HANDLING PuF_4 POWDERS. W. R. Kennedy, A. Dumrose, and A. Ludwig. July 31, 1947. Decl. Apr. 27, 1959. 18p. $3.30(ph), $2.40(mf) OTS.
Studies were made of the air-borne contamination present during the operations of reducing plutonium tetrafluoride powder to the metal. Equipment design changes were made and operation technique changes were made until the amount of contamination present during operations was well below tolerance levels. Conclusions reached were that all operations with active materials should be carried on in closed, vented systems, and sequent operations should be connected in series so as to eliminate transfers of the material through the open room. Where such transfers cannot be eliminated clean, disposable containers should be used to make the transfers. (auth)

11151 AERE-T/M-63
[Gt. Brit. Atomic Energy Research Establishment, Harwell, Berks, England].
SAFETY FACTORS IN PLUTONIUM STORAGE. M. B. Biram and K. T. Spinney. [nd]. 18p.
A projected method of storing Pu is examined from the point of view of safety. The effects of concentrating Pu into separate containers and the interaction between such containers are considered together with the possibility of slowing down and reflection of neutrons in the surroundings of the storeplace. Two group diffusion theory was used in the latter investigation. It is concluded that the proposed method is quite adequate for the amounts of Pu which are required to be stored. (auth)

REMOTE HANDLING 4.02.07

See also, under PLANTS AND EQUIPMENT,

DESIGN--
LABORATORY—REMOTE EQUIPMENT--General (5.18.03.01).

15075 ✓ A/CONF.15/P/1838
Oak Ridge National Lab. Tenn.
RADIATION LIMITATIONS ON RECYCLE OF POWER REACTOR FUELS. E. D. Arnold. 33p. $0.50(OTS).
Prepared for the Second U. N. International Conference on the Peaceful Uses of Atomic Energy, 1958.
The buildup of isotopic contaminants during successive irradiations can greatly affect the handling techniques associated with the recycle of power reactor fuels. The three methods of refabrication considered are direct, semi-remote, and remote. Radiation hazards for U^{233}, Th, U^{235}, normal uranium, and Pu are enumerated. (W.D.M.)

14641 A/CONF.15/P/533
Los Alamos Scientific Lab., N. Mex.
ANALYTICAL CHEMICAL LABORATORIES FOR THE HANDLING OF PLUTONIUM. C. F. Metz. 22p. $0.50(OTS).
Prepared for the Second U. N. International Conference on the Peaceful Uses of Atomic Energy, 1958.

SHIPPING AND HANDLING OF RADIOACTIVE MATERIALS 4.02

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The analytical laboratories at Los Alamos equipped with dry and glove boxes are described and the philosophy of handling plutonium is presented. The boxes are so designed that all required operations in chemical analysis can be safely performed without room contamination and with minimum risk to the analyst. These boxes are fabricated of stainless steel, with windows of lucite or safety glass. All metal exposed on the inside is painted with a stripable plastic base paint. Glove ports at a convenient height permit easy use of rubber gloves. Experience has shown that plutonium in solution can be safely handled in these enclosures without rubber gloves on the ports, but for handling plutonium in solid form, rubber gloves must be attached to the glove ports. These enclosures are equipped with all the usual laboratory services. Doors between boxes are of an unusual design, vertically operated by compressed air. Provisions exist for operation of equipment such as centrifuges and pH meters within the boxes yet permitting removal in an uncontaminated condition. Ventilation is provided through filters for all gloved boxes and is regulated so as not to interfere with operations by means of dampers in the exhaust ducts. In case of open front boxes, a minimum face velocity of 100 feet per minute is maintained. Polyvinyl plastic was used for exhaust duct installations and was found to be quite satisfactory. (auth)

2875 AERE-C/R-2622
United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England.
THE SMALL SCALE REMOTE HANDLING OF CURIE LEVELS OF BETA, GAMMA ACTIVE SOLUTIONS. J. H. Moss, G. P. Kitt, and P. E. Brown. Oct. 1958. 33p. $0.63(BIS).

A description is given of simple and flexible chemical equipment and techniques used in the small-scale (0.1 to 400 ml) remote handling of up to 10 curies of fission products. The advantages, limitations, and possible extensions of the methods used are discussed. (auth)

2789
REMOTE HANDLING. 5. HANDLING TECHNIQUES. R. A. G. Welsher (A.E.R.E., Harwell). Nuclear Eng. 2,. 469-73(1957) Nov.

Remote handling techniques and equipment are presented for handling beta-gamma and alpha-beta-gamma emitters. (W.L.H.)

121
REMOTE HANDLING. 3. ALPHA-ACTIVE MATERIALS. W. K. Curtis (A.E.R.E., Harwell). Nuclear Eng. 2, 381-5 (1957) Sept.

11761
REMOTE OPERATIONS IN U-235 PROCESSING. Charles A. Rohrmann (Hanford Atomic Products Operation, Richland, Wash.). Chem. Eng. 63, No. 10, 195-8(1956) Oct.

14640 A/CONF.15/P/532
Los Alamos Scientific Lab., N. Mex.
HOT CELLS FOR PLUTONIUM REACTOR FUEL RESEARCH. P. J. Peterson, R. L. Thomas and J. L. Green. 10p. $0.50(OTS).

Prepared for the Second U. N. International Conference on the Peaceful Uses of Atomic Energy, 1958.

The structure consists of four 6 ft. by 6 ft. by 10 ft. high cells in a line backed by a common corridor 11 ft. by 30 ft. long. Shielding is accomplished with a combination of magnetite and ordinary concrete. One pair of Argonne Model No. 8 manipulators are used in each cell and a General Mills Mechanical Arm, in the corridor. The former will be used for actual experimentation and the latter to transfer material into and out of the cells. Because of the types and quantity of plutonium to be handled, the material will be processed within a portable enclosure located in a cell. The enclosure is designed for versatility. The Model No. 8 Manipulators will have access to the interior of the enclosure through contamination-tight plastic booting de-

647
A SIMPLE PERISCOPE SYSTEM FOR REMOTE OPERATIONS. A. G. Silvester (General Electric Co., Schenectady, N. Y.). Nucleonics 13, No. 11, 80-1(1955) Nov.

9197
LABORATORY FOR REMOTE ANALYSIS OF HIGHLY RADIOACTIVE SAMPLES. F. W. Dykes, R. D. Fletcher,

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REMOTE HANDLING 4.02.07

E. H. Turk, J. E. Rein, and R. C. Shank (Phillips Petroleum Co., Idaho Falls, Idaho). Anal. Chem. 28, 1084-91(1956) July.

The function of the Idaho Chemical Processing Plant is to recover enriched uranium from expended fuel elements from various types of reactors. The Remote Analytical Facility provides facilities for chemical research on extremely radioactive materials and for around-the-clock analytical service for operation of the processing plant. The general building layout and some typical remote analytical apparatus are described. (auth)

2024 TID-5208(Suppl.1)
FOURTH ANNUAL SYMPOSIUM ON HOT LABORATORIES AND EQUIPMENT, HELD IN WASHINGTON, D. C., SEPTEMBER 29 AND 30, 1955. SUPPLEMENT 1. Jan. 1956. 123p.

Nine papers are presented covering the following subjects: electrical discharge machining for hot laboratories; radiation shielding; remote reactor manipulations; design of a storage safe and a cut-off wheel for hot laboratory use; tension testing of radioactive specimens; proposed methods for remote transfer of α and γ active materials into and out of high level caves; windows for remote viewing; the performance of radiation protected microscope objectives; and problems and costs encountered in the handling of irradiated fuels. (cf. TID-5208.) (C.H.)

11269 ✓
REMOTE VIEWING. F. S. Bloxam. Nuclear Eng. 2, 315-20(1957) Aug.

Work behind a biological shield necessitates direct viewing through windows with and without lenses, or through mirror systems, or with closed circuit TV. The windows would consist of a tank of $ZnBr_2$ solution or a heavy lead glass which can be obtained in blocks or plates of a limited size It is possible to stabilize the glass against gradual obscurement by radiation. The characteristics of different glasses are reviewed. (Tr-auth)

2057 ✓ NAA-SR-2778
Atomics International Div., North American Aviation, Inc., Canoga Park, Calif.
THE PROCESSING-REFABRICATION EXPERIMENT (PRE) FOR IRRADIATED UO_2. D. I. Sinizer, E. G. Kendall, K. L. Mattern, D. J. Stoker, J. R. Foltz, G. E. Brand, and D. Janeves. [1958]. 67p. Contract AT-11-1-GEN-8. $12.30(ph OTS); $4.50(mf OTS).

The processing-refabrication experiment (PRE) was re-oriented toward development of equipment, methods, and techniques for remote processing and reconstitution of highly irradiated and short-cooled UO_2 fuel. In the first phase of the program, equipment and techniques for remote processing, shape reconstitution, and fuel rod fabrication will be mocked up and operated remotely with non-radioactive material. In the second phase, a large shielded cell structure and associated supporting services will be added to the facility at Santa Susana. The second-phase facility will contain hot cells for processing UO_2 fuel and reconstituting fuel shapes under an inert atmosphere. (W.L.H.)

13780 ✓ CF-58-7-87
Oak Ridge National Lab., Tenn.
MEASUREMENTS THROUGH A HOT CELL WINDOW USING OPTICAL TOOLING. A. A. Abbatiello. July 18, 1958. 49p. Contract [W-7405-eng-26]. $7.80(ph OTS); $3.30(mf OTS).

Optical tooling has been evaluated for the measurement of physical dimensions of radioactive parts through hot cell windows. Instruments were set up outside of a four foot thick lead glass window and by means of a grid plate which had been accurately scribed, a "contour map" or calibration chart of the window variations was recorded. Although the window was not specially selected, the readings were within 1.0% of the true dimension without using correction factors. One of the calibration chart with the window reduced the error to ±0.1%. The method is considered feasible and sufficiently fast for a wide variety of hot cell measurements. A pin point light source is suggested as a simple check for selective assembly of lead glass laminates during manufacture of hot cell windows to provide control of optical properties. (auth)

SHIPPING AND HANDLING OF RADIOACTIVE MATERIALS 4.02

REMOTE HANDLING 4.02.07

14642 A/CONF.15/P/543
Argonne National Lab., Lemont, Ill.
HOT LABORATORY FACILITY FOR PHYSICAL MEASUREMENTS ON IRRADIATED PLUTONIUM. R. C. Goertz. 11p. $0.50(OTS).

Prepared for the Second U. N. International Conference on the Peaceful Uses of Atomic Energy, 1958.

A new facility is being developed to carry out physical measurements on irradiated plutonium-bearing fuel elements. The shielded enclosure (cave) will be sealed tight enough to contain the radioactive particulate material and a portion of it will be tight enough to contain a high purity inert atmosphere. Handling and manipulation within the enclosure are to be performed entirely by remotely controlled slave-robots, manipulators, and cranes. Viewing will be by means of shielding windows, periscopes, and television. Slave-robots are to have capabilities of setting up, operating, and repairing or removing any of the equipment to be used in the facility.

1262
THE CONTAINMENT PHILOSOPHY AT THE SAVANNAH RIVER LABORATORY. A. J. Hill, Jr. (E. I. du Pont de Nemours & Co., Inc., Wilmington, Del.). Chem. Eng. Progr. 52, Symposium Ser. No. 19, 25-6(1956).

The application of the containment method of working with radioactivity at the Savannah River Laboratory is reviewed. The method requires the radioactive materials to be isolated from the worker insofar as practical and has been successfully used for several years at the Radiation Laboratory of the University of California. The organization and functions of the Savannah River Laboratory Radiation Control Group, which furnishes the services necessary to work within the scope of the containment philosophy, are described, and the advantages resulting from the method evaluated. (auth)

SOVERMENNOYE OBORUDOVANIYE DLYA RABOTY S RADIOAKTIVNYMI IZOTOPAMI; SBORNIK MATERIALOV. (Modern Equipment for Working with Radioactive Isotopes; Collection of Materials.) A. I. Zavodchikova and S. M. Popova, eds. (Suppl. No. 5, to Atomnaya Energ. (1958)). Moscow, Izd-vo Glavnogo Upravleniya po Ispol'zovaniyu Atomnoy Energii pri Sovete M-va SSSR, 1958. 110p.

A book for personnel engaged in activities involving the use of radioisotopes is presented. Three articles deal with modern techniques, methods, and apparatus for handling radioisotopes. Schematic diagrams and illustrations of modern equipment for remote handling and detailed descriptions of operating principles are given. (TCO-J.S.R.)

SHIELDING 4.02.08

See also, under PROCESS CHEMISTRY AND ENGINEERING, RADIATION EFFECTS (6.15).

BORON 4.02.08.01

6696
ON THE SOLUBILITY OF BORON IN SILICON. V. M. Sleptsov and G. V. Samsonov (Inst. of Metalloceramics and Special Alloys, Academy of Sciences, Ukrainian SSR). Dopovidi Akad. Nauk. Ukr. R.S.R. No. 9, 982-4(1959). (In Ukrainian)

The solubility of boron in silicon was investigated by metallographic and x-ray methods. The solubility of boron in silicon was found to increase from 0.50 wt. % (1.2 at. %) at room temperature to 1.6 wt. % (2.9 at. %) at about 1300°C. The existence of a eutectic corresponding to 18 at. % of boron and a melting point of about 1370°C is shown. A hypothetical form is constructed for the section of the boron–silicon system ranging up to 40 at. % of boron. (auth)

5878 APEX-292
General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati.
EXPERIMENTAL DETERMINATION OF THE REDUCTION OF INDUCED ACTIVITY IN METALS BY ADDITION OF BORON. J. Moteff, W. J. Stapp, and M. Tetenbaum. Feb. 1957. 6p. Contracts AF33(038)-21102 and AT(11-1)-171. $0.15(OTS).

Curves are presented which indicate additions of 0.5 to 1% additions of B^{10} to stainless steel, tungsten, and thorium results in a significant reduction in neutron activation. (D.E.B.)

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SHIELDING

3325 CF-56-1-94
Oak Ridge National Lab., Tenn.
PHYSICAL PROPERTIES OF BORAL USED IN LID TANK MOCKUPS. J. R. Smolen. Jan. 23, 1956. 3p. Contract [W-7405-eng-26]. $1.80(ph OTS); $1.80(mf OTS).

An analysis of Boral used at the LTSF was made for application to shielding calculations. Results indicate an elemental composition of 79 wt. % Al, 15.9 wt. % B, and 4.1 wt. % C. (D.E.B.)

8422
DETERMINATION OF THE SUBLIMATION HEAT OF BORON BY MASS SPECTROMETRY. P. A. Akishin, O. T. Nikitin, and L. N. Gorokhov (Lomonosov Moscow State Univ.). Doklady Akad. Nauk S.S.S.R. 129, 1075-8(1959) Dec. 11. (In Russian)

An attempt is made to determine the sublimation heat of crystalline boron by a method combining the evaporation from an effusion chamber with mass spectrometric determination of the composition and absolute vapor pressure. The results indicate the sublimation heat $\Delta H_0^0 = 131.6 \pm 5$ kcal/g atom. (R.V.J.)

1842 Y-B31-273(Del.)
Oak Ridge National Lab., Y-12 Area, Tenn.
CLARITY OF BORATED WATER IN CONCRETE TANKS. H. P. House and C. D. Susano. July 24, 1951. Decl. Mar. 12, 1957. 6p. Contract W-7405-eng-26. $0.20(OTS).

It has been proposed, for the safe disassembly of equipment, large concrete tanks containing solutions of $K_2B_4O_7 \cdot 5H_2O$ or other salts of boron be used as a shielding solution. The disassembly is carried out beneath the surface of the liquid. Exposure tests were carried out in order to determine whether boron salt solutions would retain the required clarity when in contact with uncoated concrete. It was found that $K_2B_4O_7 \cdot 5H_2O$ retained its clarity. (W.L.H.)

CALCULATION 4.02.08.02

SHIELDING FROM THE γ-RAYS EMERGING FROM THE BASE OF A CYLINDRICAL SOURCE. D. P. Osanov. Atomnaya Energ. 6, 333-8(1959) Mar. (In Russian)

Data are given on calculations for shielding against γ radiation from a cylindrical source base. The calculations are carried out with the assumptions that the active material is uniformly distributed along the volume of the source and each elementary volume emits γ quanta of similar energies. (R.V.J.)

7840 AD-157592
Air Force Inst. of Tech., Wright-Patterson AFB, Ohio.
A MONTE CARLO METHOD FOR COMPUTING THE TRANSMISSION OF FAST NEUTRONS THROUGH A LEAD SHIELD (thesis). Jack Thomas Humphries. Mar. 1958. 64p.

A digital computer program, employing Monte Carlo techniques, was designed to compute the transmission of fast neutrons through a spherical lead shield. The source is contained in a void at the center of the shield, and surface fluxes are computed. Both elastic and inelastic scattering of the neutrons are considered by the program. Flow charts were constructed to facilitate coding. (auth)

8854 CF-58-1-41
Oak Ridge National Lab., Tenn.
STRATIFIED SLAB GAMMA-RAY DOSE-RATE BUILDUP FACTORS FOR LEAD AND WATER SHIELDS. L. A. Bowman and D. K. Trubey. Jan. 16, 1958. 10p. Contract [W-7405-eng-26]. $1.80(ph OTS); $1.80(mf OTS).

The ORACLE Monte Carlo code for the calculation of the penetration of gamma rays through stratified slabs was used to calculate a total of 512 problems for eight different lead and water configurations. The energy of the incident radiation, the angle of incidence, the thickness of the shield, and the percentage of lead preceding or following water were varied. The source was assumed to be a monodirectional beam with energies of 1, 3, 6, and 10 Mev. The in-

13734 IGIS-7(RD/W)
THE CALCULATION OF THE GAMMA-RADIATION PROTECTION IN EXTENSIVE RADIATION FIELD. R. Plesch. Translated by G. Cooke (U.K.A.E.A., Sellafield) from Atompraxis 4, 402-7(1958). 10p.

The usual calculation of shield thicknesses for gamma radiators gives minimum values which in many cases cannot provide the desired protection, since the influence of secondary radiation caused by single or

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multiple Compton processes is not taken into consideration in the exponential calculation. By applying the dose build-up factor B, which can be represented in close approximation as a function of the shield thickness A, the influence of scattered radiation can be taken into account; the maximum values thus obtained for shield thickness result in adequate radiation protection. Two diagrams are given for these values, using lead as shield material. Another diagram makes possible the calculation of equivalent iron thicknesses. By introducing a specific identification number K for each problem in radiation protection, the diagrams can be used freely for various protection conditions. It is shown how to determine shield thickness for complex gamma-radiators (radiation mixtures), and in conclusion all the processes are illustrated by practical examples. (auth)

4860

NOMOGRAMMY DLYA RASCHETA ZASHCHITY OT GAMMA-LUCHEĬ Ra, Co^{60}, Cs^{137}, i Ir^{192}. (Nomograms for Computing Shielding Requirements Against Ra, Co^{60}, Cs^{137}, and Ir^{192} γ Rays). N. G. Gusev and E. E. Kovalev. Moscow, Publishing House of the Main Administration on Atomic Energy, Council of Ministers, 1959. 71p.

Forty-five nomograms are plotted for fast and accurate estimates of shielding against equilibrium and non-equilibrium decay products of radium, Co^{60}, Cs^{137}, and Ir^{192} The shielding materials are lead, iron, lead glass, concrete, and water. The nomograms are plotted for wide γ beams. Descriptions and instructions for use are given. The book is designed for engineers, medics, and other personnel handling γ emitting isotopes. (R.V.J.)

11962 NARF-59-11T

Convair, Fort Worth, Tex.

AIR AND CONCRETE SCATTERING OF GAMMA RAYS. M. B. Wells. Mar. 20, 1959. 108p. Project 6-1-9964. Contract AF33(600)-32054. (MR-N-229).

A Monte Carlo method of computing the angular distribution and energy spectrum of gamma rays scattered in air and ground is described. The development of the integrals representing the contribution of each order of scattering to the total scattered flux, and the application of random sampling methods to the evaluation of these integrals, are outlined in detail. Calculation of the flux arising from pair-production interactions is also described. Results obtained in a parameter study for a source-detector height of 12.5 feet above a concrete slab are presented in both graphical and tabular form for various source energies and separation distances. (auth)

12804

DIMENSIONING OF SHIELDING WALLS AGAINST γ-RAYS. L. Tihanyi. Acta Tech. Hung. 21, 255-74 (1958).

The usual tabular method of calculating dimensions of nuclear shields is compared with a simpler graphical method proposed. This method enables thickness of Pb walls to be determined accurately, even when a number of different isotopes are present together. It provides for their additive radiation effect by a determination of the resultant dose-rate for nonenergetic, cascade, or series disintegration. The construction and use of the graphs is explained. (TCO)

14668

INFLUENCE OF THE SIZE OF AN EXTENDED PLANE SOURCE ON GAMMA-RAY ATTENUATION IN SHIELDING MATERIALS. E. E. Kovalev and P. D. Osanov. Reactor Technol. 1, 52-4(1959) Apr.

A treatment of the effects of source dimension on gamma attenuation is presented. Data are given to illustrate the conclusion that the large dimensions of an extended source influence the estimated gamma attenuation in two ways: the existence of oblique rays increases the calculated attenuation and multiple scattering decreases it more strongly than would be calculated. Thus, corrections can be made for these effects in shielding calculations. (T.R.H.)

3406 NARF-57-49-T

Convair, Fort Worth, Tex.

STUDIES IN SHIELDING-III. Monte Carlo Calculations of Neutron Scattering in Air. M. B. Wells. Nov. 4, 1957. 47p. Project 6(1-9964). Contract AF-33(600)-32054. (FZK-9-120).

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A Monte Carlo method is described for calculating the angular distribution and energy spectrum of air-scattered neutrons. The method was used to solve the integrals that represent the contribution to the total-scattered flux from each order of scattering. Results of the calculations giving the scattered flux from a 3.25-Mev point monodirectional source are presented in both graphical and tabular form for various source angles and separation distances at 10,000-ft density altitude. (auth)

2580
THE ATTENUATION OF GAMMA RAYS AND NEUTRONS IN REACTOR SHIELDS. Herbert Goldstein. Washington, U. S. Atomic Energy Commission, 1957. 306p. Available from U. S. Government Printing Office for $2.00.

A discussion of the fundamentals of shielding is presented; the factors affecting the permissible radiation levels, the sources and characteristics of the radiation to be shielded against, and bulk shielding measurements are discussed. The theoretical or empirical calculation of the attenuation of neutrons and γ rays in shield materials is discussed at length. (M.H.R.)

8232 UCRL-3477
California. Univ., Berkeley. Radiation Lab.
A GRAPHIC SOLUTION FOR GAMMA SHIELDING. William G. Ruehle, Jr. July 24, 1956. 16p. Contract W-7405-eng-48. $3.30(ph OTS); $2.40(mf OTS).

An equation for calculating gamma radiation through shielding is derived, which is applicable to practical monitoring and equipment-design problems. A graphic solution of the equation is included, as well as examples of its use and tables of values for specific conditions. (auth)

2196 KAPL-M-CJR-2
Knolls Atomic Power Lab., Schenectady, N. Y.
DISTANCE EFFECT ON SHIELD WEIGHT OF SINGLE PIPE ARRANGEMENT. Carol J. Ranney. Feb. 2, 1956. 17p. Contract [W-31-109-eng-52]. $3.30(ph OTS); $2.40 (mf OTS).

The effect of distance between the shield and the parallel coolant pipes has been studied. Calculations of dose rate outside a slab shield from parallel cylindrical sources have been performed, using both the point source equation with Peebles buildup and the line source approximation of a cylinder applying slant penetrations through the shield. It is shown that the slant penetration method gives an unrealistic picture for pipes lying close to the shield. (auth)

1615
WEIGHT CHANGE IN CYLINDRICAL SHIELDS. David G. Chappell (Knolls Atomic Power Lab., Schenectady, New York). Nucleonics 13, No. 12, 46-7(1955) Dec.

A nomogram is given for the evaluation of weight change in cylindrical shields with diameter changes. (B.J.H.)

10904 HW-33121
[Hanford Atomic Products Operation, Richland, Wash.]
HANFORD SHIELDING PROGRAM PROCEDURES FOR RADIOACTIVE FOIL PREPARATION AND COUNTING. R. L. Tomlinson. Jan. 1, 1955. Changed from OFFICIAL USE ONLY July 6, 1956. 39p. Contract [W-31-109-Eng-52]. $6.30(ph OTS); $3.00(mf OTS).

Procedures are described which were devised to aid engineering and laboratory assistants in carrying out their specific assignments in Hanford shield attenuation measurements and at the same time in obtaining an understanding of some of the more basic fundamentals associated with the field of beta counting and neutron flux determinations. It is not intended to be a strictly technical document but merely a guide that may answer many of the routine questions that arise from time to time when working with low level radioactivity. This manual may also serve as reference for the laboratory procedures used in obtaining the large amount of shield attenuation data taken at Hanford. (auth)

11822 BNL-2796
Brookhaven National Lab., Upton, N. Y.
CALIBRATION OF THE BROOKHAVEN SHIELDING STUDIES FISSION SOURCE. Herbert Kouts and William Pratt. Nov. 29, 1951. Decl. Feb. 13, 1957. 15p. $3.30 (ph OTS); $2.40(mf OTS).

Power generation in the Brookhaven fission source was measured by evaluating the heat added to coolant air. This

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determination allows direct comparison with Oak Ridge neutron sources. The experimental arrangement, method of measurement, and calculations are reviewed. (D.E.B.)

5428 ORNL-748(Suppl.)
Oak Ridge National Lab., Tenn.
SHIELD CALCULATIONS FOR LEAD AND WATER MIXTURES. F. H. Murray. Dec. 11, 1950. Decl. Jan. 6, 1956. 7p. Contract W-7405-eng-26. $1.80(ph OTS); $1.80(mf OTS).

The penetration of neutrons through mixtures of Pb and H_2O is calculated. The general formulas given for 20% Pb, 30% Pb, 40% Pb include the contribution of the continuous spectrum; the calculations show the necessity of using this contribution for distances up to about half a meter from the source plane, so that a better fit with empirical data can be expected at small distances. When certain corrections for the high-energy theoretical curves, and other corrections to empirical curves are estimated, a fair agreement with the experimental results for 33% Pb is indicated. (auth)

5658 CEA-948
France. Commissariat à l'Énergie Atomique, Paris.
REFLEXION DES NEUTRONS RAPIDES SUR LE POLYETHYLENE. (Reflection of Fast Neutrons by Polyethylene). P. Lafore, J. P. Millot, and J. Rastoin. Dec. 1958. 7p.

The reflection of fast neutrons of 0.5, 1, and 2 Mev, converging at various angles of incidence on thicknesses of 3 and 6 cm of polyethylene, has been studied by a Monte-Carlo method. To simplify the calculations tables are given showing as a function of the emitting reactor, the flux, the dose, and the error on the dose, as well as the total albedo. (auth)

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20866
TECHNISCHER STRAHLENSCHUTZ. I. STRAHLENABSCHIRMUNG DURCH BETON. II. BESEITIGUNG RADIOAKTIVER ABFALLSTOFFE. (Industrial Radioprotection. I. Radiation Shielding by Concrete. II. Elimination of Radioactive Waste Material.) Thomas Jaeger. Munich, Verlag Karl Thiemig, 1959. 192p. DM 8.60.

As an introduction to the consideration of industrial radioprotection, the radiobiological fundamentals are explained with a discussion of the biological effects of radiation and a tabulation of the highest permissible radiation burdens. In the section on radiation shielding by concrete, the physical foundations of radiation protection, calculation of radiation attenuation, and the application of concrete as a shielding material are considered. In the discussion of elimination of radioactive wastes the methods used in the processing and disposal of wastes, which are formed in large quantities and with a wide range of activity levels in nuclear research and nuclear industry, are surveyed. 364 references. (J.S.R.)

11261 AERE-R/R-2782
United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England.
THE EFFECT OF HYDROGEN CONTENT ON NEUTRON DOSE ATTENUATION IN PORTLAND CONCRETE. A. F. Avery and J. H. W. Simmons. Jan. 1959. 16p.

The build-up of thermal and intermediate energy neutrons in equilibrium with the high-energy penetrating neutron flux was studied for Portland concrete with hydrogen contents varying from 0.1 to 1.0% by weight. The asymptotic dose contributions from thermal neutrons and from intermediate energy neutrons are found to increase significantly if the hydrogen content is reduced below 0.5 and 0.3%, respectively. (auth)

13599
THE ECONOMICS OF HEAVY CONCRETE AS A RADIATION SHIELD. A. N. Komarovskii. Atomnaya Energ. 4, 437-42(1958) May. (In Russian)

A review is given of foreign publications on the use of various types of concrete for biological protection against radiation from nuclear reactors and heavy particle accelerators. The economics of heavy concrete shields or ordinary concrete with mineral admixtures are discussed. Calculations and economic analysis made by Russian specialists are included. The results show that special heavy concrete shielding should be used only in exceptional cases. (tr-auth)

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16802 HW-56195
General Electric Co. Hanford Atomic Products Operation, Richland, Wash.
RADIATION DAMAGE TO CONCRETE. R. G. Clark. Mar. 31, 1958. 23p. Contract W-31-109-Eng-52. $0.75(OTS).

A literature survey on the subject of radiation damage to concrete was proposed, because the question of damage continues to be raised. A compilation of significant results to date and a current bibliography on the subject are presented. Data are available for conditions of flux up to 2×10^{19} nvt (thermal) and temperature to 120°C. Under these conditions, radiation damage to concrete is apparently insignificant. All effects on concretes due to radiation per se were too slight to reliably measure because of the gross effects from the increased temperatures during exposure. (auth)

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12942
CONCRETE IN RADIATION SHIELDING TECHNIQUE. Thomas Jaeger. Atomkern Energie 2, 217-22(1957) June. (In German)

9173
THE SHIELDING PROPERTIES OF CONCRETE. V. S. Dikarev, M. B. Egiazarov, E. N. Korolev, and V. G. Madyeev. J. Nuclear Energy 5, No. 1, 166-8(1957).

It is shown that for the given neutron and γ-ray spectra, limonite concrete has better shielding properties than ordinary concrete. Detailed results are tabulated and apparatus described. (M.H.R.)

10169 NP-tr-191
MATERIALS FOR BIOLOGICAL SHIELDING EXPERIMENTS ON NATIONALLY OBTAINABLE MATERIALS. Emanuele Fumagalli. Translated by R. J. Royston (U.K.A.E.A., Atomic Energy Research Establishment) from Paper No. 207 of the Tenth National Congress of Italian Engineers, Milan, 1957. 12p. $3.30(ph), $2.40 (mf) JCL or LC.

An exploration of the whole range of densities obtainable with aggregates in cement was conducted with locally procurable materials. The most suitable materials examined included barytes, limonites, magnetites, metallic iron, and ferrophosphorus. Aggregate preparation is described, comparing the various possible mixtures and granule size distributions. Economic aspects are emphasized. Water content is considered, and mixing techniques are examined. Results of experiment are discussed, and it is concluded that very high density concrete can be obtained by use of ferrophosphorus and steel punchings. (J.R.D.)

19444 NP-7761
Iowa State Coll., Ames.
GAMMA RAY SHIELDING PROPERTIES OF MORTARS CONTAINING SLAG (thesis). James Richard Dughi. 1957. 47p.

The results of the tests of the γ-ray shielding properties of mortars containing slag are presented. The use of slag as a fine aggregate may result in porous mortars. The shielding properties of this mortar are reduced as a result of this porosity. The use of fly ash in conjunction with slag as the fine aggregate in mortar shows an increase in the linear absorption coefficient of from 2.5 to 5%. The use of water to keep the mortars saturated resulted in an increase of from 5 to 7% regardless of the aggregate used. (W.L.H.)

SODIUM GRAPHITE REACTOR QUARTERLY PROGRESS REPORT FOR JULY-SEPTEMBER 1955. SECTION A. A. B. Martin, ed. SECTION B. J. C. Cochran, ed. Mar. 15, 1956. Decl. Apr. 8, 1957. 141p. (NAA-SR-1513)

The shielding requirements for the radioactive liquid waste disposal system have been re-evaluated. Data on the radiation level from hold-up tank as a function of concrete thickness for one tank containing fresh cleaning cell effluent are plotted as well as calculations to check the adequacy of the earth shielding above the sump discharge line leading to the hold-up tank vault.

13600
RADIATION PROTECTION. A. Ye. Desov. Stroitel. Prom. No. 2, 28-31(1956). (Translated from Referat. Zhur. Khim. No. 3, 1957, Abstract No. 10713).

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The absorption coefficient for Co^{60} γ radiation was measured for five concrete compositions using heavy fillers and for cast iron. Slabs 75 by 75 by 10 cm and 75 by 75 by 3 cm were irradiated with γ-rays, using a broad and a narrow beam. It was established that when a narrow beam (diameter of the diaphragm, 10 to 12 mm) is used the intensity of the radiation decreases more rapidly than when a broad beam is used. The absorption coefficient (in cm^{-1}) for narrow and broad beams are as follows: cast iron, 0.42 and 0.289; concrete with various fillers: limonite and cast iron, 0.249 and 0.205; sand and cast iron, 0.22 and 0.186; limonite and limonite, 0.152 and 0.136; sand and gravel, 0.134 and 0.123; sand and gravel with the addition of

13601 ✓
CONCRETE FOR RADIATION SHIELDING APPLICATIONS. S. A. Mironov and J. K. Ponomarev. Beton i zhelezobeton No. 7, 259-62(1956). (Translated from Referat Zhur. Khim. No. 3, Abstract No. 10715).
The authors discuss briefly the composition and properties of various types of concrete used in radiation shielding applications. Empirical formulas are given for the calculation of the half-thickness for gamma radiation in various concretes as a function of the energy of radiation.

3075 ✓
CONCRETE RADIATION SHIELDING MEANS. L. B. Borst (to U. S. Atomic Energy Commission). U. S. Patent 2,726,339. December 6, 1955.
The shielding efficiency of a concrete shield to emanations from radioactive substances, particularly neutrons and gamma radiations, has been increased by the random inclusion in the matrix of small masses of free elements having a specific gravity of over 6.5, for example, pellets of Fe, Pb, Cr or Ni, and compounds such as colemanite or limonite, the weight of the added material varying between $^2/_3$ and $^3/_4$ of the total weight of the matrix. The increased shielding effect permits a reduction of 30 to 40% in the thickness of the shielding. (auth)

13215 ✓ HDC-2095
[Hanford Works,] Richland, Wash.
ANALOGUE STUDY OF HEAT TRANSFER IN A CONCRETE BIOLOGICAL SHIELD. L. E. Foster, L. H. McEwen, and C. E. Bonham. Apr. 24, 1951. Decl. Mar. 13, 1957. 14p. Contract [W-31-109-Eng-52]. $3.30(ph OTS); $2.40(mf OTS).
An analogue study is reported on temperature gradients through a concrete biological shield considering conduction of heat from the face near the thermal shield to the outside face, and of the heat generated in the shield due to neutron capture. (F.S.)

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11262 ✓
USE OF REMOVABLE LACQUERS FOR PROTECTION AGAINST RADIOACTIVE CONTAMINATION.
H. Dreiheller and E. H. Graul (Univ. of Marburg). Atompraxis 4, 177-8(1958). (In German)
Removable plastic-base varnish is an indispensable help for laboratory work with radioactive material. The chemical and physical permanence of the varnish makes it particularly valuable and time saving for such work. Through use of an easily applied, water-soluble undercoating the varnish can also be put on, and removed from, rough and porous surfaces. The undercoating can also be used as an isolation between two layers of varnish, thus forming several layers which can be removed one after the other (onionskin). This makes possible an effective wall protection for laboratories. Certain examples of application technique are given. (auth)

9949 ✓ UR-489
Rochester, N. Y. Univ. Atomic Energy Project.
PROTECTION FROM RADIANT THERMAL ENERGY BY FABRICS USED AS A SHIELD. F. W. Payne, J. R. Hinshaw, and H. E. Pearse. May 3, 1957. 11p. Contract W-7401-eng-49. $0.15(OTS).

UTILISATION OF BARRIER CREAMS IN ATOMIC ENERGY PLANTS. G. S. Towler (U. K. Atomic Energy Authority). Atomics 7, 88-90(1956) Mar.
The use of a system of barrier creams as a protective agent in atomic energy installations is one of many examples of the building-up of a new technique for handling materials

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possessing physical properties not commonly found in the chemical industry. The method developed was designed to cope with a specific problem, and the approach employed was empirical in character. (auth)

GAMMA 4.02.08.05

Australia. Atomic Energy Commission Research Establishment, Lucas Heights, New South Wales.
SOME DESIGN DATA FOR GAMMA SHIELDING IN N.S.W. D. R. Ebeling. Dec. 1957. 25p.
It is indicated that the use of pits and ponds is the cheapest method of containing active materials but that many things can make these methods impracticable. Concrete is thought to be the most generally useful material for above-ground shields and high density shields can be made comparably cheaply by using steel punchings, ilmenite sand, iron ore or a combination of these. Lead and cast iron are among the most expensive shielding materials but they can often be justified because of their compactness. Costs are included wherever possible. A quick method of calculating shielding thicknesses is included in the appendices. (auth)

THE EVALUATION OF RADIATION PROTECTION MATERIAL IN CONTACT WITH GAMMA RADIATION FROM RADIOACTIVE ISOTOPES. Hellmut Glubrecht. Strahlentherapie 102, 489-96(1957) Mar. (In German)
Valuation of substances providing protection from the gamma radiation of radioactive isotopes can be done only in first approximation by their densities. Apart from this, the following items have to be taken into consideration: the spectral composition of the incident radiation, the geometrical conditions for the attenuation of rays, especially with regard to dispersion, the energetic nature of the rays coming out, and the stability of the material towards very high doses of rays. A number of examples have proved lead and special kinds of concrete of high density to be favorable not only as concerns economy in space, but also with regard to the problem of diffuse radiation. (auth)

7356 ✓
THE THEORY OF γ-RAY MULTIPLE SCATTERING. V. S. Galishev, V. I. Ogievetskii, and A. N. Orlov. Uspekhi Fiz. Nauk 61, 161-216(1957) Feb. (In Russian)
A systematic review of calculations for multiple scattering of 0.05- to 10-Mev γ quanta are presented. The general regularities of γ-ray attenuation in thick absorbers were determined and the spatial expansion and γ emission energy spectrum for all practical problems were calculated. (R.V.J.)

RADIATION PROTECTION AGAINST A 10 CURIE SOURCE OF COBALT. Arch. Ind. Health 14, 299-300(1956) Sept.

11946 ✓ AERE-HP/GEN-5
United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England.
ABSORPTION IN WATER OF THE γ RADIATION FROM IRRADIATED URANIUM SLUGS. E. M. Flew and B. T. James. Nov. 29, 1955. 4p.
Graphs are presented of the fraction of gamma radiation transmitted through water thicknesses up to 5.5 ft. Measurements were taken at water level and at four inches above water level. (W.D.M.)

6878 ✓ A/CONF.15/P/1484
QUANTITATIVE & QUALITATIVE ESTIMATION OF GAMMA RADIATION SCATTERED FROM PROTECTIVE BARRIERS. K. A. Mahmoud (Egyptian Atomic Energy Commission, Cairo). 19p.
Protective barriers against primary and secondary radiation are necessary in x- and γ-ray rooms. As well as absorbing radiations, these barriers inevitably scatter radiation back into the room. Hence it is important to determine the factors which affect quantity and nature of scattered radiation in order to find means to minimize the effects. Investigations on quantity and quality of radiation scattered from lead and concrete walls of density 2.4 g/cm^3 are reported. The effects of covering concrete with lead sheets of different thicknesses was also studied for the energy range 0.085 to 2.76 Mev. (auth)

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GENERAL 4.02.08.06

See also, under SURVEYS (GENERAL),

FUEL CYCLE--General (7.03.03).

8215 NP-8312
Nuclear Shielding Supplies and Service, Inc., White Plains, N. Y.
RADIATION SHIELDING—BIBLIOGRAPHY. 1959. 27p.
A bibliography of 331 references on shielding is presented. (J.R.D.)

11684 CF-58-8-79
Oak Ridge National Lab., Tenn.
SHIELDING REQUIREMENTS FOR THE POWER REACTOR FUEL REPROCESSING PILOT PLANT.
J. P. Nichols. Aug. 29, 1958. 11p. Contract [W-7405-eng-26]. $3.30(ph), $2.40(mf) OTS.
Shielding requirements for the Power Reactor Fuel Reprocessing Pilot Plant were determined as an aid to storage canal and building design. The recommendations are made so that plant personnel will not be exposed to a radiation dose rate in excess of one mr per hour during routine plant operation. Fuel assemblies in the storage canal should be covered with 12 ft of water. The dissolver charging machine should be covered with 12 in. of lead. The concrete cell wall should be 5 ft thick. (auth)

1784
REMOTE HANDLING. 4. SHIELDING SYSTEMS. R. A. G. Welsher (A.E.R.E., Harwell). Nuclear Eng. 2, 427-30 (1957) Oct.
Various types of materials for shielding against high-energy radiation are considered. (W.L.H.)

ON MISCONCEPTIONS ABOUT SOME PROTECTIVE MEASURES FOR INDIVIDUAL PROTECTION OF PERSONNEL AGAINST γ RADIATION. S. M. Gorodinskii and E. A. Fishevskaya. Med. Radiol. 2, 83-4(1957) May-June. (In Russian)

5676 NDA-2015-93
Nuclear Development Corp. of America, White Plains, N. Y.
FINAL REPORT ON SHIELDING CONTRACT FOR 1956.
J. Certaine and H. Goldstein. Dec. 31, 1956. 4p. Contract [AT(30-1)-862-Modification No. 31]. $1.80(ph OTS); $1.80(mf OTS).
A brief outline of the NDA shielding materials development program is presented. (D.E.B.)

SHIELDING AGAINST NUCLEAR RADIATION. C. E. Iliffe (U.K.A.E.A., Industrial Group, Risley). J. Brit. Nuclear Energy Conf. 1, 241-60(1956) July.
The characteristics of neutron radiation are first described and the concepts of cross-section, flux, and current density defined. Fick's Law of Diffusion as applied to neutrons then leads readily to the two-group theory of neutron diffusion as used in reactor theory, with the additional concepts of diffusion, slowing-down and extrapolation lengths. The shortcomings of the two-group theory in shielding problems are emphasized. The properties and sources of

Technical Information Service Extension, AEC.
RADIATION SHIELDS AND SHIELDING: A BIBLIOGRAPHY OF UNCLASSIFIED REPORT LITERATURE. July 1956. 20p. (TID-3303).
This bibliography contains 77 annotated references to unclassified reports written prior to November 1954. Author, subject, and report number indexes are provided.

10193 AERE-HP/GEN-6
United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England.
CALCULATION OF U, Pb, Fe AND Al SHIELDING FOR IRRADIATED NATURAL URANIUM. E. M. Flew and B. T. James. Dec. 5, 1955. Decl. Mar. 31, 1958. 6p.
A list of all gamma-emitting fission products with significant yield after decay for one day was compiled, and the products grouped according to gamma-energy ranges. Dosage transmission factors were calculated and graphs plotted for fractions of gamma dosage transmitted against thickness of aluminum, iron, lead, and uranium for cooling times of 1, 16, and 63 days assuming an irradiation time of 3 weeks. (J.R.D.)

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GLASS 4.02.08.07

14359 TID-7556(p.160-7)
Argonne National Lab., Lemont, Ill.
SHIELDING WINDOW DESIGN FOR THE EBR-II PROCESS BUILDING. K. R. Ferguson and L. M. Safranski. p.160-7 [of] SIXTH HOT LABORATORIES AND EQUIPMENT CONFERENCE, MARCH 19-21, 1958, INTERNATIONAL AMPHITHEATRE, CHICAGO, ILLINOIS. 8p.

The shielding window design for the facility for processing and refabrication of fuel elements for the Experimental Breeder Reactor No. II is described. The window is designed for a gamma radiation intensity up to 10^6 r/hr for eight hours per day. Steel shutters will shield the window when it is not in use. The design reasons for the window configuration and the choice of materials are discussed. Operation of the plant in an inert atmosphere requires a gas tight seal at the window aperture. The design details of the seal and test data on its performance are included. Also, data are included on the computed light transmittance of the window before and after a 10^{10} r exposure. (auth)

13534 NAA-SR-3267
Atomics International Div., North American Aviation, Inc., Canoga Park, Calif.
THE LEAD-GLASS VIEWING WINDOW IN THE PROCESSING REFABRICATION EXPERIMENT. G. Gustovich. May 1959. 31p. Contract AT-11-1-GEN-8. $0.75(OTS).

Design data and features incorporated in the all-glass radiation-shielding window designed for the proposed PRE facility and the techniques for servicing components of the window assembly are discussed. The PRE shielding window was designed so that all in-cell components can be replaced by the in-cell crane. If necessary, the lead-glass window can be replaced from the operating gallery. An in-cell cover glass gasketed to the cell liner prevents a loss of cell atmosphere during the replacement operation. Auxiliary in-cell shielding would be used during window replacement. (auth)

THE ROLE OF GLASS IN RESEARCH AND APPLICATION OF ATOMIC ENERGY. Oszkar Knapp. Energia és Atomtech. 11, 647-9(1958) Sept.-Oct. (In Hungarian)

The use of lead glass as shielding material in hot cell windows is reviewed. The measurement of γ energy, the Cherenkov effect in special lead glasses, and the use of silver phosphate and cobalt borosilicate glasses for γ dosimetry by determining the darkening effect are discussed. (R.V.J.)

14359 TID-7556(p.160-7)
Argonne National Lab., Lemont, Ill.
SHIELDING WINDOW DESIGN FOR THE EBR-II PROCESS BUILDING. K. R. Ferguson and L. M. Safranski. p.160-7 [of] SIXTH HOT LABORATORIES AND EQUIPMENT CONFERENCE, MARCH 19-21, 1958, INTERNATIONAL AMPHITHEATRE, CHICAGO, ILLINOIS. 8p.

The shielding window design for the facility for processing and refabrication of fuel elements for the Experimental Breeder Reactor No. II is described. The window is designed for a gamma radiation intensity up to 10^6 r/hr for eight hours per day. Steel shutters will shield the window when it is not in use. The design reasons for the window configuration and the choice of materials are discussed. Operation of the plant in an inert atmosphere requires a gas tight seal at the window aperture. The design details of the seal and test data on its performance are included. Also, data are included on the computed light transmittance of the window before and after a 10^{10} r exposure. (auth)

6443 AECD-3786
Hanford Works, Richland, Wash.
ATTENUATION OF GAMMA RADIATION BY HIGH DENSITY LEAD GLASS COMPARED WITH STEEL. R. G. Wheeler. Mar. 21, 1950. Decl. with deletions Dec. 2, 1955. 11p. Contract W-31-109-eng-52. $0.15(OTS).

Calculations, based on absorption coefficients obtained previously indicate that 80% PbO in glass should attenuate 1.5 to 2.5 Mev gamma radiations as effectively as steel. The comparison of steel with lead glass having a density of 6.17 g/cc showed that for practical purposes the shielding properties of the two materials are the same, when irradiated U and Al are used as the sources of radiation. The efficiency of light transmission of 6.17 density lead glass compared favorably with 4.6 density commercial fluoroscopic grade lead glass. (auth)

14358 TID-7556(p.155-9)
Argonne National Lab., Lemont, Ill.
COLORATION OF SHIELDING WINDOW GLASSES. K. R. Ferguson and R. L. Reed. p.155-9 [of] SIXTH HOT LABORATORIES AND EQUIPMENT CONFER-

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SHIELDING 4.02.08

GLASS 4.02.08.07

ENCE, MARCH 19-21, 1958, INTERNATIONAL AMPHITHEATRE, CHICAGO, ILLINOIS. 5p.

Gamma irradiation tests on commercially produced shielding glasses with sp. gr. of 2.7 and 3.3 were extended to 10^{10}r. Data on the rate of fading after exposure and the rate of re-coloring with re-exposure are included. Data are presented on the effect of the intensity of irradiation and the temperature during irradiation on the total coloration produced by a given exposure. Results of tests on experimentally melted glasses with improved resistance to coloration are included. (auth)

NEUTRONS 4.02.08.08

11538 ✓

RADIATION SHIELD. P. Morrison (to U. S. Atomic Energy Commission). U. S. Patent 2,796,529. June 18, 1957.

A shield is described which is capable of absorbing rays emitted from a source of radiation and in particular a shield capable of absorbing fast neutrons. The disclosed shield utilizes the principle that an effective shield comprises alternate layers of a dense material and a mixture of neutron-slowing material and a substance having nuclei which, after the absorption of a neutron will transmute only into heavy charged particles without any appreciable release of high energy gamma rays. The material arrangement of the disclosed shield consists of a layer of iron, a layer of compressed wood fibers and a plurality of alternate layers of iron and of cellulose acetate containing boron dispersed substantially uniformly therein. (auth)

11537 ✓

RADIATION SHIELD. R. E. Zirkle and H. J. Curtis (to U. S. Atomic Energy Commission). U. S. Patent 2,796,411. June 18, 1957.

Radiation shielding is discussed and in particular a shield used against fast and slow neutrons is described. The novel shield protective material includes a plastic comprising methyl methacrylate resin, which has the desired mechanical properties, and a boron compound. The concentration of boron to be employed in the shielding depends on the neutron flux to be encountered and the desired neutron energies to be shielded out. (auth)

11485

RADIATION SHIELDING. B. T. Price, C. C. Horton, and K. T. Spinney. New York, Pergamon Press, 1957. 358p.

Topics are included on the biological hazards of nuclear radiations, attenuation of γ rays and high-energy electrons, shielding against neutrons and neutron physics, neutron attenuation in thick shields, useful mathematical formulas, and the shielding of reactors and radioactive materials. (M.H.R.)

13218 KAPL-704

Knolls Atomic Power Lab., Schenectady, N. Y.
NEUTRON SHIELDING MATERIALS. T. M. Snyder. Feb. 12, 1952. Decl. Mar. 28, 1957. 8p. Contract W-31-109-Eng-52. $0.20(OTS).

Odd Z elements proved to be better than even Z elements for neutron shielding. The nuclear properties of V, Mn, Co, Cu, As, Br, Ag, Sb, and I were studied. From this study, Cu appears to be the best of the odd Z elements in every regard. It was concluded that Cu should receive serious attention as a possible shielding material wherever compactness and low shield weight are at a premium. (C.H.)

STORAGE 4.02.09

See also, this section,

CRITICALITY (4.02.03),

and,

under FISSIONABLE MATERIAL—RECOVERY,

HEAD-END TREATMENTS--Decay Storage (3.01.03),

and,

under PROCESS CHEMISTRY AND ENGINEERING,

RADIATION EFFECTS (6.15),

and,

under WASTE TREATMENT AND DISPOSAL,

DECAY STORAGE (8.02).

SHIPPING AND HANDLING OF RADIOACTIVE MATERIALS 4.02

STORAGE 4.02.09

DRY STORAGE FACILITY FOR IRRADIATED MATERIAL. S. O. Lewis and S. E. Dismuke (Oak Ridge National Lab., Tenn.). p.199-206 in "Proceedings of the Seventh Hot Laboratories and Equipment Conference."

A shielded dry storage facility for storing canned radioactive materials is described. There are two hundred cylindrical receptacles, 6-½ inches inside diameter by 40 inches deep, which receive the 6-inch diameter storage cans. A remotely operated manipulator is used for transferring the canned materials in and out of this storage facility. (auth)

A NEW RADIATION-SECURE VAULT FOR THE STORAGE OF RADIOACTIVE SUBSTANCES. K. Knopp and A. Rummel (Univ.-Frauenklinik Würzburg, Ger.). Fortschr. Gebiete Röntgenstrahlen u Nuklearmed. 89, 483-5(1958) Oct. (In German)

A new vault for the storage of radioactive substances was constructed. It has advantages compared with previous ones in offering not only good protection against radiation and theft, but also in shielding the hands of the therapist. This was achieved by means of a mechanism placed at some distance from the source and which causes opening or closing of the tubular container by means of pressure or traction. (auth)

INVENTORIED STORAGE OF LARGE NUMBERS OF SMALL RADIOACTIVE PARTICLES. L. E. Preuss (Edsel B. Ford Inst. for Medical Research, Detroit). J. Sci. Instr. 35, 307(1958) Aug.

A large number of small metal samples of radioactive tungsten, chromium, and gold have been activated in the Oak Ridge Pile. The problems of storage, records, and shielding are discussed. (A.C.)

NEW KIND OF STORAGE INSTALLATION FOR RADIOACTIVE SUBSTANCES. (to August Hofmann). German Patent 1026011. Atompraxis 4, 342(1958). (In German)

3035

CARRIER-FREE SOLUTION STORAGE IN GLASS. I. L. Preiss and R. W. Fink (Univ. of Arkansas, Fayetteville). Nucleonics 15, No. 10, 108(1957) Oct.

Solutions of carrier-free radioactive nuclides in laboratories often are stored in glass containers. It is pointed out that carrier-free solutions always should be stored in inert plastic containers. Moreover, the introduction of extraneous solids from reagents such as HCl that have been stored in glass must be avoided, usually by repurification of all reagents. (L.T.W.)

5255 HW-61510

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

PLANT MODIFICATIONS FOR REPROCESSING NON-PRODUCTION REACTOR FUELS. DESIGN CRITERIA FOR FUEL ELEMENT STORAGE FACILITY, BUILDING 221-U. Project CGC-830. M. E. Yates. Aug. 17, 1959. 16p. Contract [AT(45-1)-1350]. OTS.

The design of facilities is reported for removing fuel elements from the casks and moving the elements to modified existing 10 ft by 16 ft by 14 ft storage tanks where they will be stored until scheduled for processing. Each storage tank is equipped with a storage rack for storing elements as received in a sub-critical array, two air-lift circulators for agitation to improve heat transfer and tank cleaning, and jumpers. Additional facilities are provided in one cell only for measuring the volume and inlet and outlet temperatures of the cooling water for technical information. All handling of the elements in their respective baskets will be accomplished by use of the existing 75-ton overhead remote crane. Provisions are also provided for the major decontamination of the casks in the railroad tunnel prior to their removal. (W.L.H.)

11672 ✓ KLX-015(Del.)

Kellex Corp., New York.

BULK STORAGE OF RADIUM CAKE—PRELIMINARY COST ESTIMATES. June 15, 1949. Decl. with deletions Feb. 26, 1957. 30p. Contract AT-30-1-GEN-169. $6.30 (ph OTS); $3.00(mf OTS).

Two alternates were considered for transferring radium cake from the point of manufacture to the place of storage.

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The cake produced in drums should be emptied individually into a storage basin, and the slurry should be put in a tank car for future pumping into a storage basin. As a result of this cost study, it is recommended that bulk storage loading be accomplished by the tank car transfer of radium cake in slurry form. The tank car transfer method is more attractive from an engineering viewpoint than the drum transfer method, but the capital investment of this system is much higher. (F.S.)

10440 ✓
STORAGE BINS FOR CONTAINERS WITH MATERIALS EMITTING γ-RAYS. V. Yemel'yanov. Atomnaya Energiya 3, 565(1957).
A storage bin was constructed for containers to store materials emitting γ rays, especially Co^{60} and Cs^{137}, with a total activity of about 100 mg-equiv. of radium. The storage bin is made of iron plate and consists of two sections. The 40-cm-high lower section, the storage space proper, is equipped with a rotary device. The 60-cm-high upper section is filled with concrete for radiation protection. A 10-cm diameter opening in the concrete layer, makes possible the placing of containers upon the rotating iron plate. (TCO)

6574
THE PROTECTION OF MULTICURIE STRONTIUM YTTRIUM (90) SOURCES J. L. Haybittle (Addenbrooke's Hospital, Cambridge, Eng.). Phys. in Med. and Biol. 1, 270-6(1957) Jan.

12653
MAXIMUM PERMISSIBLE CONCENTRATION OF RADIOISOTOPES. A. Catsch. Atomkern Energie 2, 181-6(1957) May. (In German)

8832 ✓ ✓ HW-42488
General Electric Co. Hanford Atomic Products Operation, Richland, Wash.
FISSION PRODUCT HEAT GENERATION TABLES. W. H. Swift and G. L. O'Neill. Apr. 10, 1956. 57p. Contract W-31-109-Eng-52. $9.30(ph OTS); $3.60(mf OTS).
The heat generation by the radioactive decay of fission products associated with one ton of irradiated uranium was calculated by the IBM-702 computer for several irradiation histories and for cooling times of 60 to 4000 days. Only those fission products of interest in separations plant waste storage were considered. These fission products are listed along with pertinent data. (M.H.R.)

12160 ✓ AAEC/E-6
Australia. Atomic Energy Commission Research Establishment, Lucas Heights, New South Wales.
GROWTH OF BERYLLIUM UNDER IRRADIATION. K. F. Alder. Feb. 1956. 10p.
The results of a calculation estimating the rate of swelling of beryllium metal by the formation of bubbles of helium gas due to irradiation are reported. (auth)

7529
A SAFE FOR RADIOACTIVE MATERIAL PERMITTING EASY SUPERVISION. A. Somerwil. J. belge radiol. 39, No. 1, 127-32(1956). (In English)
To allow quick, easy and accurate visual checking of a stock of Ra material a safe of relatively small dimensions was built. It offers sufficient protection and the stock is stored in such a way that visual control can be made in a few minutes without the controlling person being exposed to radiation of any importance. Construction and other details of the safe, which has no heavy mobile parts, are presented. (auth)

173 AECU-3096
Knolls Atomic Power Lab., Schenectady, N. Y.
SEALING RADIOACTIVE SPECIMENS IN GLASS AMPOULES. Myron B. Reynolds. [1955?]. 3p. Contract W-31-109-Eng-52.
The handling, sealing in glass ampoules, and storage of specimens of neutron-irradiated metal wire is described. (C.H.)

RECOMMENDATIONS FOR THE STORAGE OF RADIUM CAKE. George White, Jr. and W. P. Lamb. May 20, 1949. Decl. with deletions Dec. 5, 1955. 27p. (AECD-3793)

9699 ✓ NYO-5228
Mallinckrodt Chemical Works, St. Louis.
THE DETERIORATION OF UO_2 IN STORAGE. G. L.

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Martin. May 1948. Decl. Mar. 7, 1957. 5p. $1.80(ph OTS); $1.80(mf OTS).

Long-term storage of UO_2 in non-airtight containers will result in losses from 2 to 4% due to oxidation as a result of temperature effects. Losses could be reduced by producing UO_2 with smaller specific surface. (W.L.H.)

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PROCEEDINGS OF THE SECOND UNITED NATIONS INTERNATIONAL CONFERENCE ON THE PEACEFUL USES OF ATOMIC ENERGY, HELD IN GENEVA, 1 SEPTEMBER–13 SEPTEMBER 1958. VOLUME 23. EXPERIENCE IN RADIOLOGICAL PROTECTION. Geneva, United Nations, 1958. 461p. $14.50.

New developments in radiation protection and recovery are reviewed. Topics discussed include developments in experimental therapy, methods for the assessment of biological contamination, radiation in the natural environment, experience in radiological protection and the control of radiation hazards, the evaluation of radiation hazards, the development of instruments for the detection of contamination, and the treatment of internal contamination. (C.H.)

Technical Information Service Extension, AEC.
A BIBLIOGRAPHY OF SELECTED AEC REPORTS OF INTEREST TO INDUSTRY. PART 8. INDUSTRIAL MANAGEMENT. PART 9. HEALTH AND SAFETY. Jan. 1953. 24p. (TID-3050(Pts. 8 and 9)).

These bibliographies consist of 12 references to nonclassified reports in the field of industrial management, and 91 in the fields of health and safety. A subject index and a list of pertinent bibliographies are included.

HOW TO WORK SAFELY WITH RADIOISOTOPES. L. J. Cherubin (Knolls Atomic Power Lab., Schenectady, N. Y.) and W. A. McAdams (General Electric Co., Schenectady, N. Y.). Mill & Factory 5p.(1958) Nov.

Information is presented on the safe handling of radioisotopes. Discussions are included on biological effects of radiation, maximum permissible dose limits, radiation protection standards, government controls over types of radiation sources, and the economics of radiation protection. Also, the following basic elements of radiation protection are discussed: well-designed facilities and equipment for handling sources; identification of sources of radiation and control of access to radiation areas; operating procedures incorporating accepted standards of radiation protection; measurement of personnel exposure and in-plant and off-plant radiation levels; and employee education in the nature of radiation hazards and principles of control. (J.H.M.)

5503 K-1436
[Oak Ridge Gaseous Diffusion Plant], Tenn; Union Carbide Nuclear Co., Paducah Plant, Ky; and Goodyear Atomic Corp., Portsmouth, Ohio.
PREVENTION AND HANDLING OF RADIATION EMERGENCIES. K. W. Bahler, A. F. Rupp, R. H. Lafferty, Jr., J. W. Wachter, L. S. O'Rourke, and C. R. Milone. Dec. 22, 1959. 68p. Contracts W-7405-eng-26 and AT(33-2)-1. OTS.

Studies carried out by a committee which was set up by Union Carbide Nuclear Company and Goodyear Atomic Corporation following the June 16, 1958, incident at Y-12 to review the prevention and handling of criticality and radiation accidents are summarized. The following areas are considered: evaluation of possible accidents, criticality philosophy and procedures, emergency procedures and mutual assistance, radiation alarms and monitors, communications, personnel monitors, area dosimeters, medical procedures, and training. (auth)

6561
HYGIENE ASSESSMENT OF LABOR CONDITIONS OF WORKERS HAVING CONTACT WITH CERTAIN RADIOACTIVE MINERALS. O. S. Andreeva. Med. Radiol. 4, No. 12, 59-63(1959) Dec. (In Russian)

Hazards arising from the handling of radioactive minerals are enumerated. Sanitation measures are recommended. Measures for radioactive contamination control with respect to equipment, protective garments, and the worker's body are discussed. (C.J.G.)

414 HASL-58
Division of Biology and Medicine, AEC and New York

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Operations Office. Health and Safety Lab., AEC. SYMPOSIUM ON OCCUPATIONAL HEALTH EXPERIENCE AND PRACTICES IN THE URANIUM INDUSTRY, HELD IN NEW YORK CITY, OCTOBER 15-17, 1958. 257p. OTS.

Separate abstracts have been prepared on 38 papers presented at this symposium. A brief summary is included of a panel discussion. (C.H.)

20068

RULES FOR WORKING WITH RADIOACTIVE SUBSTANCES. N. N. Khvostov (Erisman Moscow Scientific–Research Inst. of Sanitary and Hygiene, Ministry of Health, R.S.F.S.R.) Gigiena i Sanit. 23, No. 10, 59-61(1958) Oct. (In Russian)

Rules and regulations are suggested for handling, storage, and transportation of radioactive substances. The rules are specified for various isotopes in relation to their comparative radiotoxicity and practical uses. (R.V.J.)

12180

SAFETY FOR ATOMIC WORKERS. F. R. Paulsen. Atomics and Nuclear Energy 9, 189-93, 197(1958) June.

The safety of atomic workers, ensured by protective clothing, monitors, health physics services, regular medical checks, shielding, glove boxes, and remote control, is discussed. (auth)

15230 TID-7569(p.1-3)

Union Carbide Nuclear Co. Y-12 Plant, Oak Ridge Tenn. and National Lead Co. of Ohio, Cincinnati. INTEGRATED SAFETY ORGANIZATION IN NUCLEAR PLANTS. F. C. Lowry and J. A. Quigley. p.1-3 [of] PROCEEDINGS OF THE 1958 ATOMIC ENERGY COMMISSION AND CONTRACTOR SAFETY AND FIRE PROTECTION CONFERENCE, HELD AT ATOMIC ENERGY COMMISSION HEADQUARTERS BUILDING, GERMANTOWN, MARYLAND, JUNE 24-25, 1958. 3p.

The two basic types of nuclear safety organizations employed by Union Carbide Nuclear Company are described. The first type is illustrated by the setup of the Oak Ridge Gaseous Diffusion Plant and involves the complete organizational integration of the safety functions themselves. The safety, fire prevention, health physics, industrial hygiene, radiation control, mechanical testing and inspection, and medical organizations all report to one man who administers the functions as a staff division. The second type is evidenced by the organization of the Y-12 plant at Oak Ridge and represents the integration of organizationally separate safety functions through coordination of effort. Functional integration is achieved through a system of safety committees. (W.L.H.)

3715

DEUTSCHE ATOMKOMMISSION. FACHKOMMISSION IV (STRAHLENSCHUTZ) REFERATENSAMMLUNG. (German Atomic Commission. Commission on Radiation Protection Data. Abstract Collection). No. 5 of "Schriftenreihe des Bundesministers für Atomkernenergie und Wasserwirtschaft. Strahlenschutz." Brunswick, Ger., Gersbach & Sohn Verlag GmbH., 1958. 130p. DM 4.

Reports presented to the German Atomic Commission on radiation measurement methods, radiation protection in working with radioactive materials, and radiobiology are compiled. The topics considered include latest methods in radiation measurement techniques, measurement methods for radioactivity determinations in air, water, soils, flora, and fauna, determination of very low activities in water, radiation standards, permissible doses, radiation protection precautions in the US and UK, distribution and effects of incorporated radioactive materials, radiohematology as center of radiobiological research, genetic effects of radiation in man, radiosensitivity during hibernation, biological basis of radiohematology, and radiation damage to genes. (J.S.R.)

13688 WADC-TR-57-118(Pt.I)

RCA Service Co., Inc., Camden, N. Y. A RADIOBIOLOGY GUIDE. Robert E. Barbiere, Richard F. Sweeton, George P. Sakalosky, and Paul E. Klatt. June 1958. 120p. Contract AF33(616)-3665. (AD-118082).

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Radiobiology pertinent to power and research applications of nuclear energy is discussed. The following topics are treated: nuclear physics, observed biological effects of radiation, shielding methods, monitoring instruments, medical evaluation of personnel, treatment of injuries, and permissible doses. (auth)

HAZARDS OF RADIOACTIVITY; THE FIFTH NATIONAL CONFERENCE ON PERSONNEL PROTECTION IN GOTTWALDOV. J. Fuska. Jaderna Energie 4, No. 1, 27 (1958) Jan. (In Czech.)

6333 A/CONF.15/P/2510
LA MEDECINE INDUSTRIELLE DANS LE CENTRE D'ETUDE DE L'ENERGIE NUCLEAIRE DE MOL. (Industrial Medicine in the Nuclear Energy Study Center at Mol.) M. H. Faes (Centre d'Etude de l'Energie Nucléaire, Brussels). 13p.

The aim of an industrial medical service is to maintain the health of the personnel in normal conditions and to treat personnel in the case of accidents or illnesses caused by the work. The first objective of a medical service is one of control, in which a thorough clinical, radiological, and laboratory examination is given to all prospective employees. This examination is described in detail. The discovery of professional illnesses is as fully described. The legal safeguards for a person accidentally exposed to radiation are discussed. (J.S.R.)

9651
PROBLEMS OF TOXICOLOGY OF RADIOACTIVE SUBSTANCES. D. I. Zakutinskii. Med. Radiol. 3, No. 1, 3-8(1958) Jan.-Feb. (In Russian)

A review of biological effects induced by radioactive substances is presented. (R.V.J.)

USES OF RADIOISOTOPES IN THE USSR. A. V. Topchiev, I. T. Alad'ev, and P. S. Savitskii. Atomnaya Energ. 5, 321-34(1958). (In Russian)

A review is presented of the production and handling of radioisotopes in the USSR. More than 90 radioactive isotopes, 170 stable isotopes, and 360 labeled compounds are produced. Production planned for the year of 1958 is as follows: Co^{60}, over 190,000 c; C^{14}, 200 c; Pu^{32}, 1100 c; S^{35}, 900 c; I^{131}, 1200 c; Au^{198}, 1000 c; Ir^{192}, 192 c; Cs^{137}, 137 c; and Tu^{170}, 750c. 75 references.

RADIATION PROTECTION. Carl B. Braestrup and Harold O. Wyckoff. Springfield, Ill., Charles C Thomas, 1958. 374p.

Potential hazards for man resulting from developments in nuclear energy are reviewed. A summary is presented of the present knowledge of radiation protection. The material is presented in a manner understandable to professional people who are not specialists in the field. The material is applicable to the training of radiological defense groups. (C.H.)

2629 USNRDL-TR-186
Naval Radiological Defense Lab., San Francisco.
RADIOLOGICAL HAZARD EVALUATION—A CRITICAL REVIEW OF PRESENT CONCEPTS AND A NEW APPROACH THERETO. E. L. Alpen. Oct. 22, 1957. 33p. Project NM-006-015.

Data are reviewed on the biological effects of whole-body radiation on human beings and the rate of recovery following whole-body exposure as a function of amount of injury. Tabulated data are presented on the estimated medical effects of radiation doses from 75 to 650 r expressed as percentages of working force affected for healthy, young adults for times up to three months post exposure; the acute effects of whole-body penetrating ionizing radiation on human beings; the biological effects of radiation on the skin; and the absorber characteristics of fabrics. An attempt is made to establish criteria based on present knowledge of radiobiological response of human

14514 A/CONF.15/P/390
General Electric Co. Hanford Atomic Products Operation, Richland, Wash.
RADIATION BIOLOGY AS A SUPPORTING FUNCTION FOR ATOMIC ENERGY INSTALLATIONS. H. A. Kornberg. 11p. $0.50(OTS).

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Prepared for the Second U. N. International Conference on the Peaceful Uses of Atomic Energy, 1958.
The radiation biology research and control programs at the Hanford Atomic Products site is described. Included is a review of research projects that arose because of knowledge needed to assess the hazards of radioactive gases, particles, and liquid effluents from the operation of reactors and chemical plants. A description of control procedures, necessary to provide continuing assessments of the effectiveness of radiation hazard control procedures by means of surveying terrestrial and aquatic animals is presented. (auth)

RADIATION HAZARDS AND PROTECTION. D. E. Barnes and Denis Taylor. London, George Newnes Limited, 1958. 185p.
Information is presented on the following topics: nature and properties of radiation; units of radiation and radioactivity; radioactivity; effects of radiation of the human system; naturally occurring radiations; the standard man; permissible doses; radiation output; measurement of radiation; fundamentals of instrumentation; building and laboratory design; shielding design; instruments for the measurement of radiation dose-rate; personal protection; instruments for measuring radiation dose; surface contamination; contamination monitors; air sampling; biological monitoring; apparatus and methods of radioassay; waste disposal; transport of radioactive material and other legal aspects; and radiation from nuclear weapons. (J.H.M.)

14185
NUCLEAR TECHNICS: PHYSICS, TECHNOLOGY, REACTORS. PART III. Wolfgang Riezler and Wilhelm Walcher, eds. Stuttgart, B. G. Teubner Verlagsgesellschaft, 1958. pp. 321-480. (In German)
Part III continues the discussions of the special technological problems of nuclear techniques. The section on the applications of radioactive and stable isotopes is finished, and the topics of hot laboratories, radiation shielding, radiation protection, and radiation damage completes the consideration of special technological problems. The chapters on reactors are introduced with a general survey of the field. Neutron kinetics and reactor statistics are considered in the section on reactor theory. (J.S.R.)

European Company for the Chemical Processing of Irradiated Fuels, Mol, Belgium.
GENERAL SAFETY FACTORS FOR A NUCLEAR FUEL REPROCESSING PLANT. PART 1. NUCLEAR SAFETY. PART 2. RADIATION SHIELDING. PART 3. CHEMICAL SAFETY PROBELMS. Technical Report No. 2. Alf Larsson. Dec. 12, 1957. 15p. $3.30(ph), $2.40 (mf) OTS.
Nuclear safety in a fuel reprocessing plant is discussed. Means of avoiding criticality such as mass limitation, safe geometry, and safe concentrations are examined along with a note of caution on reflection. In addition, shielding is discussed, and it is pointed out that major pieces of equipment must be heavily shielded especially at the head-end of the process. Designs based on maximum permissible dose rates are described, and recommendations for minimizing radiation are presented. Also, chemical safety aspects are considered including processes which involve toxic and irritant chemicals and those which involve inflammable or explosive materials. Several chemicals are listed according to their hazardous properties, and examples are given of the results of poor safety procedures. An outline of hazards to be avoided is also presented. (J.R.D.)

1924
PREVENTING INJURY FROM RADIATION. John R. Hall (Office of the Surgeon General, Department of the Army). Public Health Repts. (U.S.) 72, 426-30(1957) May.

8506 TID-7554(p.240-52)
Brookhaven National Lab., Upton, N. Y.
RADIATION SAFETY IN A RESEARCH LABORATORY. F. P. Cowan. p.240-52 [of] PROCEEDINGS OF THE INTER-AMERICAN SYMPOSIUM ON THE PEACEFUL APPLICATION OF NUCLEAR ENERGY, BROOKHAVEN NATIONAL LABORATORY, MAY 13-17, 1957. 13p.
In planning and executing research work involving radioactive materials, emphasis must be placed on

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radiation safety. The need to do so arises from the fact that radioactive materials are extremely toxic as compared with nonradioactive poisons, and the radiations they emit produce no sensory response in the body even for lethal exposures. The health physics program in a large laboratory is outlined, and many aspects of health physics are discussed. (C.H.)

4103
RADIOCHEMICAL LABORATORIES. R. Gwozdz (Inst. of Nuclear Research, Warsaw). Nukleonika 2, 507-23(1957). (In Polish)
The danger of exposure to ionizing radiation during the work is discussed, and radiochemical laboratories are classified according to their level of radiation. A concise description of tracer and low-activity laboratories is included. Problems of radioactive contamination in radiochemical laboratories are analyzed. (tr-auth)

12651 ✓ KAPL-1831
Knolls Atomic Power Lab., Schenectady, N. Y.
HEALTH PHYSICS REPORT FOR JANUARY, FEBRUARY, MARCH 1957. 32p. Contract W-31-109-Eng-52. $0.25 (OTS).
Personnel, in-plant, and environmental radiation monitoring procedures engaged in during the period are summarized. (For preceding period see KAPL-1699.) (C.H.)

1262
THE CONTAINMENT PHILOSOPHY AT THE SAVANNAH RIVER LABORATORY. A. J. Hill, Jr. (E. I. du Pont de Nemours & Co., Inc., Wilmington, Del.). Chem. Eng. Progr. 52, Symposium Ser. No. 19, 25-6(1956).
The application of the containment method of working with radioactivity at the Savannah River Laboratory is reviewed. The method requires the radioactive materials to be isolated from the worker insofar as practical and has been successfully used for several years at the Radiation Laboratory of the University of California. The organization and functions of the Savannah River Laboratory Radiation Control Group, which furnishes the services necessary to work within the scope of the containment philosophy, are described, and the advantages resulting from the method evaluated. (auth)

16135 ✓ JPRS-453-D
TECHNOLOGY OF SAFETY AND LABOR PROTECTION IN WORK WITH RADIOACTIVE ISOTOPES. Translated from Vrachebnoe Delo, 329-32(1957). 4p. $0.50(OTS).
The status of radiation protection procedures in laboratories and agencies engaged in work involving the use of radioisotopes is discussed. (C.H.)

11768 ✓
THE CONTROL OF RADIATION HAZARDS IN INDUSTRY, 1957. New York State Department of Labor, 1957. 127p.
A compilation is given of the material presented at the first state Radiological Health Conference in Buffalo, Jan. 1956. The chapters are entitled: Fundamentals of Radiation Science; Biological Effects of Ionizing Radiation; Radiation in Industry; Principles of Radiation Hazard Control; Instruments for Detection and Measurement of Radiation; Specific Installations and Operations; Surveying Methods and Procedures; and Regulation of Radiation Hazards in New York State. (T.R.H.)

903
RADIOACTIVE WASTE AND HEALTH PROTECTION PROBLEMS. A. N. Mareĭ. Med. Radiol. 1, No. 4, 3-7(1956) July-Aug. (In Russian)

HEALTH AND SAFETY IN A NUCLEAR POWER INDUSTRY. A. S. McLean and W. G. Marley. J. Brit. Nuclear Energy Conf. 1, 24-34(1956) Jan.
A short review of the general effects of radioactivity and ionizing radiation on human beings is given, and the basic problems of radiation protection are stated. The various features of nuclear power development, such as the nuclear reactors, chemical separation plants and waste-disposal facilities, are examined in relation to their potential occupational and public health hazards and these are compared with the health and safety problems arising elsewhere in industry. The extensive experience of the Atomic Energy Authority in this field is reviewed and used to indicate the type of protective measures and procedures which are likely to be effective in ensuring continued safe development in the new industry. (auth)

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9966 AERE-HP/L-23
Gt. Brit. Atomic Energy Research Establishment, Harwell, Berks, England.
A SHORT COURSE IN RADIOLOGICAL PROTECTION.
R. J. Sherwood and H. J. Dunster, eds. June 1956. 103p.

4326 DP-186
Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Augusta, Ga.
RADIATION CONTROL AT THE SAVANNAH RIVER LABORATORY. Gordon M. Nichols. Nov. 1956. 15p.
Contract AT(07-2)-1. $0.20(OTS).
A general discussion of the philosophy, organization, and functions of the Radiation Service organization of the Savannah River Laboratory is presented, together with a brief summary of operations to January 1956. (auth)

RADIOISOTOPES—USES. HAZARDS. CONTROLS. U. S. Atomic Energy Commission, Division of Civilian Application. Oak Ridge, Tenn. 1956. 28 p.
Contents: General information on radioisotopes and their uses; hazards associated with radiation; control of radioisotope distribution.

1710
PROTECTION MEASURES IN A UNIVERSITY. Titus C. Evans (State Univ. of Iowa, Iowa City). Radiology 65, 875-83(1955) Dec.
Radiation safeguards in a university would appear to be maintained most successfully by rigorous training and self-discipline, by a willingness on the part of the users to be extremely cautious in preventing those conditions which might give rise to either adverse publicity or mental unrest even though permissible exposure levels are not exceeded. Supervision may be carried out by routine visits by a radiation protection officer to each user's laboratory, by providing a central hot lab, where potentially hazardous materials are handled in collaboration with members of that laboratory, or by a combination of the two methods. (auth)

23027
WORK OF INTERNATIONAL COMMISSION ON RADIOLOGICAL PROTECTION. Lauriston S. Taylor (National Bureau of Standards, Washington, D. C.). p.2889-2979 of "Hearings on Industrial Radioactive Waste Disposal. Volume 4."
Committee reports on radioactive materials include: the handling of radioactive isotopes and disposal of radioactive waste; facilities necessary for laboratory work with open sources of radioactive material and distributable sources; working habits and procedures (pertaining to industrial personnel working with radioactive materials); area and personnel monitoring and decontamination; storage, transportation, and disposal of radioactive wastes. (C.J.G.)

19987 NP-7834
European Company for the Chemical Processing of Irradiated Fuels, Mol, Belgium.
SAFETY HAZARDS CONSIDERATIONS. Technical Report No. 45, Chapter 500. H. H. Ph. Moeken and J. J. H. Alderhout. 22p. $4.80(ph), $2.70(mf) OTS.
The effects of an emergency release of radioactive materials from the Eurochemic plant into local ground water or the atmosphere were evaluated. Leakage from liquid waste tanks is considered as well as atmospheric contamination by I^{131} escape. Credible accidents are analyzed, and recommendations concerning equipment and procedures are made. (J.R.D.)

1026 TID-7517(Pt. 1)
Division of Reactor Development, AEC and Public Health Service, Washington, D. C.
SANITARY ENGINEERING ASPECTS OF THE ATOMIC ENERGY INDUSTRY. A SEMINAR SPONSORED BY THE AEC AND THE PUBLIC HEALTH SERVICE, HELD AT THE ROBERT A. TAFT ENGINEERING CENTER, CINCINNATI, OHIO, DECEMBER 6-9, 1955. 635p. (Issued in two parts: (Pt. Ia), 322p. and (Pt. Ib), 313p.). $3.10 (OTS).

1993 APEX-218
General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati.
RADIOLOGICAL EDUCATION AND TRAINING PROGRAM — INDUSTRIAL HYGIENE. 1955. 28p.
Methods and materials employed in the radiological education and training program of the General Electric Company are described. (C.H.)

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SAFE HANDLING OF BODIES CONTAINING RADIOACTIVE ISOTOPES. A Guide for Surgeons, Pathologists, and Funeral Directors. National Bureau of Standards Handbook 65. Washington, National Bureau of Standards, 1958. 26p. Available for $0.15 from Superintendent of Documents, Washington.

Procedures are outlined for the guidance of surgeons, pathologists, and funeral directors who must handle radioactive bodies. (C.H.)

8155
SUGGESTED PROCEDURE FOR PERFORMANCE OF AUTOPSIES ON CADAVERS CONTAINING RADIOACTIVE IODINE. Russell F. Cowing and Egilda DeAmicis (New England Deaconess Hospital, Boston). Am. J. Clin. Pathol. 26, 29-35(1956) Jan.

Procedures are outlined for the protection of personnel during the performance of autopsies on cadavers containing radioactive iodine. (C.H.)

2633
RESULTS OF RADIATION-PROTECTION MONITORING BY THE FILM BADGE METHOD IN THE YEARS 1957 AND 1958. Walter Brichzy and Felix Wachsmann (Arbeitsgemeinschaft für Strahlenschutz, Erlangen, Ger.). Atompraxis 5, 305-10(1959). (In German)

Approximately 40,000 radiation-protection badges and rings which were evaluated in 1957 and 1958 are used to give statistics on radiation exposure in various groups, which are listed according to type and length of employment, professional and age groups, size of factory and laboratory, etc. The following findings are of particular importance. Radiation exposure has generally decreased over the years. It is relatively high in the professionally less qualified and older groups, and in those employed in medium-sized plants. Obviously, persons who work with radium (gynecologists) are particularly endangered. Radiation exposure in other countries is generally higher than in Western Germany. (auth)

4220
RADIATION SAFETY AND MAJOR ACTIVITIES IN THE ATOMIC ENERGY PROGRAMS, JULY-DECEMBER 1956. Washington, United States Government Printing Office, Jan. 1957. 412p. Price $1.25.

A summary is given of the activities of the various atomic energy programs of the AEC. A section on radiation safety in atomic energy activities is included. (T.R.H.

Refer also to abstract 4681.

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Shipping and Handling of Radioactive Wastes

NBS Handbook No. 42

See also, this section,

LEGAL ASPECTS (4.02.05).

14099
THE DISTRIBUTION OF RADIOACTIVE ISOTOPES. Roman Broszkiewicz (Inst. of Nuclear Research, Polish Academy of Sciences, Warsaw). Nukleonika 3, 329-34 (1958). (In Polish)

The present position and the methods used in the distribution of radioactive isotopes at home and abroad are discussed. Types of isotopes produced in various countries and the range of labeled chemical compounds are described. (tr-auth)

15240 TID-7569(p.68-73)
Idaho Operations Office, AEC.
SHIPPING OF RADIOACTIVE MATERIALS AT THE NATIONAL REACTOR TESTING STATION. Ralph V. Batie. p.68-73 [of] PROCEEDINGS OF THE 1958 ATOMIC ENERGY COMMISSION AND CONTRACTOR SAFETY AND FIRE PROTECTION CONFERENCE, HELD AT ATOMIC ENERGY COMMISSION HEADQUARTERS BUILDING, GERMANTOWN, MARYLAND, JUNE 24-25, 1958. 6p.

A review of the shipment procedures for radioactive materials at the National Reactor Testing Station and an outline of the problems involved in these shipments is presented. (W.L.H.)

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6453
CRITICALITY AND ITS EFFECT ON THE STUDY AND THE USE OF CHEMICAL INSTALLATIONS TREATING FISSILE MATERIALS. A. H. Gillieson (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Énergie nucléaire 1, 17-19(1957) Jan.-Mar. (In French)

A summary is given of the theoretical and practical factors for safe operations in the transport, storage, and treatment of fissile materials. (tr-auth)

2289 CF-57-5-24
Oak Ridge National Lab., Tenn.
COMMENTS ON THE TRANSPORTATION OF IRRADIATED FUEL AND RADIOACTIVE WASTES FOR M. LOUIS ARMAND, EURATOM GROUP. F. L. Culler. May 6, 1957. 32p. Contract [W-7405-eng-26]. $6.30(ph OTS); $3.00(mf OTS).

General considerations involving the transportation of irradiated fuel and radioactive wastes are reviewed. It is assumed that many reactors will supply feed to a few large multipurpose chemical plants which ultimately send radioactive waste to a few disposal sites. General economic considerations of irradiated fuel reprocessing, economic aspects of the nuclear economy complex, growth predictions of the nuclear power economy in the U.S., general requirements for the shipment of fuel and waste, regulations applicable to fuel shipments, and permissible radiation levels are discussed. (C.H.)

15239 TID-7569(p.54-67)
Atomic Energy Commission, Washington, D. C.
COST AND SAFETY CONSIDERATIONS IN THE TRANSPORT OF RADIOACTIVE MATERIALS. Harold A. Knapp. p.54-67 [of] PROCEEDINGS OF THE 1958 ATOMIC ENERGY COMMISSION AND CONTRACTOR SAFETY AND FIRE PROTECTION CONFERENCE. HELD AT ATOMIC ENERGY COMMISSION HEADQUARTERS BUILDING, GERMANTOWN, MARYLAND, JUNE 24-25, 1958. 14p.

The object of this presentation is to summarize, on the basis of available information, the frequency and severity of accidents that can be expected in rail, air, and truck shipments of radioactive materials and to describe the method for deciding when greater safety during shipment is worth additional cost. (W.L.H.)

21707
AN OPERATIONS RESEARCH STUDY OF THE TRANSPORTATION OF HIGHLY RADIOACTIVE MATERIALS. PROGRESS REPORT, APRIL 1959. J. T. Thompson and F. F. Leimkuhler (Johns Hopkins Univ., Baltimore). p.1724-87 of "Hearings on Industrial Radioactive Waste Disposal. Volume 2."

The transportation of highly radioactive materials is treated as an operations research problem of selecting that combination of controllable transportation factors which minimizes cost and maximizes safety. Maximum safety is equated with minimum expected hazard cost, which makes it possible to construct decision models in terms of a total transportation cost, including the expected hazard cost. A detailed analysis is made of the significant factors in the transportation problem; and various methods of evaluating transportation hazards are examined. Examples and applications of the decision models are presented in considerable detail. (auth)

10550
ECONOMICS OF SHIPPING SPENT NUCLEAR FUEL ELEMENTS. Charles E. Dryden (General Electric Co., Schenectady, N. Y.). Nucleonics 14, No. 7, 77-80(1956) July.

Regulations for shipping, shipping cost estimates, design of shipping containers, shielding requirements and transportation for the shipping of spent nuclear fuel elements are discussed. (W.L.H.)

2195 APAE-Memo-34
Alco Products, Inc., Schenectady, N. Y.
SHIELDING OF IRRADIATED APPR-1 FUEL ELEMENTS. F. B. Fairbanks and D. C. Morse. July 6, 1956. 9p. Contract AT(11-1)-318). $1.80(ph OTS); $1.80(mf OTS).

The shielding requirements for irradiated APPR fuel elements in storage and in transit to the reprocessing plant were determined. Results are presented for a single fuel element of twice the average activity. The distance indicated is from the surface of the water in the storage tanks to the nearest point of the active core section. (F.S.)

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6325 TID-7583(p.26-40)
General Electric Co. Hanford Atomic Products Operation, Richland, Wash.
RECEIVING, STORAGE, AND MECHANICAL TREATMENT OPERATIONS AT HANFORD FOR CHEMICAL PROCESSING OF POWER REACTOR FUELS. L. L. Zahn, Jr. 15p.

Plans at Hanford for its cask receiving and unloading, fuel element storage, and mechanical processing functions under the Non-Production Fuels Processing Program are outlined in this paper. These operations will be performed, along with dissolution and metal solution storage, in Hanford's 221-U Building built originally for the now-obsolete bismuth-phosphate separations process. The one new building planned for Hanford under this program will house a crane to transfer the shipping cask to a Hanford railcar for admittance to the 221-U Building, thereby protecting the cross-country car or truck from accidental contamination. The cask unloading and fuel element storage provisions within the 221-U Building are described in the paper Mechanical equipment is planned to complement Hanford's fundamental approach to decladding of fuel elements by chemical means in geometrically safe equipment. The functions of the mechanical cell will include sawing of end fittings, shearing through core material containing sections, examination of dissolver debris following chemical dissolution, and special operations such as separating the Yankee fuel element assembly. Hanford's current status under the Non-Production Fuels Processing Program is also described. (auth)

RADIOACTIVE MATERIAL HANDLING. A. L. Maharam and R. R. Fouse (Westinghouse Electric Corp., Pittsburgh). p.424-32 in "Proceedings of the Seventh Hot Laboratories and Equipment Conference."

Radioactive material handling is discussed both from the problem of correct design and actual operations. Material handling equipment is described from the point of view of activity levels, size of the samples, ease and dependability of operation, and problems encountered in contamination control. (auth)

CHEMICAL TREATMENT AND HANDLING OF RADIOELEMENTS. H. Laurent (Centre d'Études Nucléaires, Saclay, France). Énergie nucléaire 1, 13-22(1959) Jan.-Apr. (In French)

Although many classical chemical techniques are used in radiochemistry, the energies used in the formation of radioisotopes, the low concentration of the isotopes formed, and the secondary effects of the radiation on the solutions and solid bodies require the development of new techniques. The more common methods for the formation and preparation of radioisotopes are reviewed. The dangers to the operator from external radiation and external and internal contamination are considered. The precautions and techniques utilized to minimize these dangers are considered. 64 references. (J.S.R.)

504
LABOR HYGIENE IN THE WORK WITH COVERED SOURCES OF GAMMA RADIATION. N. Yu Tarasenko. Trudy Vsesoyuz. Konf. Med. Radiol. Moskov., Medgiz, 11-18(1957). (Translated from Referat. Zhur. Met., No. 8, 1958, p.285).

Possible cases of irradiation by γ sources in the transportation of compounds and in work with apparatus of movable and stationary types were examined. A table of the character of radioactive isotopes used as sources of γ rays is included. (TCO)

SAFETY MEASURES IN HANDLING RADIOISOTOPES. V. Slouka (Purkyne Military Medical Academy, Hradec Kralove). Pracovni lekarstvi, Praha 10, 176-8(1958). (In Czech.)

Experience acquired in the Purkyne Military Medical Academy in Hradec Kralove City and in English isotope laboratories is described. Personal hygiene and protection of personnel, safety techniques, decontamination, and waste disposal are discussed. Suggestions are made for improvements in working conditions and techniques. (tr-auth)

6329 TID-7583(p.99-112)
Phillips Petroleum Co. [Atomic Energy Div.], Idaho Falls, Idaho.

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any shipment. Inadequate or improper information can result in expensive special handling or return of the shipment. Fuel must have a minimum of 90 days cooling before it will be accepted for storage at ICPP. End plate cutting and simple dismantling can be carried out at ICPP, but complex mechanical operations can probably best be carried out at the reactor site. (auth)

ICPP FACILITIES FOR RECEIVING STORAGE AND MECHANICAL TREATMENT. A. L. Ayers and C. B. Leek. 14p.

The ICPP facilities for unloading, storage and charging irradiated fuel elements are flexible enough to handle a large variety of fuels. However, if the fuel is to be handled efficiently and economically, there must be close liaison between the shipper and the plant. Casks up to 75 tons in weight may be received by rail or motor freight. Whether large or small, a shipping cask must be compatible with the available unloading and underwater handling equipment if the fuel is to be handled. The physical limitations for this equipment are readily available at ICPP. Complete data including detailed composition of the elements, geometric configuration, removable non-fuel bearing parts and criticality limitations including any neutron poison present in the fuel cask must be received by ICPP well in advance of

4688 LA-2147
Los Alamos Scientific Lab., N. Mex.
SAFETY CONSIDERATIONS FOR HANDLING PLUTONIUM, URANIUM, THORIUM, THE ALKALI METALS, ZIRCONIUM, TITANIUM, MAGNESIUM, AND CALCIUM. Ellis L. Stout, comp. Sept. 4, 1957. 24p. Contract W-7405-eng-36. $4.80(ph OTS); $2.70(mf OTS).

This report compiles from various sources safety considerations for work with the special metals plutonium, uranium, thorium, the alkali group, magnesium, titanium, calcium, and zirconium. General criteria to be observed in handling all of these metals and their alloys are listed, as well as characteristics of individual metals with regard to health hazards, pyrophoricity, explosiveness, and other chemical reactions, in both handling and storage. (auth)

4391
ATOMIC FUEL PROCESSING. PART II. HANFORD: ATOMS FOR PEACE. Chem. Eng. 67, 113-18(1960) Jan. 11.

The safety procedures involved in receiving and storing a spent reactor core are discussed. Mechanical processing procedures such as sawing and shearing are described. The chemical processing facilities include a dissolver for removal of cladding and conversion of the fuel cores to an aqueous nitrate solution and equipment for recovering core material in the cladding removal solutions. The specific mechanical-chemical processes used in aluminum, stainless steel, and Zircaloy cladding removal are described. Fuel processing after cladding removal of UO_2 and U–Mo dissolutions are discussed. Waste disposal and criticality problems are outlined. (C.J.G.)

14532 A/CONF.15/P/1431
California Research Corp., Richmond, Calif.
TEN YEARS' SAFE USE OF ISOTOPES IN PETROLEUM LABORATORIES AND REFINERIES. B. A. Fries and D. E. Hull. 17p. $0.50(OTS).

Prepared for the Second U. N. International Conference on the Peaceful Uses of Atomic Energy, 1958.

Most of the radiation problems in using isotopes in petroleum refineries and research laboratories relate to external exposure. Any task that exposes a worker to more than 7 mr/hr calls for radiation protection. Safety equipment and procedures are designed to take maximum advantage of the factors of distance, time, and shielding, in that order. This results in exposure 10 to 100 times below tolerance without costly remote handling tools and massive shielding. These principles are illustrated by their application to actual problems. (auth)

1199
ORGANIZING AND CONTROLLING THE USE AND SAFE HANDLING OF ISOTOPES. Bertram V. A. Low-Beer (Univ. of California School of Medicine, San Francisco). Hospitals 29, No. 12, 51-7, 156(1955) Dec.

Practices to insure the safe handling of radioisotopes for diagnostic and therapeutic uses are reviewed. (C.H.)

Refer also to abstract 1476.

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MEANS FOR INDIVIDUAL PROTECTION IN HANDLING RADIOACTIVE ISOTOPES. S. M. Gorodinskiĭ. Med. Radiol. 1, No. 5, 84-91(1956) Sept.-Oct. (In Russian)

11344
THE HANDLING OF RADIOACTIVE MATERIALS. R. Martin (Centre d'Etudes Nucleaires, Saclay, France). Rev. de la sécurité 8p. (1957). (In French)
The physical properties and biological effects of radiations are reviewed. Procedures and equipment for handling small quantities of radioactive materials are described. (C.H.)

THE PREPARATION AND HANDLING OF ARTIFICIAL RADIOELEMENTS. René Constant. Industrie chim. belge 22, 1151-60(1957). (In French)

HAZARDS OF RADIOACTIVE MATERIALS. Paul E. Smith, Jr. pp.82-8 in "Transactions of the Nineteenth Annual Meeting of the Industrial Hygiene Foundation of America, Held at Mellon Institute, Pittsburgh, Penna.. November 17-18, 1954". Transactions Bulletin No. 28. Pittsburgh, Industrial Hygiene Foundation of America, 1955. 241p.
Some of the more common industrial uses of radioactive materials are discussed. Hazards and protective measures for handling radioisotopes are discussed. (C.H.)

19068 AERE-Bib-122
United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England.
TECHNIQUES FOR HANDLING RADIOACTIVE MATERIALS. A BIBLIOGRAPHY. A. C. Foskett. June 1959. 37p. $0.70(BIS).
The scope is restricted to the actual handling of radioactive materials and does not include the materials themselves except incidentally. The sources checked include Nuclear Science Abstracts and the indexes at AERE Harwell, the period covered being July 1953 to December 1958. Previous work in the field is covered by AERE Inf/Bib 53 and Supplements. (auth)

15295
OPENER FOR RADIOISOTOPE BOTTLES. G. R. Taylor and H. A. Malcolm (Northern Ireland Radiotherapy Centre, Purdysburn, Belfast). J. Sci. Instr. 36, 291-2 (1959) June.
A radioisotope-bottle opener is described which prevents "spraying" of the radioactive solution on opening the bottle. (A.C.)

POLONIUM^{210}. Am. Ind. Hyg. Assoc. J. 20, 251-2(1959) June.
Recommended procedures are outlined for handling polonium-210. Data are included on properties and maximum permissible exposure levels. (C.H.)

6341 TID-7583(p.432-46)
Oak Ridge National Lab., Tenn.
ACCOUNTABILITY OF SPECIAL NUCLEAR MATERIAL AT OAK RIDGE NATIONAL LABORATORY. W. T. McDuffee. 15p.
The accountability program currently in use at the Oak Ridge National Laboratory is discussed. (W.L.H.)

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20864
RADIATION HYGIENE HANDBOOK. First Edition. Hanson Blatz, ed. New York, McGraw-Hill Book Company, Inc., 1959. 947p.
A compendium of information is presented which will be useful in industry and research involving peaceful uses of atomic energy. It includes: general reference data, glossary of terms, exposure standards and regulations, natural background, ionizing radiation, sources, effects on matter, attenuation data, lab design, detection and measurement, industrial and research and medical applications, determination of exposures, nuclear safety, radiation hygiene chemistry, equipment for handling, storage, and transportation of radioactive materials, surface contamination and decontamination, physiological effects of radiation, sampling equipment, waste disposal, control of radioactive air pollution, and personnel control. (T.R.H.)

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22231 KAPL-A-HP-4
Knolls Atomic Power Lab., Schenectady, N. Y.
OPERATING MANUAL; RADIOLOGICAL STANDARDS AND MEASUREMENTS. G. W. Gasper. Oct. 1, 1958. 62p. Contract W-31-109-Eng-52. $12.30(ph), $4.50 (mf) OTS.

This manual contains the procedures for distribution, recall, calibration, and maintenance of personnel monitoring devices; the techniques of determining radiation exposure and maintaining continuous and permanent records; and the procedures for notification in the event of significant exposure. (auth)

15221 AERE-L-101
United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England.
A SHORT COURSE IN RADIOLOGICAL PROTECTION. R. J. Sherwood, ed. Mar. 1959. 155p. (AERE-HP/L-23(2nd. Ed)). $3.78(BIS).

A brief course in radiation protection was planned for those employing radioisotopes in various industrial applications. A brief outline of some of the fundamental considerations in radiological protection is included, and practical advice is presented of direct use to people actually engaged in handling radioactive materials. Forty-one photographs of equipment and numerous tables of data are included. (C.H.)

9068 ANL-5574
Argonne National Lab., Lemont, Ill.
RADIATION SAFETY GUIDE. J. R. Novak, ed. June 1956. 74p. Contract W-31-109-eng-38. $0.75(OTS).

Work with radioactive substances may involve some danger, and safety precautions must be taken before the work is started. This Guide includes suggested precautions to provide adequate protection, as well as some general information concerning possible radiation hazards and the effects of radiation on the body. It also contains procedural information which will be an aid in coping with radiation safety problems as they occur. (auth)

RADIOLOGICAL HEALTH HANDBOOK. Simon Kinsman. Jan. 1957. 358p. (PB-121784)

This edition of the handbook contains a large amount of readily available information of interest to anyone working in the field of radiation. Sections are included on physical, chemical, and mathematical data; radioisotope, decay, and radioassay data, and radiation protection data. A list of all the radioactive and stable isotopes of the elements, together with a number of their salient features including decay schemes is given. A glossary, a subject index, and a list of references are included.

10411 HW-25457(Rev. 1)
General Electric Co. Hanford Atomic Products Operation, Richland, Wash.
MANUAL OF RADIATION PROTECTION STANDARDS. July 1957. 59p. Contract W-31-109-Eng-52. $9.30(ph OTS); $3.60(mf OTS).

Hanford policies and procedures are reviewed relevant to the control of hazards during work with radiation and radioactive materials. (C.H.)

RADIOISOTOPE LABORATORY TECHNIQUES. R. A. Faires and B. H. Parks. London, George Newnes Limited, 1958. 252p.

A practical guide to the laboratory use of radioisotopes is presented. The terminology may be easily understood by workers having only basic scientific knowledge. The theory of nuclear physics is reviewed briefly. Design features and equipment for radiation laboratories are discussed. Electronic techniques are discussed and radiation detection equipment and techniques are described. Applications of isotopes are reviewed. (C.H.)

LEITFADEN FÜR RADIOAKTIVITÄT UND STRAHLENSCHUTZ. (Manual for Radioactivity and Radiation Protection.) Nicolai Grigor'evich Gusev. Translation of "Spravochnik po Radioaktivnym Izlucheniyam i Zashchite." Berlin, VEB Verlag Technik, 1957.

The essential information on the physical properties of radioactive materials and their radiations is compiled. The question of radiation protection is especially considered. The fundamentals of atomic physics are briefly discussed. The maximum permissible doses

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recommended in the literature for internal and external irradiation are reviewed. A detailed discussion is presented on protection against gamma radiation and the bremsstrahlung from betatrons. Quantitative indications on the absorption coefficient of a narrow gamma radiation beam, self-absorption of gamma rays in extensive radiation sources, quantitative indications on alpha and beta particles, and gamma radiation of radioactive elements are briefly considered. (J.S.R.)

721 IDO-16466
Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho.
A STANDARD PRACTICES GUIDE FOR HAZARD ANALYSIS OF EXPERIMENTAL SYSTEMS. R. J. Nertney. Sept. 8, 1958. 28p. Contract AT(10-1)-205. $1.25(OTS).
This guide is to assist experiment sponsors in performing hazard analyses of experimental systems at the MTR and ETR. The requirements for such analyses are described in general terms. (auth)

5665 IDO-14384
Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho.
MANUAL OF PROCEDURES FOR EFFECTING CONTROL OF SS MATERIAL. B. S. Lewis, F. H. Tingey, and F. P. Vance. Sept. 1, 1956. Changed from OFFICIAL USE ONLY Dec. 28, 1959. 63p. Contract AT(10-1)-205. OTS.
A program of nuclear materials control is described which represents a practicable approach to an optimum combination of measurement and accounting. The program is based on the principle that surveillance of plant material balance is basically a chemical engineering function. Measurement data are under rigorous statistical scrutiny. Chemical process engineers maintain surveillance over routinely collected process control data, and by means of an effective project organization, the information so generated flows via direct lines to the attention of a small clerical staff who prepare periodic reports. The procedure has proved very economical. (C.H.)

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7204 UR-562
Rochester. N. Y. Univ. Atomic Energy Project.
THE CHEMICAL TOXICITY OF THORIUM DIOXIDE FOLLOWING INHALATION BY LABORATORY ANIMALS. H. C. Hodge, E. A. Maynard, and L. J. Leach. Jan. 5, 1960. 33p. Contract W-7401-eng-49. OTS.
Short-term inhalation studies of thorium dusts, soluble or insoluble, inhaled by laboratory animals in high concentrations for short periods, gave practically no evidence of chemical toxicity. Because toxic effects unpredicted from short-term studies sometimes appear in protracted exposures, a one-year inhalation study of thorium dioxide at an atmospheric concentration of 5 mg Th/m^3 was conducted. This study confirmed the inertness of thorium in the body. The retention of thorium in the tissues was followed in serially sacrificed dogs and rats. The data indicate appreciable accumulation of thorium in the lung. For example, for the dog and the rat the lung values averaged 183 and 121 μg Th/g fresh lung, respectively, at the end of the one-year exposure. Of the tissues examined (lung, liver, kidney, spleen, and bone) only the lung showed an increased thorium content with increased exposure. This is demonstrated when the average lung values after one month exposure for the dog (28 μg Th/g) and the rat (31 μg Th/g) are compared with the one-year values. This 5-fold increase was not seen in any of the other tissues examined. (auth)

9463 BNL-483(p.179-80)
Brookhaven National Lab., Upton, N. Y.
RADIATION HAZARDS IN RECYCLED THORIUM FUELS Samuel Zwickler. p.179-80 [of] THORIUM-U^{233} SYMPOSIUM, SPONSORED BY THE UNITED STATES ATOMIC ENERGY COMMISSION AT BROOKHAVEN NATIONAL LABORATORY, JANUARY 9-10, 1958. 2p.
The radiation hazards that will exist at high burn-ups are briefly discussed. (W.L.H.)

9470 BNL-483(p.198-200)
Oak Ridge National Lab., Tenn.
FUEL RECYCLE AND HANDLING. E. D. Arnold. p.198-200 [of] THORIUM-U^{233} SYMPOSIUM, SPONSORED BY THE UNITED STATES ATOMIC ENERGY COMMISSION AT BROOKHAVEN NATIONAL LABORATORY, JANUARY 9-10, 1958. 3p.

SHIPPING AND HANDLING OF RADIOACTIVE MATERIALS 4.02

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The problems associated with recycle and handling of thorium and U^{233} can be divided into several categories: reactor irradiation, activity of recovered irradiated thorium and U^{233}, handling of thorium and U^{233} after processing, and allowable or workable specifications for recovered products. The major problems in handling these materials are due to the external gamma hazard from U^{232}–Th^{228} daughters or the internal hazard due to alpha contamination of air. The problem of spontaneous fission or α-n reactions, although present, appears secondary to the others. (auth)

12146 ✓✓ ISC-771
Ames Lab., Ames, Iowa.
HAZARDS ASSOCIATED WITH THORIUM METALLURGY. A. F. Voigt. [1957]. 32p. Contract [W-7405-eng-82]. $6.30(ph OTS); $3.00(mf OTS).

The permissible limits established for handling of thorium are discussed. The information is divided into sections on chemical toxicity, radiological toxicity (internal and external), and fires and explosions. (T.R.H.)

2244 AECD-3808
Clinton Labs., Oak Ridge, Tenn.
TOLERANCE VALUES FOR THORIUM. Karl Z. Morgan. Nov. 29, 1945. Decl. with deletions Dec. 5, 1955. 9p. $1.80(ph OTS); $1.80(mf OTS).

Problems for consideration in calculating tolerance values for Th are summarized. Data are included on physical characteristics of Th. (C.H.)

2629 AECU-4285
Massachusetts Inst. of Tech., Cambridge. [Radioactivity Center].
RADIUM AND MESOTHORIUM POISONING AND DOSIMETRY AND INSTRUMENTATION TECHNIQUES IN APPLIED RADIOACTIVITY. Annual Progress Report. May 1959. 164p. Contract AT(30-1)-952. OTS.

The half-period of thorium-232 was redetermined as 1.41×10^{10} years. The result is in substantial agreement with the half-periods already reported in the literature. The study of radium and mesothorium toxicity in human beings was continued, with emphasis on living persons as distinct from persons no longer living whose dosimetry is reconstructed from bone or tooth samples. Assays of whole-body gamma emission due to radium burdens were made in the controlled background facility. Semiquantitative radium burden estimates were made on 32 individuals by means of breath samples. Over 200 persons with occupational or therapeutic exposure to radioactive materials were located. Over 800 cases of exposure to radium, mesothorium, or their decay products have been located on which some details are available. Data on patients exposed to radioactive materials are being put on punched cards for a central catalog of cases. Data are tabulated on the radium and mesothorium burdens of subjects and pathological conditions in individuals exposed to radioactive materials with particular reference to radium content. Methods of physical dosimetry are discussed. Progress is reported in the development of fast neutron dosimeters. Medical data on patients are appended. (For preceding period see AECU-4422.) (C.H.)

13567 AMES-1
New York Operations Office, AEC.
OCCUPATIONAL EXPOSURE TO THORIUM AND BERYLLIUM [AT] AMES RESEARCH LABORATORY. Paul B. Klevin. July 14, 1952. Decl. Mar. 12, 1957. 23p. $4.80 (ph OTS); $2.70(mf OTS).

This preliminary survey presents data on the health and safety problems existing during refining and production of Th metal, from which an estimation of the daily average exposure can be determined for personnel. A brief study was also made of several Be operations. Dust-sampling procedures for Th, thoron, and Be, and analytical procedures for radiation measurements are given. From the data obtained, recommendations are presented for the reduction of the airborne contaminations from Th and Be. (C.H.)

6344 A/CONF.15/P/338
LE THORON ET LES RISQUES ASSOCIES DANS LA MANIPULATION DES COMPOSES DU THORIUM. (Thoron and Hazards Associated with the Handling of Thorium Compounds.) J. Pradel and F. Billard (Commissariat à l'Énergie Atomique, Paris). 42p.

Thoron and its daughters are continually released from thorium compounds, and their radiations present

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a danger to persons handling the compounds. A study was made of various methods for the determination of thoron in equilibrium with ThA in the air. The danger presented by thoron in the immediate vicinity of Th sources in a plant extracting thorium from urano-thorianite ores was evaluated. A comparison was made of a continuous and a discontinuous method for the determination of thoron alone in air. The determination of thoron and radon with a scintillation chamber is described in detail. The evaluation of the dangers associated with the handling of thorium ores and compounds showed that the maximum permissible concentration for thoron in equilibrium with ThA is 10^{-6} $\mu c/cm^3$ and is 10^{-10} $\mu c/cm^3$ for ThB in equilibrium with its daughters.

Studies on the Toxicity of Thorium Nitrate, W. L. Downs et.al. Dec. 16, 1959. UR-561

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TID-7019
Oak Ridge Gaseous Diffusion Plant, Tenn.
GUIDE TO SHIPMENT OF U-235 ENRICHED URANIUM MATERIALS. H. F. Henry, comp. and ed. June 1959. 82p. $1.00(OTS).

Basic criteria applicable to the shipment of U materials enriched in U^{235} isotope are presented. The manual is presented as a guide rather than a source of answers to specific problems and is concerned only with nuclear safety aspects. General provisions are given including definitions, followed by basic nuclear safety requirements, and a discussion of shipping containers. Also, included are various container system drawings as well as nuclear safety data. (J.R.D.)

12386
URANIUM TOXICITY. C. Garavaglia (Univ. of Milan and CISE, Milan). Energia nucleare (Milan) 6, 141-6 (1959) Feb. (In Italian)

The mechanism of uranium poisoning according to the most recent studies is reported. Soluble and insoluble natural uranium are primarily considered. Chemical toxicity and radiological hazards are closely related and at present it is believed that chemical toxicity prevails for soluble uranium and radiological toxicity for insoluble uranium. The toxicity of enriched uranium and U^{233} is briefly discussed. The radiological toxicity prevails in U^{233} in both soluble and insoluble forms. The maximum permissible concentration of natural uranium and U^{233} in the air is reported. 22 references. (auth)

9462 BNL-483(p.175-8)
Los Alamos Scientific Lab., N. Mex.
HEALTH PHYSICS ASPECTS OF HANDLING U^{233} FEED MATERIALS. J. Lawrence. p.175-8 [of] THORIUM-U^{233} SYMPOSIUM, SPONSORED BY THE UNITED STATES ATOMIC ENERGY COMMISSION AT BROOKHAVEN NATIONAL LABORATORY, JANUARY 9-10, 1958. 4p.

Two distinct radiation problems exist in the purification and fabrication of U^{233} feed materials. These are the control of alpha and gamma radiation. All work at Los Alamos Scientific Laboratory with large quantities of U^{233} feed materials is done in dry boxes. The cleaning up after spills, transfer of samples to air from dry-boxes, use of respirators, and determination of U^{233} in air are discussed. (W.L.H.)

14520 A/CONF.15/P/739
Rochester, N. Y. Univ. School of Medicine and Dentistry.
THE QUESTIONS OF HEALTH HAZARDS FROM THE INHALATION OF INSOLUBLE URANIUM AND THORIUM OXIDES. Harold C. Hodge and Robert G. Thomas. 8p. $0.50(OTS).

Prepared for the Second U. N. International Conference on the Peaceful Uses of Atomic Energy, 1958.

The insoluble compounds of uranium and thorium, particularly the oxides, are important in the development of atomic energy. The questions of health hazards from exposures to dusts of these insoluble compounds are strikingly similar in many but not all respects. Among the similarities may be listed the following facts: The insoluble compounds present no chemical hazard. Both uranium and thorium dioxides, for example, are remarkably inert physiologically. No radiation injuries have so far been described in the lungs of experimental animals inhaling dust concentrations many times the recommended MAC. The lungs of a few dogs

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URANIUM TOXICITY. C. Garavaglia (Univ. of Milan and CISE, Milan). Energia nucleare (Milan) 6, 141-6 (1959) Feb. (In Italian)

The mechanism of uranium poisoning according to the most recent studies is reported. Soluble and insoluble natural uranium are primarily considered. Chemical toxicity and radiological hazards are closely related and at present it is believed that chemical toxicity prevails for soluble uranium and radiological toxicity for insoluble uranium. The toxicity of enriched uranium and U^{233} is briefly discussed. The radiological toxicity prevails in U^{233} in both soluble and insoluble forms. The maximum permissible concentration of natural uranium and U^{233} in the air is reported. 22 references. (auth)

14742 ✓ A/CONF.15/P/1987
Los Alamos Scientific Lab., N. Mex.
HEALTH PHYSICS ASPECTS OF HANDLING URANIUM-233 FEED MATERIAL. J. N. P. Lawrence. 8p. $0.50(OTS).

Prepared for the Second U. N. International Conference on the Peaceful Uses of Atomic Energy, 1958.

The processes of separation, purification, and fabrication of feed materials containing U^{232}, U^{233}, U^{234}, U^{235}, and U^{238} require much closer health physics supervision than do the enriched or naturally occurring mixtures of U^{234}, U^{235}, and U^{238} found in natural uranium. The primary problem is the control of alpha and gamma radiation. The isotope U^{233} presents only an alpha control problem; however, the daughters of U^{232} constitute a gamma problem. Because of the high specific activity of these materials, all chemical purification, metallic casting, and fabrication is done in dry boxes. A discussion of the maximum permissible body burden and the

414 ✓ HASL-58
Division of Biology and Medicine, AEC and New York Operations Office. Health and Safety Lab., AEC.
SYMPOSIUM ON OCCUPATIONAL HEALTH EXPERIENCE AND PRACTICES IN THE URANIUM INDUSTRY, HELD IN NEW YORK CITY, OCTOBER 15-17, 1958. 257p. OTS.

Separate abstracts have been prepared on 38 papers presented at this symposium. A brief summary is included of a panel discussion. (C.H.)

420 ✓ HASL-58(p.34-40)
National Lead Co. of Ohio, Cincinnati.
STUDIES OF HUMAN EXPOSURE TO URANIUM. J. A. Quigley, R. C. Heatherton, and J. F. Ziegler. 7p.

Data are summarized on the distribution of radioactivity in tissues obtained at autopsy from subjects exposed occupationally to external and air-borne uranium. Findings are compared with those on normal subjects with no exposure to uranium or other radioactive materials in excess of natural background. Findings substantiate the opinion that the deaths of the employees were in no way related to their occupations. (C.H.)

422 ✓ HASL-58(p.53-68)
Union Carbide Nuclear Co. Y-12 Plant, Oak Ridge, Tenn.
EVALUATION AND CONTROL OF INTERNAL EXPOSURE FROM ENRICHED URANIUM AT Y-12. G. R. Patterson, Jr. 16p.

This paper presents the details of the program for evaluating and controlling, within recognized permissible limits, the internal radiation exposures of employees working in the enriched uranium processing facilities of the Y-12 Plant of Union Carbide Nuclear Company at Oak Ridge, Tennessee. Derivation of basic limits and formulas for estimating internal dose from the results of urinalysis; the use of machine tabulators; and the applications of statistical analysis for the control of analytical precision and evaluation of the reliability of dose estimates are all discussed. Steps in the procedure for a simplified method of electrodeposition of uranium from urine are included. At the Y-12 Plant a fluorometric method is used for the quantitative detection of uranium in the urine of employees processing only normal or depleted uranium; however, this paper deals only with the program for evaluating exposures to enriched uranium. (auth)

434 ✓ HASL-58(p.151-6)
Union Carbide Nuclear Co. K-25 Plant, Oak Ridge, Tenn.
THE DEVELOPMENT OF SURFACE ALPHA CONTAMINATION LIMITS. A. F Becher. 6p.

Inhalation of the various uranium compounds processed or handled in large-scale production facilities is the primary health hazard associated with uranium,

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and, since the action of inhalation is an involuntary one, some type of external detection and control is required. Sampling of the environmental air is usually considered to be the most direct and efficient means of evaluating the personnel exposure potential. The local program includes the use of commercially available high volume air samplers, low flow rate samplers (approximating the breathing rate of man) used for obtaining breathing zone samples for specific operations or service activities, and locally developed continuously recording air samplers. These last record both 0.5-hr peak values and 8-hr average values on a tape, which is also identified as to time, date, and year for the recorded sample. An alarm device is under local development for use in conjunction with or independent of the above recording unit. The performance of monitoring equipment is described. From the work reported it is concluded that surface contamination levels, as expressed by the contamination indices, will reflect operational changes or inadequacies in the control methods. High surface contamination levels are almost invariably identified with correspondingly high air activity measurements. Standardization of survey techniques and areas permits a rapid, simple determination of the surface contamination levels to be made by relatively inexperienced personnel, which, when expressed in terms of the contamination index, provides management with an effective yardstick to measure performance and evaluate the effectiveness of the control measures employed. (auth)

421 ✓ HASL-58(p.41-6)
United Kingdom Atomic Energy Authority. Industrial Group. Springfields Works, Springfields, Lancs, England.
HUMAN DATA ON URANIUM EXPOSURE. A. Butterworth. 6p.

Data are summarized which were obtained following accidents, from normal industrial experience, and from analysis of tissues obtained post-mortem from employees of a uranium processing plant. No evidence was found that any of several thousand employees suffered any injury to the kidneys or other organs as a result of working with uranium. Data are included on the relationship between uranium exposure, as air contamination, and resultant effects on the kidneys. It is concluded that soluble natural uranium should be considered as a chemotoxic rather than a radiotoxic agent. Radiotoxicity is probably of importance only when the specific activity is increased by a factor of 10 or more above levels encountered in industrial exposure. It is improbable that either the kidneys or lungs can retain a maximum permissible amount of soluble natural uranium, since the limiting factor is the renal sensitivity to the chemotoxic effect. The biological half-time of UO_2F_2 in the lungs was estimated to be one day. The biological half-time of soluble uranium in the kidney was estimated to be considerably less than 30 days, and probably no more than 15 days. (C.H.)

426 ✓ HASL-58(p.89-94)
Knolls Atomic Power Lab., Schenectady, N. Y.
KAPL EXPERIENCES IN URANIUM HEALTH PROGRAMS. M. R. Kennedy. 6p.

The facilities for machining uranium at the Knolls Atomic Power Laboratory are discussed. The health physics aspects of the uranium health program are summarized, including air cleaning systems, calculations of maximum permissible urinary excretion levels, bio-assay analyses, and typical bio-assay results. (auth)

7680 UR-515
Rochester, N. Y. Univ. Atomic Energy Project.
SUGGESTED URINARY TOLERANCE LEVELS FOR ENRICHED URANIUM. John B. Hursh. Dec. 26, 1957. 15p. Contract W-7401-eng-49. $0.50(OTS).

The animal experimentation basis for estimates of permissible levels of airborne, soluble, and insoluble natural uranium is briefly reviewed. It suggested that permissible air and urinary levels for enriched uranium be set at values equivalent to those for natural uranium in terms of disintegrations per minute per unit volume. An attempt is made to calculate the safety factors introduced by this procedure. (auth)

427 ✓ HASL-58(p.95-7)
Oak Ridge National Lab., Tenn.
INTERSPECIES CORRELATIONS. W. S. Snyder. 3p.

Procedures for calculating the maximum permissible concentration of uranium for man are discussed. A

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method based on kidney toxicity is described in detail. A formula is presented for use in calculations. Data are discussed on the relationship of uranium level in the kidney to toxicity. Estimates of the half-time of uranium in the kidney are included for mice, rats, and man. Problems involved in extrapolation from animal data to man are discussed. (auth)

4761 AERE-M/R-1075
Gt. Brit. Atomic Energy Research Establishment, Harwell, Berks, England.
THE CONTROL OF URANIUM FIRES. H. Lloyd. Dec. 9, 1952. Decl. Dec. 20, 1956. 24p.

Fires have occurred in the production, storing, handling and shipping of uranium powder and turnings. Batches of uranium powder, swarf and solid scrap have been ignited to observe fire temperatures and combustion rates and materials and methods to suppress or extinguish uranium fires investigated. The effect on various metals in contact with burning uranium has also been examined. The uranium content of the fire fumes was assessed. Recommendations are given for storing and shipping these materials. (auth)

4393 K-1323
Oak Ridge Gaseous Diffusion Plant, Tenn. and Union Carbide Nuclear Co. Paducah Plant, Ky.
A BRIEF GUIDE TO UF_6 HANDLING. J. W. Arendt, E. W Powell, and H. W. Saylor, comps. and eds. Feb. 18, 1957. 25p. Contract W-7405-eng-26. $0.25(OTS).

Techniques used in the transfer of UF_6 to and from shipping containers are outlined. The physical and chemical properties of UF_6 are also included. (auth)

12658
HAZARD CONTROL IN PROCESSING STAINLESS STEEL AND COPPER CONTAMINATED WITH URANIUM. D. M. Davis, J. C. Hart, and A. D. Warden (Oak Ridge National Lab., Tenn.). Am. Ind. Hyg. Assoc. Quart. 18, 235-41(1957) Sept.

EFFECTS OF REACTOR ENVIRONMENT ON MATERIALS 4.03

DECONTAMINATION 4.03.01

See also, under

Plants and Equipment — Decontamination (5.06)

6066

CONTAMINATION AND CLEANUP OF NRU. HOW CONTAMINATION OCCURRED. E. O. Hughes and J. W. Greenwood (Atomic Energy of Canada, Ltd., Chalk River, Ont.). Nucleonics 18, No. 1, 76-80(1960) Jan.

The cause for the contamination of the NRU heavy-water research reactor is presented in chronological order. The methods for the removal of the contaminant and contamination are explained. Radiation fields around and over the maintenance pit, in which the burning fuel rod was lying, were in excess of 1,000 r/hr. During the extinguishing of the uranium fire with wet sand, the highest individual exposure was 5.3 r. The maximum individual exposure was 6.4 r during the removal of the burned rod to the disposal area. Forty men were detailed to clean up the uranium debris and the contaminated sand in the pit, of these only fourteen exceeded the 5-r limit. Of the latter, 11 received 5 to 6 r, two received 10 r (by slightly overstaying their allotted 1½ min) and one received 19 r (by making an extra trip to the pit edge to bring a can to the elevator). Lessons learned from the incident were that the use of mobile change rooms for personnel and the use of graphite powder instead of wet sand in quenching fires would be advantageous. (B.O.G.)

4532 HW-59708

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

CORROSION OF ZR-2 AND 304 STAINLESS STEEL FOLLOWING THE TURCO-4501 DECONTAMINATION PROCESS. A. P. Larrick and R. J. Lobsinger. Apr. 20, 1959. 17p. Contract AT(45-1)-1350. OTS.

Investigation at HAPO showed that a proprietary commercial process is one of the more effective methods of decontaminating reactor components exposed to high temperature water. This process consists of a highly alkaline film conditioning bath, a highly alkaline oxidizing bath, and a nitric acid passivation bath. It will remove over 95% of the contamination with relatively low metal losses. The uniform corrosion losses due to the solutions for sensitized and nonsensitized 304 stainless steel are 0.008 and 0.003 mils, respectively, for exposure times of 1 hour in each of the first two solutions and one-half hour in the third solution. Zircaloy-2 and Zircaloy-3b are not attacked by these solutions. No evidences of crevice corrosion or caustic cracking due to the decontaminating solutions were found. A mild intergranular attack was found on sensitized 304 stainless steel. The presence of hydrogen during a special decontamination resulted in large penetrations to Zr-2 and induced breakaway corrosion upon subsequent exposure to pH 4.5, 300°C water. (auth)

United Kingdom Atomic Energy Authority. Industrial Group H.Q., Risley, Lancs, England.

RADIOACTIVE DECONTAMINATION PROCEDURES AND EQUIPMENT. Information Bibliography. Sept. 1957. 12p. (IGRL-IB/R-27).

A selection of 57 report, book and journal references to publications issued up to December 1956 is listed. Sources used were U.K., Canadian, and U.S. report abstracts, *Nuclear Science Abstracts*, *Engineering Index* (1950-1955), and *Industrial Arts Index* (1956).

6470 A/CONF.15/P/1589

THE DEPOSITION OF TRACE AMOUNTS OF RADIOACTIVE CATIONS ON METAL SURFACES. J. Siejka and I. G. Campbell (Polish Academy of Sciences, Warsaw). 27p.

Work is reported on the investigation of the mechanism of sorption of tracer amounts of radioactive cation on various metal surfaces. Particular attention is paid to the phenomenon of the sorption of trace amounts of less noble cations on more noble metals, in which adsorptive processes are involved, rather than known processes involving the Nernst potential. Sorption isotherms and adsorption kinetics is reported for Sr^{90}, Zn^{65}, and Co^{60} on such metals as Al, Cu, Pb, Fe, and stainless steel. The effects of such factors as degree of dissolution of surface, pH, and nature of anion are also investigated. (auth)

6047 A/CONF.15/P/2345

DECONTAMINATION AND POTABILIZATION OF THE WATERS OF THE RIVER PLATE FOLLOWING ACCI-

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DECONTAMINATION 4.03.01

DENTAL CONTAMINATION BY FISSION PRODUCTS. Leopoldo José Anghileri (Comision Nacional de Energia Atómica, Buenos Aires). 36p.

Tests were carried out to demonstrate the decontamination of the River Plata water in case of an accident. The investigation consisted of adding a known quantity of radioactive substance to the water, subjecting it to the chosen process, and determining what amount of radioactive material was eliminated from the liquid. The three decontamination techniques tested were decontamination with coagulant, precipitation with Na_3PO_4 and NaOH, and precipitation of $(HO)_3Fe$. (W.D.M.)

See also, under Process Chemistry and Engineering — Radiation Effects, 6.15.

COOLANTS 4.03.02.01

SELECTING THE REACTOR COOLANT. PART II. SPECIFIC MATERIALS. J. F. Ablitt (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Atomics and Nuclear Energy 9, 355-9(1958) Oct.

Liquid metals, heavy and light water, gases, and organic compounds are considered for use as reactor coolants. The physical and chemical properties of these materials are examined, and applications are proposed by screening the various materials for desired qualities. (J.R.D.)

COOLANTS – Aqueous 4.03.02.01.01

9878 CP-715
Chicago. Univ. Metallurgical Lab.
THE CONTAMINATION OF COOLING WATER BY A P-9 PLANT. F. L. Friedman. June 1, 1943. Decl. Feb. 14, 1956. 11p. (A-901). $3.30(ph OTS); $2.40 (mf OTS).

The following sources of contamination in cooling water of the P-9 plant are considered: fission recoils; corrosion of metal; recoil from aluminum; and induced activity in the water. It is found that for a P-9 plant of 3.5×10^4 kw contamination of the river at "X" should not exceed the 0.1 r criterion unless coating failure occurs. Tables of the amount of coating failure permissible are given as a function of holdup time. (auth)

9839 CF-51-1-6
[Oak Ridge National Lab., Tenn.]
EFFECT OF FAST NEUTRON ABSORPTION BY $_8O^{16}$ IN THE BOILER WATER ON THE INDUCED ACTIVITY OF STEAM IN THE POWER CIRCUIT OF THE HRE AT 1000 KW POWER LEVEL. Charles L. Segaser. Jan. 3, 1951. Decl. Feb. 7, 1956. 5p. Contract [W-7405-eng-26]. $1.80(ph OTS); $1.80(mf OTS).

An estimate is made of the radiation from the N^{16} produced by the reaction of O^{16} in the boiler water with fast neutrons. It is concluded that the radiation thus formed and carried over from the steam to the turbine is negligible. (B.J.H.)

7136
CIRCULATION CALCULATION FOR A BOILING WATER REACTOR. [PART I]. W. Balz and R. Schwarzwälder (AEG-Kernenergieanlagen, Frankfurt am Main). Atomkernenergie 4, 469-73(1959) Dec. (In German)

A critical analysis of experimental work on the relative velocities of the mixture components reported in the German and foreign literature showed that the few results could be used in calculation on boiling water reactors only with great reservations. The measurement devices for a water-steam mixture vary according to the geometry of the reactor. Investigations on unheated water are not applicable to reactor fuel elements. Research done in America on boiling water reactors can be applied to fuel elements, but the data are unavailable or only incompletely published. Therefore a comparison of German and American research is not possible. (tr-auth)

9247
DETERMINATION OF SMALL AMOUNTS OF RADIONUCLIDES IN THE PRIMARY COOLING WATER OF JRR-1.

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DECONTAMINATION 4.03.01

COOLANTS – Aqueous 4.03.02.01.01

K. Ueno (Japan Atomic Energy Research Inst., Tokyo). J. Atomic Energy Soc. Japan 1, 419-24(1959). (In Japanese)

A sample of primary cooling water taken from the stainless steel loop facility of JRR-1 on May 9, 1959, had gamma activities of about 10^{-4} μc/ml. The gamma spectrum of the sample showed peaks at 0.32, 0.51, 0.83, 1.1, and 1.3 Mev. The separation of radionuclides was done as follows: the sample solution was dried, dissolved with 11.4 N hydrochloric acid, and transferred to a Dowex 1 (H type) anion exchange resin column bed (ϕ 1cm,h 10cm, 100 to 200 mesh); the nuclides absorbed on the column were successively eluted with acid solutions of decreasing acidities (11.4, 6.0, and 3.0 N hydrochloric acid) to separate fractions of nickel, manganese, cobalt, and iron. The gamma activities of the fractions were measured with a 256 channel pulse height analyzer. The nuclides were identified by their gamma energy, chemical properties, and half lives. The results show that the radionuclides found in the sample are formed by activation of impurities and corrosive material present in the water. (auth)

450 ORNL-2568
Oak Ridge National Lab., Tenn.
HRP BLANKET PROCESSING STUDIES OF O_2-H_2 HAZARDS IN A LOOP PRESSURIZER. P. A. Haas. Oct. 9, 1958. 28p. Contract W-7405-eng-26. $1.00 (OTS).

Results of experiments made under conditions proposed for homogeneous reactor blanket-processing loop studies indicated that spontaneous $H_2 + O_2$ reactions will not occur frequently enough to seriously hamper operation for reasonable steady state periods and will not result in hazardous equipment failures. Calculated ($2\ H_2$-O_2) concentrations below literature values for explosive concentration limits were detonated with an ignition coil. This result was probably due to segregation of gases, which would be expected from the test system geometry. The pressurizer was not damaged in more than 25 detonation reactions, some of which were for 200 psi H_2 + 100 psi O_2 with no diluent at room temperature. Recorded pressure peaks indicated that pressure rises would be less than 1600 psi in other loop components. The peak pressures would be within the test limit of the pump rotor can (4000 psi) and of all other loop components. (auth)

14653 A/CONF.15/P/951
Argonne National Lab., Lemont, Ill.
RECENT STUDIES ON REACTIONS IN IRRADIATED WATER. Edwin J. Hart. 18p. $0.50(OTS).

Prepared for the Second U. N. International Conference on the Peaceful Uses of Atomic Energy, 1958.

Ionizing radiations create free hydrogen atoms and hydroxyl radicals in water. All phases from the ionization act to the final stages of complex chemical reaction are under investigation. This survey deals with recent research on diffusion theory, free radical yields, new radical species, chemical dosimetry, and the chemistry of some simple aqueous inorganic and organic reactions.

10833 AERE-C/R-2155
United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England.
THE HYDROLYTIC BEHAVIOUR OF PLUTONIUM IONS IN SULPHURIC ACID. D. W. Grant and D. E. Glanville. May 1957. 18p. (HARD(B)/P/31; RCTC-P-94).

A thermal reduction of Pu(VI) sulfate by water at elevated temperatures is reported. The solubility of Pu(III) sulfate and the hydrolysis of Pu(IV) sulfate at elevated temperatures are investigated. The results are considered with particular reference to the possible use of plutonium sulfate solutions in a homogeneous aqueous reactor. (auth)

6482 A/CONF.15/P/2022
STUDIES IN THE RADIATION CHEMISTRY OF AQUEOUS SOLUTIONS. M. A. Proskurnin and Y. M. Kolotyrkin (L. Y. Karpov Inst. of Physical Chemistry, U.S.S.R.). 37p.

It is generally considered that the yields of radiation-chemical reactions in aqueous solutions are determined by the initial formation of approximately 4 pairs of radicals (H + OH) per 100 ev. New data are presented which indicate that it is possible to involve short-lived particles in reactions (radicals, ions, and excited molecules) whose role should not be overlooked and whose

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reaction capacity proves to be considerable. Studying the reaction of oxidation of Fe^{2+} in a vacuum and in an atmosphere of N_2O is a compelling reason for giving up the generally accepted Krenz–Dewhurst's scheme. T. Rigg's, G. Stein's, and J. Weiss' assumption regarding the oxidizing action of H_2^+ has not been confirmed in experiments on oxidation of Sn^{2+} and Ti^{3+} ions in a vacuum. The above contradictions are eliminated by the new assumptions. (auth)

COOLANTS – Fused Salts and Liquid Metals 4.03.02.01.02

6764 A/CONF.15/P/25
COMPATIBILITY OF REACTOR MATERIALS IN FLOWING SODIUM. M. Davis (United Kingdom Atomic Energy Authority. Culcheth, Lancs, Eng.), and A. Draycott (Atomic Energy Commission, Australia). 36p.

The validity of various types of compatibility tests is briefly discussed, particularly the severe limitations of static experiments. Differences expected between sodium and NaK are noted. A typical corrosion test rig is described and its application to radioactive mass-transfer measurements discussed. The types of specimens used, the measurements made before and after tests, the assessment of the results, and their correlation with reactor circuits are detailed. The variables studied include the temperature of the specimen, the velocity of the liquid metal over the specimen, the oxide level in the liquid metal and the initial state of the specimen. The materials investigated include stainless steel, various ferritic steels, zirconium, niobium, vanadium, uranium and fission products, thorium, and beryllium. Niobium and vanadium were studied in greatest detail. (auth)

6787 A/CONF.15/P/1091
THE COMPATIBILITY OF BERYLLIUM WITH LIQUID SODIUM AND NaK IN DYNAMIC SYSTEMS. F. L. Bett and A. Draycott (Australia). 16p.

The mechanism of corrosion of beryllium in oxygen-bearing sodium and NaK is briefly discussed. Experiments are described which measure the rate of corrosion of beryllium in cold-trapped NaK. These corrosion rates are found to be excessive. As oxygen in the liquid metal is considered to be the cause of the corrosion, cold trapping is supplemented by hot trapping as a means of deoxidation of NaK in a second series of experiments. These experiments show that with a thorium hot-trap reduced corrosion of beryllium occurs compared with cold-trap conditions, but is still excessive. Calcium, however, when used in the hot-trap reduces beryllium corrosion to an acceptable level. At the levels required for successful hot-trapping calcium removes negligible quantities of nickel from stainless steel which can therefore be used as a container material. (auth)

5627 NAA-SR-Memo-557
North American Aviation, Inc., [Downey, Calif.]
COMPATIBILITY OF SODIUM AND VARIOUS MATERIALS OF INTEREST IN REACTOR CONSTRUCTION. F. E. Bowman. Jan. 5, 1953. Decl. June 6, 1956. $1.80(ph OTS); $1.80(mf OTS).

Available data relative to the compatibility of Na and various materials of interest in reactor construction are summarized. (J.E.D.)

3813
THE SOLUBILITIES OF NIOBIUM, CERIUM, AND STRONTIUM IN LIQUID BISMUTH. R. J. Pleasance (National Physical Lab., Teddington, Eng.). J. Inst. Metals 88, 45-8 (1959) Sept.

The solubility of niobium in liquid bismuth is shown to be very low, with no indication of the formation of intermetallic compounds. The equilibrium diagram of the bismuth–cerium system was determined up to 17.5 wt.% cerium and that of the bismuth–strontium system up to 12.5 wt.% strontium. Evidence is given that the first intermetallic compounds to form are Bi_3Ce and Bi_3Sr, respectively. No indication of a eutectic was found at the bismuth end of the bismuth–cerium system, but a eutectic occurs at about 0.2% strontium in the bismuth–strontium system. (auth)

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6381 CF-49-11-180
Oak Ridge National Lab., Tenn.
ARGON ACTIVITY IN REACTOR COOLING AIR. J. A. Lane. Nov. 17, 1949. Decl. Feb. 14, 1956. 4p. Contract [W-7405-eng-26]. $1.80(ph OTS); $1.80(mf OTS).

Calculations indicating the activity of the pile cooling air due to neutron capture in A and resulting A^{41} decay for the existing design of the graphite reflector. (F.S.)

6791 A/CONF.15/P/1148
OXYDATION D'UN ACIER ORDINAIRE CHAUFFE DANS LE GAZ CARBONIQUE SOUS PRESSION. (Oxidation of Steel Heated in CO_2 Medium Under Pressure). R. Darras, D. Leclercq, and C. Bunard (Commissariat à l'Énergie Atomique, Paris). 16p.

The behavior of low-alloy steels heated up to 400°C in CO_2 under pressure is reported. The observed weight increases were small, even after more than a thousand hours of heating. The oxidation curve is linear. The oxide formed at a pressure of 15 kg/cm^2 is more compact and adherent than the one formed at a pressure of 1 kg/cm^2. The passivation treatments appear to have no effect on the behavior of the steel in CO_2 atmospheres. (J.S.R.)

8956 CF-49-1-281
Oak Ridge National Lab., Tenn.
AN ESTIMATE OF THE AIR COOLING REQUIREMENTS OF THE HIGH FLUX PILE—GRAPHITE PEBBLES. R. Van Winkle. Jan. 18, 1949. Decl. Feb. 20, 1956. 12p. Contract [W-7405-eng-26]. $3.30(ph OTS); $2.40(mf OTS).

From these fairly rough calculations, the order of magnitude of gas flow and pressure drop through the reactor may be estimated at about 15,000 to 18,000 cfm and 6 to 12 inches H_2O, depending upon the pebble size chosen. Since the total air requirement is rather independent of pebble diameter, the cost of the pebble system depends more on ball fabrication costs than on power requirements. The optimum occurs at about two-inch diameter pebbles although such pebbles are too large from the standpoint of fast neutron streaming and air-channelling characteristics. A compromise between fabrication cost and the need for an adequate loading around vertical experimental holes is therefore necessary and on this basis, one-inch-diameter balls are suggested. (auth)

8955 CF-48-7-312
Oak Ridge National Lab., Tenn.
AIR COOLING REQUIREMENTS OF THE HIGH FLUX PILE. James A. Lane. July 13, 1948. Decl. Feb. 20, 1956. 15p. Contract [W-7405-eng-26]. $6.30(ph OTS); $3.00(mf OTS).

A modification of the design of the Graphite Cooling system using an annulus of BeO spheres adjacent to the pile tank is discussed. Reduced air requirements, greater protection to the graphite from fast neutron bombardment, and elimination of the cumbersome replaceable graphite ring are the advantages of the system. (F.S.)

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14665 A/CONF.15/P/1779
Atomics International Div., North American Aviation, Inc., Canoga Park, Calif.
A STUDY OF THE POLYPHENYLS FOR USE AS MODERATORS AND COOLANTS IN NUCLEAR POWER REACTORS. C. A. Trilling, D. W. Bareis, J. G. Burr, and R. H. J. Gercke. 49p. $0.50(OTS).

Prepared for the Second U. N. International Conference on the Peaceful Uses of Atomic Energy, 1958.

The predicted stability of aromatic hydrocarbons to radiation and heat was confirmed by an extensive experimental program. This experimental work was divided into three phases: (1) a basic program to measure the physical properties of the polyphenyls of interest and to determine the effects of radiation damage upon these properties; (2) an engineering program to study the behavior of the polyphenyls under process conditions; and (3) operation of two in-pile loops to study the rate and the effects of radiation damage to the polyphenyls under reactor conditions and to provide samples of irradiated materials for the other two programs. The two in-pile loops were operated at high temperatures in the Materials Testing Reactor. The fluids tested included diphenyl, the eutectic mixture of diphenyl and ortho-terphenyl, isopropyl diphenyl and two different mixtures of terphenyls. The results showed that the rates of damage under irradiation were approximately the same for all the fluids tested and of the same order of magnitude as previously measured in capsule experiments under electron and reactor irradiations. There was no appreciable deposition of high boiling materials on the heat transfer surfaces, and the observed changes in heat transfer properties could be attributed to the increase in viscosity of the fluids

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under irradiation. The physical properties of these hydrocarbons were measured as a function of temperature and of radiation damage. Changes in density, hydrogen density, viscosity, heat capacity, vapor pressure and melting point were determined. Heat transfer characteristics of irradiated and unirradiated polyphenyls were determined in a laboratory loop, together with high temperature fouling and burn-out heat transfer data. Purification of the damaged hydrocarbons was studied in a bench-scale distillation unit. (auth)

6068 NAA-SR-Memo-4495
Atomics International Div., North American Aviation, Inc., Canoga Park, Calif.
PRELIMINARY HB COMBUSTION EXPERIMENT. R. R. Stiens. Oct. 16, 1959. 11p. OTS.

A series of investigations was conducted to obtain information on the problems associated with employing combustion as a method of disposing of the high boiler (HB) formed by the decomposition of the organic reactor coolant. Successful operation of the experimental combustion apparatus, using HB as the fuel, has demonstrated the mechanical feasibility of employing combustion as a means of disposal. Required combustion air temperature and HB temperature was determined to be in the range of 300 to 400°F and 400 to 500°F, respectively. Two methods of removing the particulate matter from the stack gas were considered: wet scrubbing and dry filtration. The dust loading in the effluent stack gas varied with the combustion air temperature. (W.L.H.)

6468 A/CONF.15/P/1516
CHEMICAL CHANGES INDUCED IN ORGANIC SYSTEMS BY IONISING RADIATIONS. R. A. Back, W. Cooper, N. Miller, and W. H. Stafford (Edinburgh Univ.), E. A. Cherniak, E. Collinson, F. S. Dainton, G. M. Meaburn, and D. C. Walker (Univ. of Leeds, Eng.), and G. A. Swan, P. S. Timmons, and D. Wright (Univ. of Durham, Newcastle-upon-Tyne, Eng.). 31p.

The identification and measurement of the products in the radiolysis of benzyl alcohol, triethylamine, and chlorinated hydrocarbons are discussed. Attention is drawn to the potential utility as radical scavengers of compounds of the transition elements which are soluble in organic media and susceptible to oxidation or reduction by organic free radicals. Examples are given of the use of ferric chloride in solid and liquid systems. An account is given of the alpha radiolysis of some n-alkanes in the gas phase and it is pointed out that these systems are to some extent self scavenging; the unsaturated products which are initially formed reacting rapidly with free radicals and hydrogen atoms and thereby causing a marked change of product distribution with dose. (W.D.M.)

14606 A/CONF.15/P/611
General Electric Co. Hanford Atomic Products Operation, Richland, Wash.
RADIOLYTIC AND PYROLYTIC DECOMPOSITION OF ORGANIC REACTOR COOLANTS. D. R. de Halas. 9p. $0.50(OTS).

Prepared for the Second U. N. International Conference on the Peaceful Uses of Atomic Energy, 1958.

Investigations were conducted on the kinetics of organic reactor coolant decomposition. The experiments consisted of low temperature irradiations of the coolants in a dynamic system. Material that had undergone essentially no pyrolytic damage, but had been considerably decomposed by radiolytic damage was obtained in this manner. The purely radiolytic damage was found to follow a first order rate law.

6423 A/CONF.15/P/51
THE EFFECT OF FAST ELECTRONS AND FAST NEUTRONS ON POLYPHENYLS AT HIGH TEMPERATURES. W. G. Burns, W. Wild, and T. F. Williams (Atomic Energy Research Establishment, Harwell, Berks, Eng.). 24p.

Biphenyl, ortho-, meta-, and para-terphenyls, and a commercial mixture of these (Santowax-R) have been subjected to fast electron beams and to irradiation in BEPO at temperatures between 250 and 400°C. Gas production and polymer formation were measured, and in some cases the changes in a variety of physical properties were studied. No great differences of stability were observed among these compounds. The initial yields of gas and polymer increased with rise in temperature, the effect on gas production being more pronounced. On continued irradiation the instantaneous

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rate of polymer formation decreased. Striking decreases were produced by the deliberate addition of polymer, suggesting that the latter contained a protective agent. The two types of radiation did not produce equivalent effects. Differences in relative amounts of products were observed. The initial radiation yields of all products were markedly greater using pile radiation. These yields increased more rapidly with rise in temperature than did those obtained with electron irradiation. The concept that equal energy inputs from differing types of radiation cause equal damage does not seem to hold for this class of compound. (auth)

6468 A/CONF.15/P/1516
CHEMICAL CHANGES INDUCED IN ORGANIC SYSTEMS BY IONISING RADIATIONS. R. A. Back, W. Cooper, N. Miller, and W. H. Stafford (Edinburgh Univ.), E. A. Cherniak, E. Collinson, F. S. Dainton, G. M. Meaburn, and D. C. Walker (Univ. of Leeds, Eng.), and G. A. Swan, P. S. Timmons, and D. Wright (Univ. of Durham, Newcastle-upon-Tyne, Eng.). 31p.

The identification and measurement of the products in the radiolysis of benzyl alcohol, triethylamine, and chlorinated hydrocarbons are discussed. Attention is drawn to the potential utility as radical scavengers of compounds of the transition elements which are soluble in organic media and susceptible to oxidation or reduction by organic free radicals. Examples are given of the use of ferric chloride in solid and liquid systems. An account is given of the alpha radiolysis of some n-alkanes in the gas phase and it is pointed out that these systems are to some extent self scavenging; the unsaturated products which are initially formed reacting rapidly with free radicals and hydrogen atoms and thereby causing a marked change of product distribution with dose. (W.D.M.)

9180
RADIOLYTIC DECOMPOSITION ANALYSIS. THE HARWELL EXPERIMENTS. Nuclear Eng. 5, 59-61(1960) Feb.

Investigations were made at Harwell on the limitations which exist in an organic moderator and of the pyrolytic and radiolytic decomposition of various organic liquids including Santowax-R. Breakdown appears to be essentially a function of the G-values of the linear energy transfer of the disruptive agency. The G-values are not the same for heavy particles (and consequently neutrons, which produce knocked-on carbon and hydrogen ions in the hydrocarbon), gamma rays, and electrons. Additional information is required concerning radiolytic decomposition, particularly at high HB content, but the Harwell interpretation of existing data does bring a large measure of consistency into what would otherwise be a mass of discrepant information. (B.O.G.)

12231 REIC-Memo-13
Battelle Memorial Inst. Radiation Effects Information Center, Columbus, Ohio.
THE EFFECT OF NUCLEAR RADIATION ON ORGANIC HEAT-TRANSFER MATERIALS. Robert E. Wyant. Feb. 28, 1959. 18p. Project No. 2133. Contract AF33 (616)-5171.

A summary of the information available at the Radiation Effects Information Center on the radiation stability of organic heat-transfer materials is presented. Of the materials surveyed, the terphenyls show the greatest radiation resistance and are the preferred class of organic heat-transfer materials for high radiation exposures. At low exposures, the para isomer shows the greatest resistance, while at higher exposures the three isomers approach one another in stability. Monoisopropylbiphenyl, biphenyl, diphenyl ether, and silicate esters also appear to possess good radiation stability. Ethylene glycol, chlorinated diphenyls, DC-710 silicone, and phosphate esters have poor stability and should probably not be used where total exposure exceeds about 8.5×10^9 ergs g^{-1}(C). (auth)

6985 NP-6021(Pt. II)
Mine Safety Appliances Co., Callery, Penna.
LITERATURE SEARCH ON ORGANIC COOLANTS. PART II. Eugene P. Meckly. June 25, 1956. 42p. Contract NObs-65426.

A literature search for journal literature on organic compounds tested for possible application as organic compounds for cooling or moderating nuclear reactors was made. The search was limited to the following compounds: biphenyl, terphenyls and higher polyphenyls, alkyl benzenes, Dowtherms, diesel fuels, isopropyl diphenyl, and diisopropyl diphenyl. A complete subject index is included. (F.S.)

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7381
NUCLEAR REACTOR COOLANT. E. L. Colichman (to U. S. Atomic Energy Commission). U. S. Patent 2,909,488. Oct. 20, 1959.

The formation of new reactor coolants which suppress polymerization resulting from pyrolytic and radiation decomposition is described. The coolants consist of polyphenyls and condensed ring compounds having from two to about four carbon rings and from 0.1 to about 5% of beryllium or magnesium dispersed in the hydrocarbon.

7380
NUCLEAR REACTOR COOLANT. E. L. Colichman (to U. S. Atomic Energy Commission). U. S. Patent 2,909,487. Oct. 20, 1959.

The formation of new reactor coolants which suppress polymerization resulting from pyrolitic and radiation decomposition is described. The coolants consist of polyphenyls and condensed ring compounds having from two to about four carbon rings and from 0.1 to about 10% of an alkali metal dispersed in the hydrocarbon.

7379
INHIBITING THE POLYMERIZATION OF NUCLEAR COOLANTS. E. L. Colichman (to U. S. Atomic Energy Commission). U. S. Patent 2,909,486. Oct. 20, 1959.

The formation of new reactor coolants which contain an additive that suppresses polymerization of the primary dissociation free radical products of the pyrolytic and radiation decomposition of the organic coolants is described. The coolants consist of polyphenyls and condensed ring compounds having from two to about four carbon rings and from 0.1 to 5% of a powdered metal hydride chosen from the group consisting of the group IIA and IVA dispersed in the hydrocarbon.

9883 IDO-16264
Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho.
THE ORGANIC LOOP PROGRAM AT THE MATERIALS TESTING REACTOR. Final Status Report. W. C. Francis. Mar. 3, 1955. Decl. Feb. 7, 1956. 7p. Contract AT(10-1)-205. (PPC-86). $1.80(ph OTS); $1.80(mf OTS).

With the transfer of project responsibility for an in-pile organic loop and the deferment of all other activity on organic loops, the organic loop program at the MTR under the direction of the Phillips Petroleum Company, has been terminated, at least temporarily. The activity of the Phillips program is summarized briefly since its inception in May, 1953, and the status of the program is reviewed. Reference is made, where applicable, to source documents. (auth)

7981 ER-8098
Martin (Glenn L.) Co., Baltimore.
POLYPHENYLS LITERATURE SEARCH. Edward H. Smith. Mar. 1956. 61p.

A literature search was made in order to find a polyphenyl that could be used as moderator or coolant in fission reactors. Possible use as secondary coolants in Na or KNa cooled reactors was also investigated. (W.L.H.)

7051 NAA-SR-1592
Atomics International Div., North American Aviation, Inc., Canoga Park, Calif.
ORGANIC IN-PILE LOOP NAA-18. S. Nakazato and R. H. J. Gercke. July 1, 1956. 37p. Contract AT-11-1-GEN-8. $0.30(OTS).

An organic in-pile loop experiment was conducted to test the behavior of a diphenyl and ortho- terphenyl eutectic mixture. The test was conducted in the A-14 reflector position of the MTR. Promising results encourage the use of selected organic fluids as possible moderators and coolants in a nuclear reactor. (F.S.)

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THE EFFECT OF REACTOR IRRADIATION ON ELECTRICAL INSULATION. J. C. Pigg, C. D. Bopp, O. Sisman, and C. C. Robinson (Oak Ridge National Lab., Tenn.). Communication and Electronics, No. 22, 717-23(1956) Jan.

The presence of a radiation field subjects the insulation of a circuit to environmental conditions which both accelerate the normal processes of deterioration and introduce new characteristics to the insulation behavior. The resistance of an insulation under irradiation drops to some value which

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is a function of the flux level and maintains this value as irradiation proceeds. Eventually the insulation resistance begins to drop again. This final resistance drop can be designated the breakdown of the insulation. The breakdown irradiation dosage for several insulations studied is shown. The change in insulation resistance in the presence of a field is greater than that caused by chemical deterioration since the ionization provides mobile charges which are available for conduction. These charge carriers give to the insulation properties similar to a semiconductor and result in the nonohmic resistance as well as photovoltages. These photovoltages change in sign and magnitude depending on the sign of the charge carrier. Voltages as high as 200 volts have been observed in commercially available wires. The nonohmic and photovoltage effects can be minimized by proper geometrical arrangement of the insulation. (auth)

4887
THE INFLUENCE OF RADIOACTIVE DECAY ENERGY OF FISSION PRODUCTS ON THE AUTOMATIC CONTROL OF NUCLEAR POWER PLANTS. Erkki Laurila. Ann. Acad. Sci. Fennicae Ser. A VI, No. 30, 1-7(1959).

A simple transfer function representation for radioactive beta- and gamma-decay power in reactors is described. The role of this power appears to be of little importance in automatic control problems. (auth)

8787 AD-209722
Battelle Memorial Inst. Radiation Effects Information Center, Columbus, Ohio.
THE EFFECT OF NUCLEAR RADIATION ON SEMICONDUCTOR DIODES. Technical Memorandum No. 6. J. E. Drennan and S. E. Harrison. Dec. 31, 1958. 18p.

Results of experiments to determine the effects of radiation on diode circuit parameters are presented. Data and illustrations showing the effects of radiation on forward and reverse characteristics of several diodes are included. Fast neutrons affect diode forward characteristics through changes in the bulk material, and the reverse characteristics through changes in junction region. Slow neutrons are a major factor in damage by a mixture of neutron energies. Gamma radiation causes transient surface damage appearing as leakage characteristics. Germanium diodes fail in the reverse direction while failure in silicon rectifying devices results primarily from deterioration of the forward characteristics. A major factor determining the radiation resistance of semiconductor diodes appears to be the manufacturing process. (J.R.D.)

4445
SELECTING TRANSISTORS FOR RADIATION ENVIRONMENTS. John R. Bilinski and Richard Merrill (General Electric Co., Ithaca, N. Y.). Electronics 32, No. 52, 38-40(1959) Dec. 25.

Nomographs are presented which can be used to determine the percentage change in grounded emitter current gain of germanium and silicon npn and pnp transistors neutron flux. Equations are given to calculate the effect of radiation on the volume recombination term and the change in transistor current gain as a function of neutron flux. (C.J.G.)

7561
RADIATION-TOLERANT ELECTRONIC EQUIPMENT. James R. Burnett (Bendix Aviation Corp., Detroit). IRE Trans. Nuclear Sci. NS6, 12-15(1959) Dec.

A study was made of electronic equipment capable of operating in radiation fields for long periods of time. To date the file contains radiation effects data on 1100 electronic components and materials. A color code based on how much nuclear radiation a device can be exposed to and still give "satisfactory performance" is used to mark the cards of the components. As a result of this compilation, several pieces of complex electronic equipment were subjected to a component interchange-replacement of radiation-sensitive with radiation-resistant components. An ARN-32 aircraft marker beacon receiver was modified and it operated for more than 370 hours during a 55 day period. After the ARN-32 was subjected to an epicadmium flux of 3×10^{17} nvt the crystal had drifted but the unit was still operating within pertinent military specifications. (B.O.G.)

713 NP-8007
Army Signal Research and Development Lab., Fort Monmouth, N. J.
EFFECTS OF MIXED NEUTRON-GAMMA PULSES ON ELECTRONIC COMPONENTS. D. Markow, H. J. Degenhart, H. M. Murphy, Jr., and R. Sanna. Sept. 30, 1959. 33p.

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Previous experiments with electronic components on a pulsed nuclear reactor (Godiva II) indicated that transient effects exist that are different from those observed during and after long-term irradiations. An experiment is described which was to determine whether the effects observed at Godiva II on selected electronic components would be detectable at the lower radiation dose rates and longer pulse widths from KEWB and TRIGA, as well as at the very low dose rates and short pulse widths from the General Atomics linac. Items tested were resistors, capacitors, and a silicon rectifier. (W.D.M.)

6441 A/CONF.15/P/983
CONTINUOUS MEASURING OF HYDROGEN IN HYDROCARBONS BY BETA-RAY ABSORPTION.
R. Berthold (Wildbad/Schwarzwald, Ger.). 7p.

With beta counters fitted on the outside of a pipeline, continuous density measurements can be carried out with an accuracy of ± 0.2% provided that suitable measuring heads will be used. When high weight per cents of hydrogen are present, the ratio Z/A for this compound will be twice as large as for the neighboring light elements, resulting in an anomalous scattering of the beta radiation in relation to the hydrogen content. This anomaly was used to determine the H/C ratio in aromatic hydrocarbons. As a result of the H/C ratio in hydrocarbons they can now be controlled continuously. (W.L.H.)

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See also, under Surveys (General), Fuel and Fuel Elements (7.04) and Fuel Cycle (7.03).

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7083 A/CONF.15/P/46
SOME CHEMICAL PROBLEMS OF HOMOGENEOUS AQUEOUS REACTORS. J. K. Dawson, B. Cox, R. Murdoch, and R. G. Sowden (Atomic Energy Research Establishment, Harwell, Berks, Eng.). 29p.

The basic chemical and engineering aspects of aqueous homogeneous reactors were investigated. The primary effort was devoted to the two-zone uranyl sulfate solution/thoria slurry system. Corrosion associated with the neutron window of the two-zone system is discussed, together with various methods of decreasing the rate of attack. The feasibility of the use of uranyl nitrate as the fissile solution and thorium nitrate as a fertile solution was examined. Thorium nitrate may find applications in core solutions, if the processing rate is sufficient to maintain a low uranium content. The rheology of aqueous slurries of thoria is described, and measurements in a pipe-line viscometer are compared with the result of pumping the same slurry in a loop system. Plutonium dioxide suspensions were examined for use in the fuel circuit of a burner reactor. The physical properties of the oxide prepared by various methods were measured, and electrophoretic properties were compared with those of thoria. (J.R.D.)

8865 CF-51-10-100
Oak Ridge National Lab., Tenn.
CORROSION NEWSLETTER NO. 6. J. L. English. Oct. 9, 1951. Decl. Feb. 9, 1956. 14p. Contract [W-7405-eng 26]. $3.30(ph OTS); $2.40(mf OTS).

The vapor-phase corrosion behavior of stainless steel and the effect of oxygen exposure on pretreated stainless steel, using UO_2SO_4 at 250°C, are discussed. (W.L.H.)

8866 CF-51-11-196
[Oak Ridge National Lab., Tenn.]
CORROSION NEWSLETTER NO. 7. J. L. English. Nov. 27, 1951. Decl. Feb. 7, 1956. 34p. Contract [W-7405-eng-26]. $6.30(ph OTS); $3.00(mf OTS).

Commercial grade Ti metal was extremely resistant to 1.71M UO_2SO_4 at 250°C; a weight gain of 0.01 mg/cm^2 after 227 hr was measured. A second sample gained 0.09 mg/cm^2 after 800 hr. Titanium autoclaves were used for these tests. In 0.17M UO_2SO_4 – O_2 pressurized systems, Ti metal gained 0.05 mg/cm^2 after 100 hr at 250°C and was slightly

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anodic to 347 stainless steel after 168 hr at 250°C. A corrosion rate of 0.9 mil/yr was obtained on the coupled Ti as compared to 0.2 mil/yr for the stainless steel. The corrosion rate on 347 stainless steel exposed to 0.17M UO_2SO_4 pressurized with O_2 was 0.3 mil/yr after 268 hr at 250°C. The results of a series of tests to determine variations in total U concentration at different levels in an autoclave operating at 250°C disclosed no such concentration gradients.

8864 CF-51-5-190
[Oak Ridge National Lab., Tenn.]
CORROSION NEWSLETTER NO. 3. James L. English. May 29, 1951. Decl. Feb. 7, 1956. 15p. Contract [W-7405-eng-26]. $3.30(ph OTS); $2.40(mf OTS).

Variations in the appearance of HNO_3-pretreated stainless steel specimens were traced to insoluble Fe compounds introduced into the bath from the treatment-vessel surface. Additional experimental data on the corrosion behavior of 347 stainless steel in 250°C UO_2SO_4 are given. (D.E.B.)

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14003 BNL-4097
Brookhaven National Lab., Upton, N. Y.
LMFR BIMONTHLY PROGRESS REPORT [FOR] SEPTEMBER–OCTOBER 1958. Dec. 1, 1958. 79p. $12.30(ph), $4.50(mf) OTS.

The first LMFR exponential assembly was built and given the code number 18. Buckling for the assembly determined from traverses is given. The distribution of Zr between the fused ternary eutectic and Bi–Mg–Zr alloys was redetermined. The data are tabulated. It was found that about 99.9% of the Po remains in the Bi when the latter is contacted with fused salt for stable fission product removal and with Zn for non-stable fission product removal. Vapor pressure measurements on BiI_3 show that no dissociation occurs at temperatures lower than about 536°C. Results of static corrosion tests indicate that 347 SS, low Cr steels, and 1020 mild steels are satisfactory for containing the NaCl–KCl–$MgCl_2$ ternary salt mixture. In absorption studies it was found that fission-product I volatilizes from the U–Bi fuel as a Bi–I compound. The solubility of Xe in Bi at 540°C was established at 3.2×10^{-9} moles/(cc)(atm). The solubility of Pd in Bi–Zn mixtures was obtained in which the Zn content was varied from 0.1 to 5%. Results of solubility tests for U and Y in Bi are reported. Results of experiments to determine the effect of additives in Bi on the contact angle between Bi and single crystals of fused ThO_2 were inconclusive. Results indicate that only a monolayer of additive on the particle surface is required for dispersing ThO_2 in Bi. In slurry studies it was found that 1.5 wt. % ThO_2 dispersed in Bi will remain stable in day-long settling periods. A summary of loop SLC-1 operation is tabulated. In material studies weld corrosion was observed after about 13,000 hr in a Ti stabilized carbon steel. Gradual losses of Zr, U, and Mg continue in a nitrided Cr–Mo loop after 17,000 hr. Other information on the status of the various loops is tabulated. Progress in surface reaction studies is reported. ZrC films appear to grow more rapidly than ZrN films on carbon steel surfaces; C, Si, Mn, N, P, and S as alloying constituents many influence the susceptibility of steel to corrosion. (J.R.D.)

6779 A/CONF.15/P/270
LIQUID METAL FUEL TECHNOLOGY. B. R. T. Frost (Atomic Energy Research Establishment, Harwell, Berks, Eng.), C. C. Addison (Univ. of Nottingham), A. Chitty (General Electric Co., Ltd., Wembley, Eng.), G. A. Geach (Assoc. Electrical Industries, Ltd., Aldermaston, Berks, Eng.), P. Gross (Fulmer Research Inst., Stoke Poges, Eng.), J. A. James (British Thompson Houston Co., Ltd., Rugby, Eng.), G. J. Metcalfe (Hawker-Siddeley Nuclear Power Co., Ltd., Langley, Eng.), T. Raine Metropolitan-Vickers Electrical Co., Ltd., Manchester, Eng.), and H. A. Sloman (National Physical Lab., Teddington, Eng.). 65p.

The work carried out at a number of laboratories on the metallurgical problems associated with the development of liquid metal fuelled reactors is outlined. The major effort has been concerned with a circulating fuel thermal system which employs a fuel of uranium dissolved in bismuth and a thorium-bismuth slurry blanket. However, a considerable amount of work has been done on a fast reactor concept. The development of suitable fuels has called for extensive work on solu-

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FUELS AND FUEL ELEMENTS –

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tions and suspensions of uranium and plutonium and their compounds in liquid metals. This has included the determination of solubility/temperature curves, the identification of intermetallic compounds, the measurement of thermodynamic activities, and the study of particle growth in suspensions or slurries. (auth)

9832 BNL-2742
Brookhaven National Lab., Upton, N. Y.
EFFECTS OF URANIUM BUILDUP IN THE LMFR BREEDING BLANKET. B. Mozer. Mar. 15, 1955. Decl. Feb. 8, 1956. 14p. Contract AT(30-2)-gen-16. $3.30 (ph OTS); $2.40(mf OTS).

The effects of U buildup in the blanket have been calculated for a spherical two-region liquid metal fuel reactor in which the flux distribution is given by the simple two-group approximation. The results indicate a small decrease in the critical size of the reactor, a constant breeding gain, and an increase in the fast leakage as a result of increasing the concentration of uranium in the blanket. The calculations show that a concentration of 200 ppm of U to Bi in the blanket is not excessive. (auth)

11838 ✓ NAA-SR-Memo-1171
North American Aviation, Inc., [Downey, Calif.].
EFFECT OF MOLTEN SODIUM ON THERMAL INSULATION SPECIMENS. M. Tarpinian. Nov. 19, 1954. 8p. $1.80(ph), $1.80(mf) OTS.

Every type of thermal insulating material tested showed attack in varying degrees. Many specimens which had been cured at 1000°F, with no color change, did show drastic changes at 950°F due to the action of sodium. The materials showing the least disintegration and greatest preservation of mechanical properties were Superex paste and Eagle-Picher mineral wool. The uncured Superex Block did not hold up as well as Superex paste, presumably due to the presence of water of crystallization; after curing, the results were similar to that of the paste. The refractory clays showed the greatest degree of destruction. The time element is of vital importance, since a long period of contact with liquid sodium would presumably result in complete destruction of every specimen tested. (auth)

FUELS AND FUEL ELEMENTS – Aqueous 4.03.02.03.01

14656 A/CONF.15/P/522
Oak Ridge Gaseous Diffusion Plant, Tenn.
RADIATION EFFECTS OF ALPHA PARTICLES ON URANIUM HEXAFLUORIDE. H. A. Bernhardt, W. Davis, Jr., and C. H. Shiflett. 19p. $0.50(OTS).

Prepared for the Second U. N. International Conference on the Peaceful Uses of Atomic Energy, 1958.

Alpha irradiation of uranium hexafluoride results in the formation of fluorine and intermediate, solid uranium fluorides; these products react with each other, apparently by a radiation-induced process, to reform uranium hexafluoride. The number of molecules of uranium hexafluoride decomposed, excluding recombination, per 100 ev of energy absorbed, G , is approximately 1 in the temperature range 21 to 87°C. Irradiation of a mixture of fluorine and uranium hexafluoride in a vessel containing uranium fluorides substantiates the postulated mechanism. At fluorine pressures of 50 to 100 mm Hg, there is an increase, rather than a decrease, in uranium hexafluoride pressure. Rates of both decomposition and recombination processes appear to depend only on the rates of radiation energy absorption. Equations formulated to describe the combined decomposition and reformation reactions can be used to calculate equilibrium concentrations of uranium hexafluoride and fluorine when the intensity of the radiation source is defined. The effects of three diluent gases, helium, nitrogen, and oxygen, were studied in an attempt to find possible electron transfer processes. (auth)

6449 A/CONF.15/P/1214
LE COMPORTEMENT DE QUELQUES GAZ POLYATOMIQUES DANS LES REACTEURS NUCLEAIRES. (The Behaviour of Several Gases Under the Influence of Pile Radiation.) L. Dollé (Commissariat à l'Énergie Atomique, Paris). 26p.

The chemical effect of ionizing radiation on polyatomic gases is described. Pile radiation decomposes ammonia into stoichiometric proportions of nitrogen and hydrogen. Colorimetric attempts to detect hydrazine gave negative results. Comparison of results obtained from cobalt-60 γ irradiations with those from pile irradiations show that the reaction $N^{14}(n,p)C^{14}$ is the principal source of energy absorption in the latter case. The recombination of H_2 and N_2 was also observed. The mechanism of NH_3 decomposition is

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complex, the apparent order of the reaction increasing with the extent of decomposition. H_2S is more rapidly decomposed than NH_3 and the only gaseous product is hydrogen. The sulfur, which is deposited on the walls of the ampules, is clearly visible. Decompositions to the extent of 84% were obtained. The influence of the $S^{32}(n,p)P^{32}$ reaction is considered. The radiochemical decomposition of N_2O gives large yields of products, but the reaction is complicated from the start by the formation of higher oxides of nitrogen which were identified and measured. Methane is decomposed to give large quantities of hydrogen and small amounts of higher hydrocarbons. Ethane gives, in addition, some polymerization products, and ethylene is rapidly polymerized by pile radiation. In this case much more hydrogen is formed than in irradiation with pure γ rays. Some of these gaseous systems lend themselves to the measurement of high doses of radiation. This problem is discussed. (tr-auth)

FUELS AND FUEL ELEMENTS – Solid – AL-U 4.03.02.03.04

7148 IDO-16558
Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho.
ERROR PROPAGATION IN HOT CHANNEL–HOT SPOT ANALYSIS. F. H. Tingey. Oct. 14, 1959. 18p. Contract AT(10-1)-205. OTS.

A statistical analysis of the hot spot–hot channel calculation was made. An explicit expression for hot spot wall temperatures was obtained which gives to within 5°F, in the ETR elements, that hot wall temperature which is obtained by implicit conventional procedures. Errors in factors and component terms in the hot spot calculations were estimated or postulated and propagated to the calculated wall temperature. The best estimate of hot spot wall temperature was calculated to be 320°F; and a risk of 0.02, i.e., the probability is 0.02 or less that the true wall temperature will exceed that calculated, was identified with the upper limit of 395°F which was calculated in the conventional manner. A review of the existing data on the MTR power estimate is made. An uncertainty of approximately 10% in calculated power was estimated. A graph for determining hot spot temperature under the conventional computational procedure is given. (auth)

FISSION GAS BEHAVIOR IN THE URANIUM–ALUMINUM SYSTEM. Myron B. Reynolds (General Electric Co., Schenectady, N. Y.). Nuclear Sci. and Eng. 3, 428-34(1958) Apr.

Data on the diffusion of fission krypton from irradiated 20 weight per cent uranium–aluminum alloy are presented. At temperatures below 640°C (the eutectic) there was no measurable loss of radiokrypton from this alloy during annealing periods of up to three weeks. At temperatures above the eutectic gas evolution occurred with a time dependence in rough agreement with the theoretical prediction for diffusion from spherical particles. The nature of the diffusion process for rare gases in metallic systems is discussed with particular reference to the limitations imposed on diffusion rate by solubility and available concentration gradient. The basic difference between the behavior of fission gases in dispersion-type nuclear fuels and in homogeneous solid-type fuels is outlined. The data on the uranium–aluminum alloy system are interpreted in light of this discussion. (auth)

4580 ANL-6059
Argonne National Lab., Lemont, Ill.
EXAMINATION OF IRRADIATED EXPERIMENTAL NRU FUEL RODS. Final Report [on] Program 6.1.25. S. H. Paine and W. F. Murphy. Nov. 1959. 26p. Contract W-31-109-Eng-38. OTS.

Examination of flat, natural uranium plates mechanically clad with aluminum sheaths revealed a tendency for thermal contact between clad and core to diminish as a result of elongation and roughening of the uranium. The assemblies containing beta-quenched uranium showed less damage than those in which material rolled in the high alpha range was used. A clad rod having square cross section was found to have failed by typical internal aqueous attack of the core material. Cause of initial perforation cannot be assigned with certainty. (auth)

14769 A/CONF.15/P/1430
General Electric Co. Hanford Atomic Products Operation, Richland, Wash.
THE USE OF ALUMINUM AS FUEL CLADDING IN HIGH TEMPERATURE WATER COOLED REACTORS.

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FUELS AND FUEL ELEMENTS – Solid – AL-U 4.03.02.03.04

J. A. Ayres, R. L. Dillon, and R. J. Lobsinger. 9p. $0.50(OTS).

Prepared for the Second U. N. International Conference on the Peaceful Uses of Atomic Energy, 1958.

Aluminum corrosion product solubility has been found to be an important factor in aqueous aluminum corrosion. High aluminum corrosion rates in dynamic tests, as compared to static test, can be accounted for in terms of oxide solubility. Hanford solubility measurements have established the solubility of aluminum corrosion product in the temperature range 200 to 350°C. Corrosion rates in dynamic systems have been successfully predicted on the basis of corrosion product solubility, sample area, and the rate of water refreshment. In the limiting case of very high water throughput and/or low sample area, however, the rate is not controlled by the oxide solubility. Instead the rate of corrosion depends on the rate of the dissolution process. Limiting (maximum) dissolution rates in deionized water have been determined at various temperatures between 200-350°C. Corrosion equations have been developed at HAPO to express the corrosion rate of aluminum in and out-of-reactor. The equations can be modified to express the corrosion rate of aluminum in either inhibited or moderately corrosive media such as Hanford process water. From these equations operating curves may be drawn which may be used to determine limits for the case of aluminum in water cooled reactors. (auth)

FUELS AND FUEL ELEMENTS – Solid – AL-Pu 4.03.02.03.05

7046 A/CONF.15/P/191

IRRADIATION EXPERIENCE WITH RODS OF PLUTONIUM–ALUMINUM ALLOY. O. J. C. Runnalls (Atomic Energy of Canada Ltd., Chalk River, Ont.). 22p. (AECL-601.) $0.25(AECL).

Results of irradiations of plutonium fuel rod designs are examined. The three such designs tested include: doubly-canned plutonium–aluminum alloys in an assembly 300-cm long, with an approximately sine-squared distribution of plutonium; a design in which uranium metal was substituted at each end of the rod for the dilute alloys which were contributing little excess reactivity; and a third design consisting of a stack of twelve cast and machined aluminum alloy cylinders containing 265 g of plutonium as a 3.7 wt.% dispersal. Ten assemblies of the last design are at present in the NRX Reactor for enrichment and to produce a source of higher isotopes of plutonium for reactor physics studies. (J.R.D.)

FUELS AND FUEL ELEMENTS –

Solid – Ceramics and Cermets 4.03.02.03.06

6781 A/CONF.15/P/318

CERAMIC AND CERMET FUELS. P. Murray and J. Williams (Atomic Energy Research Establishment, Harwell, Berks, Eng.). 25p.

The fabrication of UO_2 by sintering, hot pressing, warm pressing, and direct swaging of the oxide powder in metal sheaths is discussed. The oxidation of UO_2 in air and in CO_2 and the compatibility of both stoichiometric and nonstoichiometric oxide in liquid sodium are considered. The preparation and fabrication of UC by various methods are discussed. Consideration is given to dispersed systems of these compounds, with particular reference to the fabrication and properties of carbides dispersed in graphite as high temperature fuels in gas-cooled reactors. (W.D.M.)

5520 AECU-4537

General Atomic Div., General Dynamics Corp., San Diego, Calif.

HEAT TRANSFER FLUIDS FOR FUEL ELEMENT CANS. Leo Brewer. Aug. 4, 1959. 4p. Project No. 32. Contract AT(04-3)-314. (GAMD-904). OTS.

The maximum temperature in the interior of the fuel element could be greatly reduced by incorporating a liquid between the fuel element and the outer can to increase heat transfer rates. It is of interest to consider what liquids would be chemically compatible with graphite and the actinide carbides. Elements which melt below 1100 and boil above 1400°C that form no stable solid carbides, include Cu, Ga, Tl, Ge, Sn, Pb, Sb, Bi, and compounds include GeP, GeS, GaP, Ga_2S, GaTe, GaAs, SnTe, Sn_3As_2, Sb_3Te_2, Zn_3Sb_2, Zn_3P_2, ZnS, ZnTe, and Zn_3As_2. Some of

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FUELS AND FUEL ELEMENTS – Solid –

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these compounds have equilibrium pressures that might be considered too high, but they may actually vaporize slowly enough because of low vaporization coefficients to make them suitable. There are probably not enough data nor adequate theories for predicting the rates, and Langmuir type vaporization experiments would be necessary to determine the rates of vaporization of these compounds. The main problem in the use of a heat transfer fluid is that of reaction between the fluid and the actinide carbides. Thermodynamically extensive attack would be expected. However, it may be possible to make the rate small enough by use of protective coatings for the fuel element or the rate even with direct contact may be small enough to allow use of the fluids proposed. Thermodynamic data used in calculating reactivity of heat exchange fluids with UC_2 are listed. (auth)

5575 AECU-4535
General Atomic Div., General Dynamics Corp., San Diego, Calif.
MELTING POINT OF Th–U–C FUEL ELEMENTS. Leo Brewer. Aug. 3, 1959. 5p. Project No. 32. Contract AT(04-3)-314. (GAMD-901). OTS.

Experiments to provide information on fuel element behavior at high temperatures are discussed. It is felt that an effort should be made to establish a value for the saturated concentration of Th or U in graphite at 2000 to 2500°C. Other experiments considered of value in establishing melting data include determination of solubility of ThC_2 in graphite, U, Zr, and rare earth mixture in ThC_2, $MoThC_2$ in ThC_2, Rh in ThC_2, and BaC_2 in ThC_2, and the melting point of BaC_2–graphite mixtures. (J.R.D.)

4914
FUEL ELEMENTS FOR NUCLEAR REACTORS. (to Physikalische Studiengesellschaft Düsseldorf m.b.H). British Patent 822,629. Oct. 28, 1959.

The use of Pu compounds such as oxides, silicides, carbides, and nitrides as reactor fuel material is suggested to offset health hazards and mechanical strength deficiencies. (T.R.H.)

CERAMIC FUEL MATERIALS FOR NUCLEAR REACTORS. J. R. Johnson (Oak Ridge National Lab., Tenn.). J. Metals 8, 660-4(1956) May.

Ceramics that take advantage of the high power densities and high temperatures potentially available in nuclear reactors are being studied as reactor construction material. Properties of graphites, oxides, carbides and concretes, which have been used, are listed. (F.S.)

FUELS AND FUEL ELEMENTS – Solid – Mg Alloys 4.03.02.03.07

6780 A/CONF.15/P/305
THE MECHANICAL AND PHYSICAL PROPERTIES OF MAGNESIUM AND NIOBIUM CANNING MATERIALS. T. J. Heal (United Kingdom Atomic Energy Authority. Culcheth, Lancs, Eng.). 40p.

The magnesium alloys used as canning materials for the Calder Hall thermal reactors are required to operate as ductile extensible envelopes allowing growth and deformation of the uranium fuel while at the same time suppressing the carbon dioxide-uranium interaction and the release of fission product gases. Mechanical properties relevant to these requirements are reported for a number of magnesium alloys for the temperature range of interest. Magnesium alloys are subject to grain boundary cavitation which is shown to affect the ductility of the material and leads to the possibility of permeable paths forming along the grain boundaries of thin walled cans. Theories advanced to explain the phenomena are discussed in relation to the results obtained. The dependence of the properties of these alloys on their structure was investigated, and the results are discussed in relation to possible fabrication routes. The niobium used as a canning material for the Dounreay Fast Reactor is required to possess both high temperature strength to limit the deformation and swelling of the fuel and sufficient ductility to allow confidence in the ability of the cans to expand without fracture up to limits set by design criteria. Mechanical properties relevant to these requirements and to the requirements of the production route were determined. The effect of heat treatment and gaseous contamination was studied, and some work is reported on the strain aging of the metal and on the effect of alloying additions on the mechanical properties. (auth)

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FUELS AND FUEL ELEMENTS – Solid – Mg Alloys 4.03.02.03.07

7248 A/CONF.15/P/1180
PARTIAL COMBUSTION OF A FUEL CARTRIDGE IN REACTOR G1. de Rouville, Leduc, and Segot (Commissariat à l'Énergie Atomique, Paris). 7p.

An event which took place on October 26, 1956, at the very beginning of the power operation of the G-1 reactor at Marcoule is described. One of the magnesium-clad uranium fuel cartridges developed a jacket leak and partial burning of the magnesium took place. The work of clearing the channel is described. No definite cause for the accident could be assigned but it was concluded that an event of this sort is not dangerous to the reactor or to personnel. The main characteristics of the jacket-leak detection device are given. (W.D.M.)

6825 A/CONF.15/P/2053
ROD FUEL ELEMENT FOR GAS-COOLED HEAVY-WATER POWER REACTOR. P. I. Christenko, P. A. Petrov, et al. (U.S.S.R.). 24p.

The fuel element consists of a bunch of thin uranium pins. Each pin has a protective sheath made of Mg–Be alloy. The bunch of pins is placed in a tube made of Mg alloy. The radiation growth of U is eliminated by tempering the pin in the beta phase. Buckling of the pins is eliminated by load annealing in the vertical position. Canning of the pin ends is accomplished by welding steel tips, which simultaneously serve to mount the pins. (W.L.H.)

FUELS AND FUEL ELEMENTS – Solid – U-Mo 4.03.02.03.08

7058 A/CONF.15/P/2192
O NEKOTORYKH FIZIKO-KHIMICHESKIKH PROTSESSAKH, PROTEKAYUSHCHIKH V DELYASHCHIKHSYA MATERIALAKH POD DEISTVIEM OBLUCHENIYA. (On some Physico-Chemical Processes Occurring in Fissionable Materials under the Influence of Irradiation.) S. T. Konobeevskii, K. P. Dubrovin, et al. (U.S.S.R.). 47p.

A survey is presented of investigations on the effect of neutron irradiation on the structural transformation in a U–Mo alloy and on the stress relaxation in α and γ uranium effected by irradiation, as well as by thermal cycling. A brief outline is given of the theoretical conceptions regarding the diffusion induced by thermal spikes in a fissionable material, and experimental data are presented on the electrical resistance of U–Mo alloys. It has been established that the irradiation of a homogeneous specimen causes rapid growth of electrical resistance which afterwards remains invariable for a long time. The time of saturation is compared with the time required for the entire volume of the metal to pass through the state of thermal spike. (auth)

FUELS AND FUEL ELEMENTS – Solid – UO_2 4.03.02.03.09

7384 WAPD-173
Westinghouse Electric Corp. Bettis Plant, Pittsburgh. RELEASE OF FISSION GASES FROM UO_2. B. Lustman. Mar. 1957. 29p. Contract AT-11-1-GEN-14. $0.25 (OTS).

The available data on release of fission gases from irradiated uranium oxide were correlated on the basis of a diffusional mechanism of gas mobility in the oxide. The diffusion rates thus estimated were found to vary with temperature and had an activation energy similar to that observed in case of the diffusion of oxygen in UO_2. The frequency factor, however, was found to be six orders of magnitude less than that observed for oxygen diffusion. The amounts of fission gas released in experimental fuel rods were found to agree within a factor of 3 with those predicted by such a diffusional mechanism when correction was made for the open porosity or density of the oxide bodies. The pressures and strains developed within fuel rods of the PWR Core 1 configuration and in experimental flat plate fuel elements were calculated for various burnups and burnup rates. The conclusions drawn from this investigation are that the release of fission gases from irradiated UO_2 is in all probability controlled by diffusion of the gases from the oxide matrix, the oxide density is important in establishing the path length for diffusion to external surfaces, the PWR Core 1 blanket fuel element

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geometry is considered safe with respect to the internal pressures and cladding strains developed to burnups and burnup rates far in excess of those proposed in PWR Core 1, and compartmented flat plate configurations are considered feasible for both seed and blanket fuel elements from the points of view of internal pressures and cladding strains. (auth)

6608 CF-60-1-2
Oak Ridge National Lab., Tenn.
TEMPERATURE STRUCTURE IN THE MIDPLANE SPACER FOR EGCR FUEL ROD. L. G. Epel and J. K. T. Jung. Jan. 4, 1960. 8p. OTS.

The steady-state temperature structure for a cross sectional area at the midplane of the EGCR fuel rod is presented. The temperatures are given for the UO_2 as well as for the stainless steel tubing and spacer. (auth)

6849 A/CONF.15/P/143
THERMAL CONDUCTIVITIES OF MIXTURES OF FISSION PRODUCT GASES WITH HELIUM AND WITH ARGON. H. von Ubisch, S. Hall, and R. Srivastav (AB Atomenergi, Stockholm). 11p.

Fuel elements consisting of canned UO_2 may also contain some helium in order to improve the heat transfer within the element. As burn-up proceeds, fission product gases mix into the helium and lower the heat conductivity of the gas. Thermal conductivities of all binary mixtures of the common rare gases and of the ternary system He–Kr–Xe over the whole concentration range were measured by means of the hot-wire method. In addition, results were compared with calculations performed by means of the Enskog-Chapman theory for nonuniform gases. As a result graphs were obtained showing the thermal conductivities of fission product gases (in this case 15.8% Kr and 84.2% Xe) and mixed with helium or argon over the whole range of concentrations. The valid temperature range is from room temperature to about 1000°C. (auth)

20620
IRRADIATION OF FUEL ELEMENTS CONTAINING UO_2 POWDER. Presented at Nuclear Engineering and Science Conference, April 6-9, 1959, Public Auditorium, Cleveland, Ohio. Preprint V–90. J. L. Bates and W. E. Roake (General Electric Co., Richland, Wash.). New York, Engineers Joint Council, 1959. 15p. $0.50.

These experiments demonstrated that a molten UO_2 core is not disastrous in a fuel element, provided that the design engineer has accepted fission gas release into his design and has incorporated some means of controlling redistribution of the fissile material. This is of considerable importance to the success of fuel elements containing non-sintered uranium oxide, such as the swaged fuel element, and will contribute to the economy of manufacture of difficult elements, such as those enriched with plutonium. The formation of columnar grains of UO_2 without melting, as demonstrated in this work, should permit upward re-evaluation of the thermal capabilities of some fuel element designs utilizing sintered UO_2. The importance of proper UO_2 powder storage conditions was demonstrated. (auth)

7047 A/CONF.15/P/193
BEHAVIOUR OF URANIUM OXIDE AS A REACTOR FUEL. J. A. L. Robertson, A. S. Bain, A. H. Booth, J. Howieson, and R. F. S. Robertson (Atomic Energy of Canada Ltd., Chalk River, Ont.) and W. G. Morison (Hydro-Electric Power Commission of Ontario). 46p. (AECL-603). $0.25(AECL).

Observations on complete pellets, fractured surfaces, and polished sections showed that uranium oxide, irradiated at temperatures below its melting point, exhibits grain growth, cracking, void formation, and other mass movement. These phenomena are affected by the fuel diameter and density, the heat rating, the initial clearance between fuel and sheath, the atmosphere within the sheath, and the oxygen–uranium ratio of the oxide. The amount of fission-product gas that emanates from the oxide was observed by analysis of the gas released from a defected sheath during irradiation, and by analysis of the gas inside an undefected sheath after irradiation. In these irradiations and auxiliary laboratory studies the gas release was related to a simple diffusion model, characterized by a particle size. The program is directed towards reducing fuelling costs, and methods of fabrication are being explored that are cheaper than the established process of sintering in hydrogen. (auth)

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FUELS AND FUEL ELEMENTS – Solid – UO_2 4.03.02.03.09

7044 A/CONF.15/P/141
THERMAL CONDUCTIVITY OF UO_2. K. Berg, J. E. Flinta, and L. Seltorp (AB Atomenergi, Stockholm). 9p.

The heat transfer coefficient of UO_2 and its dependence on the thermal load, and on the neutron irradiation was investigated. UO_2 of different densities produced by various methods was used. Thermal load was produced by electrical heating. The neutron irradiation was done in the research reactor R1. (auth)

5644 WAPD-TM-159
Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh.
RADIOCHEMISTRY OF THE PWR FUEL MATERIAL CYCLING TESTS (WAPD-29-1 AND -2) IN THE WAPD-29 VH-3 LOOP OF THE MATERIALS TESTING REACTOR. R. Ehrenreich. Nov. 1959. 21p. Contract AT-11-1-GEN-14. OTS.

The results of in-pile irradiation tests of PWR fuel materials with particular regard to the chemical and radiochemical aspects are reported. These tests were conducted to study the difference of fission product release from defected fuel specimens containing UO_2 fuel materials of two different specific densities; also, one test included a comparatively high oxygen concentration in the loop water to study the effect of an accidental oxygen addition on the rate of fission product release. No firm deduction could be drawn as to the effect of different fuel densities on the emanation of fission products from defected specimens, and the high oxygen concentration had practically no effect on the rate of fission product release. (auth)

FUELS AND FUEL ELEMENTS – Solid – Zr Alloys 4.03.02.03.10

5581 HW-61077
General Electric Co. Hanford Atomic Products Operation, Richland, Wash.
HYDROGEN EFFECTS ON ZIRCALOY-2 TENSILE PROPERTIES. H. H. Burton. July 10, 1959. 48p. Contract W-31-109-Eng-52. OTS.

Results of an investigation of hydrogen effects on the tensile properties of Zircaloy-2 are presented. The hydrogen range studied was 10 to 5000 ppm at room temperature to 400°C. The mechanical properties studied were the ultimate and 0.2 per cent offset yield strength, total elongation and reduction in area at fracture, proportional elastic limit, and elastic modulus. It was found that the experimental procedure and the data collected did not permit conclusions regarding the latter two properties. (auth)

5637 ANL-5918
Argonne National Lab., Lemont, Ill.
IRRADIATION OF EXTRUSION-CLAD URANIUM-2 w/o ZIRCONIUM ALLOY FOR EBR-I, MARK III. J. H. Kittel. Oct. 1959. 18p. Contract W-31-109-eng-38. OTS.

The fuel material specified for the Mark III core of EBR-I was uranium-2 wt.% zirconium alloy coextruded with Zircaloy-2 cladding. From previous work on swaged or rolled uranium-2 wt.% zirconium alloy, it was anticipated that the extruded alloy would be dimensionally unstable under irradiation unless stabilized by suitable heat treatment. In order to determine an effective heat treatment, irradiation studies were made on both clad and unclad extruded uranium-2 wt.% zirconium alloy specimens at irradiation temperature estimated at 200 to 750°C. The irradiation specimens included material with three different heat treatments, selected on the basis of previous studies, and material transient melted in its cladding. For unclad specimens, it was found that the irradiation temperature strongly influenced the various irradiation growth rates resulting from different heat treatments. Growth rates of the clad specimens were relatively insensitive to either irradiation temperature or prior heat treatment. An exception was the transient-melted material, which shortened under irradiation. The cladding had only limited ability to restrain the swelling rates of specimens irradiated at the more elevated temperatures. Clad transient-melted material was found to be most resistant to high-temperature swelling under irradiation. The results of the present study combined with observations in earlier investigations resulted in a recommendation that the reference heat treatment for the core consist of gamma solution at 800°C followed by isothermal transformation at 690°C. (auth)

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5527 GEAP-3097
General Electric Co. Atomic Power Equipment Dept., San José, Calif.
HYDROGEN IN ZIRCONIUM. C. N. Spalaris. Dec. 24, 1958. 12p. (R-58-APE-16).
The hydrogen redistribution in Zircaloy-2 fuel jacket was studied, using typical reactor parameters. Based on reasonable assumptions, it was calculated that the critical hydrogen concentration in Zircaloy-2 clad, Dresden type fuel elements is 60 ppm. For Zircaloy-2 fuel jackets having an initial hydrogen content of 40 ppm, the hydride free reactor operating time was calculated to be 1000 days. (auth)

2140 GEAP-3191
General Electric Co. Atomic Power Equipment Dept., San Jose, Calif.
METAL–WATER REACTIONS: III. FUEL ELEMENT STRESSES DURING A NUCLEAR ACCIDENT. K. M. Horst. July 24, 1959. 26p. Contract AT(04-3)-189. OTS.
The thermal and pressure stresses in metallic plate and rod type nuclear fuel elements during a nuclear accident severe enough to produce a metal-water reaction have been reviewed. The initial reactor periods required to cause these severe accidents are in the range of 4 to 12 milliseconds. The result of the stress review presented in this report indicates that the metallic plate type fuel will swell from internal fission gas pressure, the rate of gas generation, and the magnitude and exposure to elevated central temperatures. Pulsed irradiation type experiments on sample fuel elements are desirable to determine the extent and consequences of this swelling including determination of the mechanism of fuel element failure and if dispersion occurs, measurement of the size of the particles. The stress review for the clad oxide rod type fuel, indicates that the oxide core will expand more than the Zircaloy cladding during severe reactor accidents producing cladding strains in the range of one to two percent. Experimentally, 7 to 10 percent strain is required to rupture irradiated Zircaloy tubing indicating that the cladding should not fail during the reactor transients considered. However, localized areas of the cladding may experience damage during fabrication, loss of ductility or strain concentrations sufficient to crack the cladding. There is no evidence to indicate that the cladding will be pulverized into small enough pieces to accelerate a metal-water reaction nor to modify the analytical models used to evaluate the core conditions during the accidents considered. Pulsed irradiation type experiments on fuel specimens simulating the conditions reviewed would be desirable to evaluate the transient material and mechanical properties of the fuel elements. (auth)

FUELS AND FUEL ELEMENTS – Solid – General 4.03.02.03.11

8658 CRRP-634
Atomic Energy of Canada Ltd. Chalk River Project, Chalk River, Ont.
FISSION PRODUCT ACCUMULATION. W. H. Walker. Mar. 15, 1956. 53p.
The concentrations of individual fission products and their cross sections for neutron capture have been calculated in terms of fissile atom concentration for U^{233}, U^{235} and Pu^{239}. Calculations cover the range of integrated flux from 0.3 to 3.0 neutrons per kilobarn for three values of the flux – 10^{13}, 10^{14} and 10^{15} neutrons per cm^2 per sec. The nuclear data used in these calculations are given, with references to the sources from which they were obtained. Individual fission product contributions are tabulated for fuel poisoning by fission products for which the capture cross section is known, for the upper limit of poisoning possible where only the upper limit of the capture cross section is known, and for concentrations of those fission products for which the cross section is unknown. Total effects for each fissile material are summarized for all combinations of flux and integrated flux. This information is also presented graphically. (auth)

8956 TID-7560
Division of Nuclear Materials Management, AEC and **Michigan State Univ., East Lansing.** Coll. of **Engineering.**
PAPERS PRESENTED AT THE REACTOR FUEL MEASUREMENT TECHNIQUES SYMPOSIUM, HELD AT KELLOGG CENTER, MICHIGAN STATE UNIVERSITY, EAST LANSING, MICHIGAN, JUNE 18-20, 1958. 208p. $2.00(OTS).

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A compilation of the papers presented at the Reactor Fuel Measurement Techniques Symposium is presented. Twenty-three papers were presented covering a variety of fuel measurement aspects, twenty of which are included in the compilation. Separate abstracts have been prepared for each paper. (J.R.D.)

4519
SOME METALLURGICAL FEATURES OF NUCLEAR REACTORS. H. M. Finniston (C. A. Parsons Nuclear Research Centre, Newcastle-upon-Tyne, Eng.). J. Joint Panel Nuclear Marine Propulsion 3, 17-33(1959) Oct.

Metallurgical features of fuels, canning materials, and pressure vessels of possible nuclear reactors for ship propulsion are examined. The growth and swelling of uranium and its alloys upon irradiation are considered. Fabrication and corrosion behavior of these alloys are discussed. The properties of Al, Be, Mg, Zr, and stainless steels for use as canning materials are discussed. (C.J.G.)

7081 KAPL-1954
Knolls Atomic Power Lab., Schenectady, N. Y.
CRITICAL FLOW VELOCITIES FOR COLLAPSE OF REACTOR PARALLEL-PLATE FUEL ASSEMBLIES. Daniel R. Miller. Aug. 26, 1958. 31p. Contract W-31-109-Eng-52. OTS.

Theoretical formulas are presented for prediction of the flow velocity at which collapse occurs in long parallel-plate assemblies. Beyond the critical velocity the pressure-unbalance forces developed as a consequence of a small deflection exceed the corresponding elastic restraining forces, and the plates collapse. Both flat- and curved-plate assemblies are considered, and the applicability of the formulas to design of reactor fuel-plate assemblies is discussed. (auth)

7093 A/CONF.15/P/157
HYDRAULIC STABILITY IN REACTOR FUEL ELEMENTS. L. Brathäll, J. Flinta, et al. (AB Atomenergi, Stockholm). 10p.

Experiments to confirm the calculations for hydraulic stability of R-3 fuel elements with a long electrically heated tube which simulates a channel in a fuel element are described. The increase in the multiplication factors given in the literature appears to be due to bubble formation on that part of the heated tube surface already at nucleate boiling. (W.D.M.)

7247 A/CONF.15/P/1157
THE FUEL ELEMENTS IN PRESSURIZED GAS REACTORS. J. A. Stohr, M. Englander, and M. Gauthron (Commissariat à l'Énergie Atomique, Paris). 74p.

Various cladding materials and processes and natural uranium base fuels were investigated for use in CO_2 cooled reactors. Tests used in connection with the fuel element study are described. The processing of the Saclay EL-2 fuel elements are described, from the vacuum casting of the raw billet to the inspection tests prior to loading into the pile. The operational results of the first set of fuel elements that have been used in EL-2 are outlined, together with a description of the few incidents which have occurred during operation. Fuel elements for the reactors now in the building stage are described, and the change in design discussed. (W.D.M.)

7107 A/CONF.15/P/306
THE ASSESSMENT AND TESTING OF FUEL ELEMENTS. H. K. Hardy and H. Lawton (United Kingdom Atomic Energy Authority, [Springfields, Lancs, Eng.]). 24p.

Recent U.K. Atomic Energy Authority experience in assessing the performance of fuel elements for power reactors is described, together with examples of the experimental work conducted out-of-pile. A theoretical appraisal was made of the factors which may limit the working life of the reactor under the design conditions or which may make large-scale manufacture of the fuel elements difficult or costly. The analysis pays attention to the sources and magnitudes of the strains likely to arise in the fuel elements. Irradiation effects on metallic uranium fuel include changes in macroscopic shape due to preferred orientation, volume swelling caused particularly by gaseous fission products, the development of surface irregularities associated with individual grains, and irradiation creep due to deformation while

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undergoing fission under applied loads. Strains may also be caused by stresses due to temperature gradients, by thermal creep under applied load and by thermal cycling. Strains in the can arise from the accommodation of the deformation of the fuel and are created by the forces due to the coolant flow. Experiments were conducted in-pile to establish the basic phenomena both at Windscale and A.E.R.E., Harwell. Creep rates were determined by tests of samples and by tests on the actual components, both separately and after assembly. The behavior of the fuel elements during a number of the postulated hypothetical reactor faults is of interest. The behavior of the Calder Hall reactors and fuel elements were examined and the implications taken into account. The experimental work includes the proving of the production techniques for the fuel elements. Nondestructive testing methods are used to establish the soundness of the materials of the final elements. The influence of the production methods on the performance of the fuel elements has been considered in the analysis and by experimental checks. (auth)

5346 ORNL-34
Oak Ridge National Lab., Tenn.
DECAY CURVES FOR 23 FISSION PRODUCTS. G. H. Hanson. Apr. 23, 1948. Decl. Jan. 13, 1956. 28p. Contract [W-7405-eng-26]. $4.80(ph OTS); $2.70(mf OTS).

A series of decay curves is presented whereby the total U^{233} fission product activity associated with one kilogram of Th irradiated for various periods of time at various thermal neutron fluxes can be obtained. Fission product activities with thermal neutron fluxes less than 10^{12} can be obtained by using the chart for a flux of 10^{12} and the relationship, $\log_{10}$(total U^{233} fission product activity) = 2 × $\log_{10}$(thermal neutron flux) + B. The constant, B, is determined when the corresponding value with a flux of 10^{12} is introduced into the equation. Tabulations from which growth curves for U^{233} fission products, U^{233}, Pa^{233}, and Th^{233} can be constructed are included. An analytical expression for the total activity from U^{233} fission products developed by N. M. Dismuke and K. Way is also presented. (auth)

7075 A/CONF.15/P/14
THE USE OF THE PILE OSCILLATOR IN THERMAL REACTOR PROBLEMS. H. Rose, W. A. Cooper, and R. B. Tattersall (Atomic Energy Research Establishment, Harwell, Berks, Eng.). 26p.

An experimental program was carried out at Harwell, using the pile oscillator facilities of Dimple and Gleep. Thermal and epithermal absorption effects were separated by integral measurements in several different neutron spectra. A large number of samples were studied, including typical canning and structural materials, the heavy nuclei Np^{237} and Pu^{240}, and many of the important fission product poisons. The fissile nuclei U^{235}, U^{233}, and Pu^{239} were compared, and relative η-values deduced for several spectrum conditions. The Gleep pile oscillator was also used to make measurements of the changes in cross section of nuclear fuels arising from intensive neutron irradiation. Data were obtained for a variety of NRX and Windscale irradiated samples including natural uranium, thorium, and aluminum alloys containing small amounts of pure fissile material. (auth)

7154 WCAP-6040
Westinghouse Electric Corp. Atomic Power Dept., Pittsburgh.
NUCLEAR MATERIALS CONTROL SYSTEM (NMCS). PHASE II. EXPERIMENTAL CONFIRMATION OF THE FEASIBILITY OF THE VARIABLE LOADING TEST REACTOR CONCEPT. J. A. Vreeland. Dec. 31, 1959. 44p. Contract AT(30-1)-2176, Task I. OTS.

A group of experiments is presented which was directed at evaluating the performance of a Variable Loading Test Reactor when used as a Reactor Fuels Measuring Facility. A parallel analytical study is presented to evaluate the effectiveness of available analytical techniques in producing comparable data. The particular experiments performed were measurements of the sensitivity to isotopic changes in a test region moderated with clean water, borated water, and air (or unmoderated), respectively. Although the test region was quite small and the applicability of the results to large regions doubtful, the results imply the ability to identify changes as small as 0.01% in the fuel content of a

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large assembly. This ability is independent of variations in thermal or epithermal poisons which might be made in an attempt to conceal the changes in the fuel content. The analytical results generally fall within the experimental error. The exceptions to this very good agreement are readily attributable to inadequacies in the analysis imposed by the limitations of time. (auth)

5984 AECU-4539
General Atomic Div., General Dynamics Corp., San Diego, Calif.
VAPORIZATION PROCESSES IN A RUNAWAY REACTOR. Leo Brewer. Aug. 4, 1959. 6p. Project No. 32. Contract AT(04-3)-314. (GAMD-919). OTS.

From the point of view of constituents of a fuel element at temperatures between 2500 and 4500°K, the fuel elements can be considered to consist of six types of material: carbon, elements less volatile than carbon, 26 moles of rare gases, 21 moles of alkali metals, 17 moles of alkaline earth metals, and 4 moles of miscellaneous volatile elements. Various processes involving the constituents from 2000 to 4500°K are considered. Reactivity gain due to can rupture is discussed. (W.D.M.)

7545 WCAP-6039
Westinghouse Electric Corp. Atomic Power Dept., Pittsburgh.
NUCLEAR MATERIALS CONTROL SYSTEM (NMCS). PHASE II. THE FUEL ASSAY SCANNER. (A Device for the Non-Destructive Assay of Highly-Enriched Fuel Elements). R. V. Babcock and S. L. Ruby. Feb. 1, 1960. 100p. Contract AT(30-1)-2176, Task I. OTS.

For the purposes of the Nuclear Materials Control System (NMCS), a device was required which would perform a non-destructive assay of the materials in a completed reactor fuel assembly. As a practical example of such a machine, a system was developed to assay the U^{235} and poison (boron) content of high-enrichment plate-type fuel elements by comparison with a standard element. The NMCS prototype device is capable of assaying the U^{235} content of ETR and MTR fuel elements with an absolute accuracy of 0.3% (95% confidence level) by the measurement of the natural gamma activity. ETR elements containing boron may in addition, be assayed for B content with a relative accuracy of 4% by a combination of the above gamma-ray technique, thermal neutron transmission, and a volume determination. The individual measurements require less than 15 minutes.

5636 AECU-4589
Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C.
FISSION GAS GENERATION AND CONSEQUENT HIGH TEMPERATURE IRRADIATION EFFECTS ON NATURAL URANIUM, INCLUDING CREEP PROPERTIES. A Literature Search. Myra Scott. Dec. 15, 1959. 13p. OTS.

A search of foreign literature to determine the development status in the area of fission gas generation and its effects on natural U is reported. The sources which were examined are listed. 64 references. (J.R.D.)

9879 CP-2468
[Chicago. Univ. Metallurgical Lab.]
FISSION PRODUCT POISONING IN A PILE. Katharine Way. Dec. 15, 1944. Decl. Feb. 14, 1956. 23p. Contract W-7401-eng-37. $4.80(ph OTS); $2.70(mf OTS).

The effect of the neutron flux on the relative importance of different fission product poisons is discussed. The general expression for the poisoning of a fission product is given with the various equations for special cases of interest. The formulas are applied to the problem of finding the poisoning due to fission products at the end of one day in a pile operating with a flux of 4×10^{14} neutrons/cm^2/sec. These results are summarized. Appendix I contains a revised list of cross sections × yields for all stable isotopes. Appendix II contains a list of radioactive fission products with half lives greater than one day with data about yields, parents, gaseous ancestors, and numbers of neutrons. (auth)

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See also,

Pyrophoricity, 4.01.10

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6785 A/CONF.15/P/767
CORROSION OF ALUMINIUM WITH ADDITIONS OF IRON AND SILICON IN HIGH-TEMPERATURE WATER.
Ketil Videm (Joint Establishment for Nuclear Energy Research, Kjeller, Norway). 19p.

Aluminum alloys with different contents of Fe and Si have been corrosion tested in demineralized water at 150 and 200°C in autoclaves and in a loop. It is found that the alloys may suffer three different kinds of attack: uniform attack, grain boundary attack, and blistering attack. A too-low iron content and a too-high silicon content lead to grain boundary attack. A too-low silicon content leads to formation of blisters after long exposure, and a high iron content seems to increase the uniform corrosion rate. A careful balance between iron and silicon is therefore needed to obtain the best corrosion resistance. (auth)

6797 A/CONF.15/P/1169
TESTS ON DYNAMIC CORROSION BY WATER; EFFECT OF THE PASSAGE OF THE THERMAL FLUX ON THE CORROSION KINETICS. MEASUREMENT OF THE pH IN HIGH TEMPERATURE WATER.
Berthod, [H]. Coriou, Fournie, [L]. Grall, [J]. Hure, LePeintre, and [R]. Saint-James (Commissariat à l'Énergie Atomique, Paris). 39p.

A low-pressure closed circuit was designed for corrosion tests on aluminum jackets. The loop is described in detail, and the results obtained with it are reported, with special emphasis on cavitation phenomena. A description is given of the high-pressure loop designed for corrosion tests on Zircaloy or stainless steel jackets. A glass electrode which can be used for pH measurements under pressure and temperatures up to 100°C is described. (J.S.R.)

8861 AECD-3003(Rev.)
Battelle Memorial Inst., Columbus, Ohio.
THE DEVELOPMENT OF ALUMINUM–6 PER CENT MAGNESIUM WROUGHT ALLOYS FOR ELEVATED-TEMPERATURE SERVICE AND THEIR RESISTANCE TO CORROSION IN WATER AT TEMPERATURES UP TO 600°F. K. Grube and L. W. Eastwood. July 15, 1950. Decl. Nov. 22, 1955. 44p. Contract W-7405-eng-92. (BMI-T-38). $0.30(OTS).

A wrought aluminum-base alloy for elevated temperature has been developed with the following composition: 6% Mg, 0.5% Cr, and 0.10% Ti. This alloy has outstanding tensile properties at all temperatures up to 600°F. Its thermal neutron cross-section value is similar to that of pure Al. Corrosion tests of 2000 hours' duration in refluxing, boiling, distilled water at 212°F. indicate that its resistance to corrosion is of the same order as 2S and 72S. The resistance to corrosion of all Al-base alloys in water decreases rapidly with increasing water temperature, and, at 600°F., none of the Al-base alloys, commercial or experimental, has appreciable resistance to corrosion. (auth)

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6829 A/CONF.15/P/2153
MAGNESIUM–BERYLLIUM ALLOYS AS MATERIAL FOR NUCLEAR REACTORS. K. D. Sinelnikov, V. E. Ivanov, and V. F. Zelenskii (Zelensky) (U.S.S.R.). 20p.

Beryllium–magnesium alloys have been investigated as corrosion-resistant cladding for use on reactor fuel elements. The preparation of Be–Mg alloys with a fairly high percentage of Be has been worked out. The cladding of uranium shapes is discussed. The properties, including oxidation and corrosion behavior, of the alloy are given. (W.D.M.)

METALS – Steels 4.03.02.04.03

5373 CF-49-11-273
Oak Ridge National Lab., Tenn.
MTR REPORT ON REACTOR STRUCTURAL STEEL.
W. R. Gall. Nov. 29, 1949. Decl. Dec. 15, 1955. 8p. Contract [W-7405-eng-26]. $4.80(ph OTS); $2.70(mf OTS).

This is one of a series of design reports on the Materials Testing Reactor written to transmit necessary information to the design contractor. This report outlines the requirements of a structural steel framework within the

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concrete shield for the purpose of supporting and maintaining alignment of the reactor tank. The design of this structure as shown on ORNL drawings is also given. This proposed design consists of four columns, a horizontal frame of beams at the sub-pile room ceiling, a set of brackets attached to tank section A and four angle brackets to support the thermal shield. The following components are supported or resisted by the steel structure: the reactor tank and its contents; the thermal shield and graphite; concrete above the sub-pile room and two feet of concrete above the thermal shield; vertical forces due to internal water pressure in the tank. (auth)

10554 KAPL-1779
Knolls Atomic Power Lab., Schenectady, N. Y.
PILE-INDUCED THRESHOLD REACTIONS IN STAINLESS STEEL. R. P. Schuman and A. C. Mewherter. May 24, 1957. 8p. Contract W-31-109-Eng-52. $0.20(OTS).

Pure samples of the major components of stainless steel have been irradiated in a receptacle slug in the BNL reactor. Radiochemical separations were made, and the yields of long-lived activities produced by (n,p), (n,2n), and (n,α) reactions were determined. It was found that Co^{58} from Ni^{58}(n,p), Co^{60} from Ni^{60}(n,p), and Mn^{54} from Fe^{54}(n,p) were important activation products with yields comparable to Fe^{59} from Fe^{58}(n,γ). (auth)

11405 AERE-M/R-2485
United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England.
THE EFFECT OF NEUTRON IRRADIATION ON THE IMPACT PROPERTIES OF En2 MILD STEEL. I. L. Mogford, A. T. Churchman, and D. Hull. Feb. 1958. 12p.

The impact properties of En2 mild steel have been measured after irradiation with neutrons to a maximum integrated dose of 9.3×10^{19} neutron cm^{-2}. The increase in the transition temperature is approximately proportional to the cube root of the dose. At the maximum dose the rise in transition temperature is 75°C. There is a reduction in the energy absorbed in ductile fracture after irradiation which is approximately 50% for specimens given high doses. (auth)

12325 AERE-M/R-2536
United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England.
THE EFFECTS OF NEUTRON IRRADIATION ON THE DUCTILE-BRITTLE TRANSITION TEMPERATURES OF WELDABLE STRUCTURAL STEEL PLATES. EXAMINATION OF A WELDED DUCOL W.30 STEEL PLATE OF 4 5/8 in. THICKNESS. R. C. Burnett, J. M. N. Allen and D. R. Harries. Apr. 1958. 31p.

Neutron irradiation effects on the notched-bar properties of a $4\frac{5}{8}$ in. thick welded Ducol W. 30 steel plate are described. Notched specimens machined from various levels in the parent plate and weld metal were irradiated to integrated neutron doses of 4×10^{19} and 7.6×10^{19} n/cm^2 at both 50 to 60°C and 130 to 140°C and tested in slow bend. Irradiation increases the ductile-brittle transition temperatures and lowers the maximum (ductile) energies, but the parent plate and weld metal are not equally affected. The magnitudes of the changes are also governed by the temperature of irradiation and the integrated neutron flux. (auth)

9507
EFFECT OF NEUTRON IRRADIATION ON THE MECHANICAL PROPERTIES OF SOME STRUCTURAL STEELS. E. E. Baldwin (Knolls Atomic Power Lab., Schenectady, N. Y.). Welding J. (N. Y.) 36, 342-s-7-s(1957) July.

Tensile and impact specimens of ASTM A302B steel were irradiated at 500 and 700° F to integrated fast fluxes of 3.8×10^{18} nvt. Notched-bend specimens of ASTM A201 steel were irradiated at 300 to 400° F to integrated fast fluxes of 4.3×10^{20}. Results indicated little or no change in properties of the A302, but substantial increases in strength and loss of ductility and energy absorption ability of the A201. Substantial recovery of the A201 damage could be accomplished by annealing at 600° F. (auth)

7045 A/CONF.15/P/190
EFFECTS OF NEUTRON IRRADIATION ON MECHANICAL PROPERTIES OF FERRITIC STEELS AND IRONS. L. P. Trudeau (International Nickel Co. of Canada, Ltd., Toronto and Atomic Energy of Canada Ltd., Chalk River, Ont.). 11p. (AECL-600). $0.25(AECL).

The effect of fast-neutron irradiation at 50 to 70°C on the mechanical properties of some ferritic steels and irons was investigated with particular emphasis on the

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correlation between the magnitude of irradiation damage and the composition and microstructure. Impact energy transition curves, and tensile-test results are reported for sub-sized specimens; the correlation between results for sub-sized samples and those for full-sized samples is given for unirradiated material. U.S. Navy HY65 alloy (a nickel–molybdenum–vanadium–copper low-carbon steel) was examined in three conditions of heat-treatment; normalized and tempered, austempered and tempered, and quenched and tempered. The third condition was the least susceptible to irradiation damage. Samples of five ferrites (carbon contents of 0.013 to 0.024%) containing 3.2% Ni, 1.5% Mn, 1.0% Cr, and 0.5% Mo have been irradiated for different times. After irradiation the brittle-ductile transition temperatures of these materials approached that of unalloyed ferrite. The increase in yield strength for a given irradiation was about 10% higher for nickel than for manganese ferrites; in turn, the value for the latter material was about 10% higher than for unalloyed and chromium ferrites. The tensile properties of the molybdenum ferrite were least affected by irradiation. (auth)

8712 WAPD-SFR-Fe-303
Westinghouse Electric Corp. Bettis Plant, Pittsburgh.
IMPACT RESULTS ON IRRADIATED STAINLESS STEEL CONTAINING B^{10}. J. R. Schettig. Oct. 20, 1955. 6p.

Bound with this report with separate pagination is WAPD-SFR-Fe-333. TENSILE RESULTS ON IRRADIATED STAINLESS STEEL CONTAINING B^{10}. Supplement to WAPD-SFR-Fe-303. J. R. Schettig. Nov. 18, 1955. 3p.

Samples of stainless steel, B^{10}–stainless steel alloys, and Hf were irradiated in the MTR and impact tested. Test results are tabulated. The impact strength of B^{10}–stainless steel alloys appear to vary inversely with B^{10} content.

9884 KAPL-M-CME-1
Knolls Atomic Power Lab., Schenectady, N. Y.
HYDROGEN EMBRITTLEMENT OF CARBON STEEL. Carl M. Erb. July 13, 1955. 5p. Contract W-31-109-Eng-52. $1.80(ph OTS); $1.80(mf OTS).

An investigation on H embrittlement of carbon steel revealed that a steel containing a minimum alloy addition of 0.5% Mo should not suffer H embrittlement under SAR conditions. H effects due to irradiation in the pressure vessel are not included. (F.S.)

METALS – Nb 4.03.02.04.04

5576 AECU-4549
Massachusetts Inst. of Tech., Cambridge.
PHYSICAL METALLURGY OF UNCOMMON METALS. John T. Norton and Robert E. Ogilvie. Oct. 15, 1959. 25p. Contract AT(30-1)-981. OTS.

The solid solubility limits of the miscibility gap in the U–Nb phase diagram were determined between 800 and 1000°C by analysis of diffusion couples using an electron microbeam probe technique. The feasibility of using x-ray-diffraction methods to measure residual stresses in U and Zr (Zircaloy-2) was investigated. The magnetic properties of hematite (α–Fe_2O_3) were investigated. The crystal structures of Y_5Si_3 and Y_5Ge_3 are being investigated. The structural relationships in the pseudo binary system $ZrFe_2$–$ZrCr_2$ were studied. (W.L.H.)

5571
WELDING A PRESSURE VESSEL FOR A CANADIAN TEST REACTOR. A. M. Bain (Dominion Bridge Co. Ltd., Montreal) and A. H. Clark and M. J. Lavigne (Canadian Westinghouse Co. Ltd., Hamilton, Ont.). Metal Progr. 77, 96-100(1960) Jan.

The problems encountered in fabricating the Type-347 stainless steel surge tank of the test loop of the NRU reactor are discussed. Type 347 stainless steel (stabilized with niobium) was used to weld the inner 1/4 in. of the longitudinal joint of the 3 in.-thick tank. The remainder of the double-V groove was filled with Type 307 stainless steel plus 1% Mo rod. Welding procedures for the circumferential welds are given. (C.J.G.)

8401 NP-8356
New Mexico Highlands Univ., Las Vegas.
THE BEHAVIOR OF SOME NIOBIUM(V)–HALIDE COMPLEXES IN AQUEOUS MEDIA. James H. Kanzelmeyer, B. M. Procter, and Patricia Mack. May 27, 1959. 53p. Contract Nonr-1839(00).

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The absorption curves of niobium in ether–HCl solutions containing concentrations of water of 0.00062 to 0.0740 M are given. Absorption peaks were noted at 260, 281, and in the region 310 to 330 m μ. The species absorbing at these wavelengths are referred to as Species I, II, and III. Species II was determined to be anionic and probably of the form $Nb(OH)_2Cl_4$. Species I is cationic and Species I, III, or both are binuclear. The coordination number of niobium is most likely 6. Evidence is presented that potassium fluoniobate, when dissolved in water, acts as a moderately strong acid reacting with four hydroxides per niobium to form a soluble niobate. The reaction appears to be both reversible and rapid. A structure is proposed for the compound, taking into account these observations and the measured conductance of the solutions. The ionic structure consists of two niobium(V) atoms held together by an ozo linkage, each niobium being covalently linked to five fluorides and one hydroxyl. Extraction ratios of niobium(V) between aqueous chloride and organic solvent phases were studied using a Nb^{95} tracer. Reactions of $NbCl_5$ with pyridine and tetramethylammonium chloride in organic media were studied and analyses were performed on all resulting precipitates for Nb, Cl, C, H, N, and Li. (C.J.G.)

12385 NMI-1157
Nuclear Metals, Inc., Cambridge, Mass.
OXIDATION RESISTANCE OF NIOBIUM-BASE ALLOYS.
H. J. Cleary. July 13, 1956. Decl. July 21, 1958.
26p. Contract AT(30-1)-1565. $4.80(ph OTS); $2.70 (mf OTS).

A program has been under way for the development of a niobium-base alloy with oxidation-resistant properties above 2000°F (1093°C); a 1000-fold improvement over the oxidation resistance of unalloyed niobium at these temperatures was desired. A considerable number of binary and ternary niobium-base alloys have been investigated for oxidation resistance at 980°C. The following alloying elements were found to be somewhat beneficial when added in sufficient amounts to niobium: Al, Cr, Ti, Sn, and Co. Addition of other binary elements lowered the oxidation resistance of niobium: V, Cu, Mg, U, Zn, and Si. Elements which had little effect on the oxidation rate of the base metal were Be, Ni, Fe, and Mn. Ternary alloys with better oxidation resistance than unalloyed niobium were: Nb–20 wt. % Cr–6 wt. % Al, Nb–10 wt. % Cr–2 wt. % Al, Nb–20 at. % Ti–5 at. % Be, and Nb–25 at. % Ti–10 at. % Al. A ternary alloy with low resistance was Nb–25 at. % Cr–5 at. % Be. The best of these binary and ternary alloys (Nb–25 wt. % Ti, Nb–20 at. % Ti–5 at. % Be, Nb–25 at. % Ti–10 at. % Al) showed less than a 40-fold improvement in the oxidation rate of unalloyed niobium at 980°C (1800°F). (auth)

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6727 AERE-R-3114
United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England.
THE OXIDATION AND CORROSION OF ZIRCONIUM AND ITS ALLOYS. VIII. THE EFFECT OF NEUTRON IRRADIATION ON THE DISSOLUTION RATE OF ZrO_2.
K. Alcock and B. Cox. Oct. 1959. 8p. BIS.

The dissolution rates of irradiated and unirradiated samples of ZrO_2 were measured. The results show that there is no significant increase in the over-all rate of dissolution of ZrO_2 following a fast neutron dose of 5.5×10^{19} nvt. It appears that the first 15% of each irradiated zirconia sample dissolves more rapidly; however, it was not shown conclusively that this accelerated rate is due to displaced atoms. A change in specific surface area resulting from the irradiation is the probable cause. (J.R.D.)

6820 A/CONF.15/P/2044
MECHANICAL PROPERTIES AND CORROSION RESISTANCE OF ZIRCONIUM AND ITS ALLOYS IN WATER, STEAM AND GASES AT ELEVATED TEMPERATURES. R. S. Ambartsumyan, A. A. Kiselev, et al. (U.S.S.R.). 82p.

In the development of commercial alloys, suitable for continuous operation in pressurized water and steam, the following alloys were studied: zirconium–niobium, zirconium–nickel, zirconium–tin, zirconium–iron, zirconium–tantalum, zirconium–niobium–tin, zirconium–niobium–tantalum, zirconium–tin–iron–nickel, zirconium–tin–iron–niobium–nickel, and a

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number of others. The purity of primary zirconium, following processes of melting and other treatment, as well as the condition of the surface has a profound influence on the properties and on their absolute values. Corrosion tests in water and steam were carried out, mainly under static conditions in distilled water. Corrosion tests in gases were carried out in a glass vacuum apparatus by means of a volumetric method, also in sealed glass capsules with various gases held in thermostatic conditions at the test temperature. Corrosion tests were followed by mechanical testing. The results of corrosion study of alloys in water and steam made it possible to determine alloy groups, which are stable under continuous operation at various temperatures. As a result of research in gases, quantitive data were gathered dealing with the kinetics of interaction with zirconium and its alloys. The change of the mechanical properties of the alloys, when affected by gases, was also obtained. (auth)

8930

THE EFFECT OF NEUTRON IRRADIATION ON THE MECHANICAL PROPERTIES OF TITANIUM AND ZIRCONIUM. M. M. Makin and F. J. Minter (Atomic Energy Research Establishment, Harwell, Berks). J. Inst. Metals 85, 397-402(1957) May.

The changes in mechanical properties of titanium and zirconium after irradiation with 5×10^{19} neutrons/cm^2 have been studied at a variety of temperatures. The yield stress of annealed titanium increased by about 8000 lb./in.^{2} at all testing temperatures between −195 and +200° C. A yield point was developed at 200° C, which indicates the migration to dislocations of vacancies produced by the irradiation. The elongation before fracture was reduced by the irradiation at all testing temperatures and the ultimate tensile strength increased slightly. The yield stress of heavily cold-worked zirconium decreased slightly at all testing temperatures after irradiation and the ultimate tensile strength rose. The elongation before fracture also increased in marked contrast to the behavior of annealed material. The reason for this "annealing" effect in heavily cold-worked metal is discussed in terms of the atomic defects produced and also in terms of the Brinkman displacement-spike mechanism. (auth)

6777 A/CONF.15/P/194

CHALK RIVER EXPERIENCE WITH ZIRCALOY-2 AND ALUMINUM–NICKEL–IRON ALLOYS IN HIGH-TEMPERATURE WATER. F. H. Krenz and G. J. Biefer (Atomic Energy of Canada Ltd., Chalk River, Ont.) and N. A. Graham (Canadian Westinghouse Co., Ltd., Hamilton, Ont.). 21p. (AECL-604). $0.25(AECL).

Experience was obtained in static autoclaves (300°C) and in loops (260°C) in which samples of aluminum and zircaloy are exposed to high-temperature water flowing at 8 to 10 meters/sec, under power-reactor conditions, in which the alloys were used to sheath UO_2 fuel elements dissipating heat in excess of 100 watts/cm^2. Long-time corrosion tests were done on extruded Zircaloy-2 tubing in static water at 360°C. A corrosion rate of 0.17 mg/dm^2/day resulted. Similar tests were carried out in steam at about 100 atmospheres and in the temperature range 400 to 540°C. The results show that there is a large difference between material extruded and annealed in the α phase and that cooled from the β phase, the latter showing the lower corrosion rates. The effect of hydrogen was investigated in the range 10 to 1200 ppm. In water at 343°C, no significant effect on the corrosion rate up to 110 days was observed. The effect of transition corrosion on subsequent corrosion was investigated in flowing water at 276°C. Samples were pre-corroded in steam at 400°C for 6 weeks after transition corrosion had set in. Subsequent corrosion tests are in progress in flowing water at 276°C, and interim results show that the corrosion rate is not influenced by the pretreatment. Aluminum alloys based on the Al–Ni–Fe system were investigated. The best alloy found to date contains 2.0% Ni, 0.5% Fe, 0.2% Si, 0.05% Be, 0.05% Zr, 0.2% Ti, and has a static corrosion rate of 1.3×10^{-3} cm/yr. Tests carried out in fast flowing water at 260°C demonstrate that the corrosion rate is strongly affected by the total exposed area of aluminum in the loop. (auth)

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FUNDAMENTALS OF LIQUID METAL CORROSION. W. D. Manly (Oak Ridge National Lab., Tenn.). Corrosion 12, 336t-42t(1956) July.

The corrosion of structural metals in liquid metals is for the most part the result of solubility of the various constituents of the metal or alloy in the liquid metal. The manner in which this solution manifests itself gives rise to

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many types of attack, ranging from a simple solution type attack to a deep intergranular attack with the preferential leaching of one constituent of an alloy. Examples of the many types of corrosion experienced with solid metal-liquid metal systems are illustrated. The role of impurities on the corrosion is discussed. In addition to the solution stage, which would soon disappear in a static one metal system on reaching a solubility limit, the corrosion of metals can be continued through the removal of materials from solution in the liquid metal with a temperature gradient or by dissimilar metal transfer. The transfer of metal in a plumbing system by the mechanisms of mass transfer—temperature gradient and dissimilar—will greatly increase the amount of corrosion as compared to the results obtained in static systems. Examples of temperature gradient mass transfer and dissimilar metal transfer are reviewed, and factors governing the occurrence of these phenomena are outlined.

1784 IDO-16475
Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho.
RADIATION DAMAGE STUDIES PROGRAM. ETR LOOP MATERIALS PROGRESS REPORT III. H. T. Watanabe. Sept. 15, 1958. 68p. Contract AT(10-1)-205. $1.75(OTS).

The results are summarized of physical tests on irradiated materials that have some attraction for use in high-pressure equipment intended for operations in the reactor. The materials selected for test were 16-1 Croloy, Hastelloy-X, Inconel-702, Inconel-X (single-aged), Inconel-X (double-aged), K-Monel, 410 stainless steel, 414 stainless steel, AM-350 stainless steel and Zircaloy-2. In progress reports published to date on effects of neutron irradiation on these materials, it is conceded that most alloys will increase in strength and brittleness with increase in irradiation time. This paper will present the latest observations of these irradiation effects. (For preceding period see IDO-16409.) (auth)

11148 ✓ REIC-5
Battelle Memorial Inst. Radiation Effects Information Center, Columbus, Ohio.
THE EFFECT OF NUCLEAR RADIATION ON STRUCTURAL METALS. B. C. Allen, A. K. Wolff, A. R. Elsea, and P. D. Frost. May 31, 1958. 40p. Project No. 2133. Contract AF33(616)-5171.

The general effects of various types of radiation on metals are discussed and the damage mechanisms are outlined. Following this is a topical discussion of the effects of fast neutrons on the physical and electrical properties and corrosion resistance of metals. Tabular data are presented on these effects. Experimental evidence to date indicates that structural metals are quite resistant to nuclear radiation when compared to such things as organic compounds or electronic components. Fast neutrons in integrated flux levels above 10^{19} nvt represent the only reactor radiation that can significantly affect the properties of structural non-fissionable metals. (auth)

NUCLEAR METALLURGY—A SYMPOSIUM ON BEHAVIOR OF MATERIALS IN REACTOR ENVIRONMENT, FEBRUARY 20, 1956. New York, American Institute of Mining and Metallurgical Engineers, 1956. 94p. $3.75.

The following papers describing the peculiar problems and fields of application of commercial metallurgical materials were read: applications of materials in reactor environments; material behavior in liquid metals; application of materials in low-temperature water power reactor; corrosion of materials in fused hydroxides. (F.S.)

8957 CF-50-4-98
Oak Ridge National Lab., Tenn.
HOMOGENEOUS REACTOR CORROSION STUDIES. J. L. English. Apr. 17, 1950. Decl. Feb. 3, 1956. 12p. Contract [W-7405-eng-26]. $3.30(ph OTS); $2.40(mf OTS).

A resume of the results of corrosion tests with zirconium and stainless steels for the homogeneous reactor in uranyl sulfate solution at 250°C is presented. These results include data available as of April 11, 1950. Considerable emphasis during the past month has been placed on the corrosion performance of these materials over an extruded period of time. The corrosion tests have been conducted with three basic conditions, all of which use uranyl sulfate solution containing 40 gm/liter of uranium. Tests are operated at 250°C and specimens are inspected weekly for measurement of corrosion damage. The three categories of corrosion test results discussed are listed under zirconium, stainless steels, and general information. (auth)

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15085 ✓ A/CONF.15/P/1878
Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho.
PERFORMANCE OF METALS DURING SIX YEARS SERVICE IN THE MATERIALS TESTING REACTOR. M. H. Bartz. 23p. $0.50(OTS).
Prepared for the Second U. N. International Conference on the Peaceful Uses of Atomic Energy, 1958.
The performance of metals during six years service in the MTR is summarized for structural components, fuel elements, control rods, high pressure piping, and pressure vessels in high radiation fields. It is concluded that not a single failure of equipment can be attributed solely to the effects of radiation changing the properties of the metals used in its structural and fuel components. (M.H.R.)

6400 A/CONF.15/P/2042
CORROSION BEHAVIOUR OF STRUCTURAL METALS IN IONIZED AIR. I. V. Shatalov and V. A. Nikitina (U.S.S.R.). 19p.
The results of investigations on the corrosion behavior of copper, aluminum, carbon steel, and stainless steel in air ionized by alpha particles are reported. The influence of relative humidity and radiation intensity was studied. (W.D.M.)

13021 ✓ HW-59300 A
General Electric Co. Hanford Atomic Products Operation, Richland, Wash.
NEUTRON DAMAGE TO METALS—A PROGRAM DOCUMENT. A. A. Bement, D. L. Gray, and R. L. Hales. Mar. 1, 1959. 62p. Contract W-31-109-Eng-52. $1.75(OTS).
A program to determine the effects of neutron irradiation on Cu, Ni, Fe, Mo, Ti, Zr, and 347 stainless steel is described. The methods of determining reaction kinetics and activation energies of recovery are described. The over-all testing program is divided into irradiation measurements and post-irradiation recovery studies. The types of property changes due to neutron irradiation were observed, as well as effects of total exposure, irradiation temperature, and metal structure on the amount of damage sustained. Determination of the mechanisms of recovery will be conducted at HAPO. The metals are to be exposed to five neutron levels, and four or more properties will be investigated over a series of isochronal and isothermal annealing treatments. The properties to be investigated include micro-hardness, electrical resistance, and lattice parameter. A schedule of specimen allocation is presented. Also included are descriptions of the major facilities to be used on the program such as annealing facility, electrical resistance apparatus, tensile instrument, and miscellaneous testing equipment. In addition, a list of documents pertaining to the program is listed. (J.R.D.)

7042 A/CONF.15/P/80
THE MECHANICAL PROPERTIES, EMBRITTLEMENT AND METALLURGICAL STABILITY OF IRRADIATED METALS AND ALLOYS. M. J. Makin, D. R. Harries, R. E. Smallman (Atomic Energy Research Establishment, Harwell, Berks, Eng.), and A. T. Churchman (Associated Electrical Industries, Ltd., Aldermaston, Berks, Eng.). 26p.
The change in the tensile properties on irradiation of a number of metals of use as reactor constructional materials is described in detail. Materials tested include titanium, zirconium, Zircaloy-2, molybdenum, tungsten, mild steel, nickel, copper, and certain magnesium alloys. In general, the results indicate an increase in yield and ultimate strength and a decrease in elongation to fracture. (auth)

11151
EFFECTS OF NEUTRON IRRADIATION ON METALS AND ALLOYS. A. H. Cottrell (Atomic Energy Research Establishment, Harwell, Berks, Eng.). J. Brit. Nuclear Energy Conf. 3, 50–67(1958) Jan.
The behavior of metals and alloys under neutron irradiation in a reactor is investigated. An explanation of how damage originates from the collision and absorption of neutrons by nuclei, and a description of the behavior of the fast ions, produced from these neutron encounters, as they penetrate the surrounding material are given. The estimated amount of damage is compared with measured values. Annealing of the damage in which displaced atoms gradually migrate back into lattice positions under the action of thermal agitation is dis-

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cussed. The effects of irradiation on the mechanical properties of metals and alloys are discussed. Radiation growth in uranium and the effects of irradiation on the corrosion resistance of metals are discussed. (W.D.M.)

8792 AFCRC-TN-59-552
General Electric Co. Research Lab., Schenectady, N. Y.
SURVEY OF RADIATION DAMAGE THRESHOLDS. Scientific Report No. 1. R. M. Walker. June 24, 1959. 34p. Contract AF19(604)-5557. (AD-225662).

One of the most important mechanisms leading to radiation-induced changes in materials is the process of direct displacement. In this process, target atoms receive energy from the incoming beam and recoil into new, interstitial positions in the lattice. The distinguishing feature of this type of radiation effect is that there is a minimum threshold energy which must be transmitted to the target atoms before changes will occur. A review is presented of existing information on threshold energies. Some preliminary new information on Au and Ag obtained under the present contract is also reported. Finally the general status of threshold measurements is discussed and promising lines of research are indicated. (auth)

5286 HW-62715
General Electric Co. Hanford Atomic Products Operation, Richland, Wash.
TECHNICAL INVESTIGATION OF AUTOCLAVE FAILURE. N. G. Wittenbrock, M. D. Freshley, B. Griggs, and R. G. Wheeler. Nov. 18, 1959. 42p. Contract AT(45-1)-1350. OTS.

Investigation of an autoclave which ruptured while being used for thermal cycling studies of Plutonium Recycle Test Reactor Al–Pu fuel elements is reported. Stand-in materials were being used and no contamination was involved. The failure was initiated by malfunction of the temperature control instrumentation which led to extreme overheating by the furnaces. Steam-metal corrosion reactions supplied the final increment of energy required to heat the autoclave to 950°C at which the autoclave failed at 1300 psig by stress rupture. No previously unrecognized chemical or physical phenomena contributed to the failure. A similar incident could not occur in a reactor unless the coolant system failed. (J.R.D.)

7190 A/CONF.15/P/2417
THE EFFECTIVE NEUTRON ABSORPTION PROPERTIES OF SOME REACTOR CONSTRUCTION MATERIALS. Pelw E. Blomberg (AB Atomenergi, Stockholm). 13p.

A series of pile oscillator measurements was made on commercial metals and alloys using Swedish Reactor R-1. The aim was to check the agreement between the calculated and measured thermal neutron absorption cross sections. The cross sections were computed from the composition determined by chemical analyses, using the cross sections of the elements compiled in BNL-325. Results are given for various low-alloy constructional steels, austenitic Cr–Ni steels (stabilized and unstabilized), and aluminum alloys. (W.D.M.)

6470 A/CONF.15/P/1589
THE DEPOSITION OF TRACE AMOUNTS OF RADIOACTIVE CATIONS ON METAL SURFACES. J. Siejka and I. G. Campbell (Polish Academy of Sciences, Warsaw). 27p.

Work is reported on the investigation of the mechanism of sorption of tracer amounts of radioactive cation on various metal surfaces. Particular attention is paid to the phenomenon of the sorption of trace amounts of less noble cations on more noble metals, in which adsorptive processes are involved, rather than known processes involving the Nernst potential. Sorption isotherms and adsorption kinetics is reported for Sr^{90}, Zn^{65}, and Co^{60} on such metals as Al, Cu, Pb, Fe, and stainless steel. The effects of such factors as degree of dissolution of surface, pH, and nature of anion are also investigated. (auth)

5626 CF-56-1-168
Oak Ridge National Lab., Tenn.
DYNAMIC SLURRY CORROSION STUDIES [FOR] QUARTER ENDING JANUARY 31, 1956. E. L. Compere, H. C. Savage, S. A. Reed, G. E. Moore, R. M. Warner, R. M. Pierce, and S. R. Buxton. Mar. 27, 1956. 41p. Contract [W-7405-eng-26]. $7.80(ph OTS); $3.30(mf OTS).

Corrosion data are presented for three slurry runs at 300°C on the 100A pump loop using three different preparations of ThO_2. Average circulating concentrations ranged from 581 to 1075 g Th/kg H_2O. Operating problems including some caking and plugging are discussed. One water run was also made. The attack rate by slurries in

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the pump loop on pin specimens of type 347 stainless steel appears to be proportional to the slurry concentration and to the square of the flow velocity. Platinum, Au, Zircaloy-2, and Ti appear to be attacked relatively less severely than stainless steel, which had a pin corrosion rate of 7 mils/year at 20 ft^3/sec and 100 g Th/kg H_2O. Studies at 250°C in toroids found no effect of increased ThO_2 calcination temperature on the attack rate on type 347 stainless steel, Ti, or Zircaloy-2 at various flow velocities. (auth)

9392 AERE-Lib/Trans-603
THE BEHAVIOUR OF THE NATURAL CIRCULATION IN WATER-PIPE BOILERS WITH A FALLING BOILER PRESSURE. O. G. Hammar and R. Jung. Translated by R. J. Richardson from Brennstoff-Wärme-Kraft 7, 1-10(1955). 26p.

It has been supposed that a disturbance in the circulation current detrimental to the heated up-pipes is to be expected when a falling off of boiler pressure owing to loading shocks leads to a self-vaporization of the water in the down-pipes. With an apparatus constructed as a section of a ready-made boiler of normal size for the examination of natural circulation the loading shocks, which arise in practice through a blowing off of steam, were imitated and the resulting variable velocities in circulation were measured. The limiting value of the temporary fall in pressure obtained from this $\Delta p/\Delta t$ exceeding which a disturbance in circulation occurs, depends in the main upon the initial values of the boiler pressure and the water velocity in the down-pipe. By the use of higher water velocities in the down-pipes and the greatest possible initial heating of the up-pipes, the behavior of the water circulation during loading shocks is favorably influenced. On the other hand an aritificial throttling of the circulation current by means of shutters of throttle obstruction leads far more easily to disturbances of circulation. Under normal conditions, especially with greater initial values of water velocities in the down-pipe, the permissible temporary fall in pressure is considerably greater than the limiting value which signals the beginning of self-vaporization of the water contents in the down-pipe. (auth)

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6336 A/CONF.15/P/24
COMPATIBILITY OF BERYLLIUM WITH OTHER METALS USED IN REACTORS. J. D. Baird, G. A. Geach, A. G. Knapton, and K. B. C. West (Associated Electrical Industries, Ltd., Aldermaston, Berks, Eng.). 20p.

The compatibility of beryllium was studied in the temperature range 500 to 700°C with a number of materials, which include copper, iron, nickel, niobium, tantalum, titanium, uranium, and Zircaloy. A more detailed study was made of the interaction between beryllium and uranium, and an assessment was made of the effect of natural or artificially produced protective films on the compatibility of these metals. (auth)

6221
INVESTIGATION OF THE EQUILIBRIUM IN A REACTION IN WHICH BERYLLIUM OXIDE IS REDUCED BY CARBON AT HIGH TEMPERATURES. F. Sh. Muratov and A. V. Novoselova (Lomonosov Moscow State Univ.). Doklady Akad. Nauk S.S.S.R. 129, 334-6(1959) Nov. 11. (In Russian)

Equilibrium in the reaction $BeO_{sol} + {}^3/_2\, C_{sol} \rightleftharpoons {}^1/_2\, Be_2C_{sol} + CO_{gas}$ is studied by manometric methods at 1400 to 2000°C. (R.V.J.)

15156 A/CONF.15/P/621
Argonne National Lab., Lemont, Ill.
THE EFFECT OF REACTOR IRRADIATION ON THE PHYSICAL PROPERTIES OF BERYLLIUM OXIDE. J. R. Gilbreath and O. C. Simpson. 20p. $0.50(OTS).

Prepared for the Second U. N. International Conference on the Peaceful Uses of Atomic Energy, 1958.

Experimental data obtained at Argonne on the effects of pile irradiation on the physical properties of beryllium oxide and beryllium oxide–uranium oxide compacts are summarized. The physical properties discussed include bulk dimensions, lattice dimensions, compressive strength, elastic modulus, specific heat, thermal conductivity, and magnetic susceptibility. Samples of pure beryllia, of 2% UO_2–98% BeO, and of 10% UO_2–90% BeO were studied. To enhance the fission fragment damage, uranium of 30% U^{235} content was used. Irradiations of 54, 109, and 219 Mwd/at were performed. In these irradiations one Mwd/at (Megawatt

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day per adjacent ton) was equivalent to about 1.8×10^{11} fast neutrons/cm^2 and 6×10^{17} slow neutrons/cm^2. All properties of pure beryllia except the thermal conductivity are affected only slightly by exposure to reactor irradiation corresponding to an integrated fast neutron flux of about 3.6×10^{18} neutrons/cm^2. The thermal conductivity decreased approximately 40% during this irradiation. Considerably greater changes were observed in the BeO–UO_2 samples exposed to fast fission fragments. A portion of these irradiation-induced changes may be annealed out by heating at 900°C. Details of the results are discussed. (auth)

6354 A/CONF.15/P/1147
CORROSION DE L'OXYDE DE BERYLLIUM. (Corrosion of Beryllium Oxide). J. Elston and R. Caillat (Commissariat à l'Énergie Atomique, Paris). 56p.

Data are presented on the volatilization of beryllium oxide in moist air. The corrosion rate of powder samples or sintered shapes of various densities is dependent on the temperature and water vapor concentration. Data on the corrosion of sintered beryllium oxide in pressurized water are also presented. At 250°C, under a pressure of 40 kg/cm^2, water is very slightly corrosive. Some data on corrosion in liquid sodium are given. (J.S.R.)

3778
STUDY ON THE PROGRESS OF NUCLEAR MATERIALS. II. MODERATORS. C. BERYLLIUM. Paris, Organisation for European Economic Co-Operation, 1959. 40p. (In French)

An outline is presented of the properties, utilization, fabrication, and production of beryllium and beryllium oxide. The present and future needs are briefly considered. In an appendix these data are tabulated. (J.S.R.)

6992 A/CONF.15/P/1634
ON THE DETERMINATION OF THE SLOWING DOWN TIME IN BERYLLIUM OXIDE. R. Ramanna (Atomic Energy Establishment, Trombay, India). 4p.

The slowing down time and other diffusion constants of beryllium oxide were determined by various methods such as the method using diffusion cooling and the time-of-flight method using a pulsed source, and the measurement of the relaxation distance of low energy monochromatic neutrons. The values are found to be consistent. The possible errors in these measurements are discussed in detail, and the results are compared with the theory. (auth)

6994 A/CONF.15/P/1637
TRANSMISSION OF SLOW NEUTRONS THROUGH POLYCRYSTALLINE BERYLLIUM OXIDE. N. Sarma, K. Satyanarayana, C. S. Somanathan, and K. Usha (Atomic Energy Establishment, Trombay, India). 5p.

The variation of total scattering cross section with energy of beryllium oxide has been measured using a slow chopper neutron velocity spectrometer, and the results are compared with that of the only previous reported measurements of Fermi et al. in 1947. (auth)

SELF-SHIELDING EXPERIMENTS WITH GASEOUS AND SOLID B-10. G. P. Rutledge and R. R. Egglesto. (Westinghouse Electric Corp., Pittsburgh). Nuclear Sci. and Eng. 4, 530-5(1958) Oct.

The relative reactivity worth of several $B^{10}F_3$ gaseous coupons has been determined at pressures up to 4.2 atmospheres. These worth values are compared with equivalent B^{10} loading as B_4C dispersed (100 mesh or less) in stainless steel. Gaseous boron is more than five times as effective as the dispersed boron due to particle self-shielding. Bulk self-shielding becomes important only at high concentrations. The gaseous coupons are also compared with two alloy coupons (normal B^{10} and enriched B^{10}). (auth)

STORAGE OF ENERGY IN BERYLLIUM OXIDE. H. O. Albrecht and C. E. Mandeville (Bartol Research Foundation of the Franklin Inst., Swarthmore, Penna.). Phys. Rev. 101, 1250-2(1956) Feb. 15.

The photostimulated ultraviolet emission of x-ray excited BeO has been measured as a function of the wavelength of the incident light. A maximum of emission occurs for a stimulating wavelength of ~4100 A. Experiments are described which are interpreted as showing the presence of doubly occupied traps in BeO which are analogous to the F-

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centers of the alkali halides. Some discussion concerning energy storage in NaCl(Ag) is included. (auth)

5416 AECD-4045
Clinton Labs., Oak Ridge, Tenn.
EFFECTS OF PILE RADIATION ON BE METAL. Sidney Siegel. June 10, 1947. Decl. with deletions Jan. 10, 1956. 6p. Contract W-35-058-eng-71. $1.80(ph OTS); $1.80(mf OTS).

A set of Be metal rods was prepared by casting, extrusion, and machining to a final size $^3/_{16}$-in. diam. and about $2^1/_2$ in. long. The effects of reactor radiation on the length, density, electrical resistivity, frequency of longitudinal vibration, and damping of mechanical vibrations of the samples were measured. (B.J.H.)

5417 M-3300
Clinton Labs., Oak Ridge, Tenn.
EFFECTS OF PILE RADIATION ON Be METAL. Sidney Siegel. Nov. 27, 1946. Decl. Jan. 13, 1956. 4p. $1.80 (ph OTS); $1.80(mf OTS).

Values of resonant frequency, equivalent resistance, and length of Be metal before and after reactor irradiation are tabulated. The radioactivity of the Be sample after irradiation is also discussed. (B.J.H.)

6996 A/CONF.15/P/1639
SLOWING DOWN OF NEUTRONS NEAR THERMAL EQUILIBRIUM IN BERYLLIUM AND BERYLLIUM OXIDE. L. S. Kothari and K. S. Singwi (Atomic Energy Establishment, Trombay, India). 5p.

Work is reported on the slowing down of neutrons in beryllium and beryllium oxide in the energy range where the effect of crystalline binding is important. For neutron energy less than $2k_0\Theta_D$, where k_0 is the Boltzmann constant and Θ_D is the Debye temperature, elastic and one-phonon inelastic cross sections are calculated on the Debye model by summing over the reciprocal lattice vectors, and the two-phonon cross section is calculated using the incoherent approximation. For neutron energy greater than $2k_0\Theta_D$, the Einstein model of a solid is used to calculate multi-phonon cross sections. Mean energy loss per collision is evaluated in the two energy regions. Assuming that the neutron energy distribution is Maxwellian at all stages of the slowing down, the time variation of the temperature of this distribution has been calculated and the relaxation time of the slowing down process in the last stages determined. It is found that the mean energy loss per collision in beryllium is zero for neutron energy 800 k_0. The neutron distribution approaches equilibrium at T = 304°K, with a relaxation time of 28μsec. In beryllium oxide the mean energy loss per collision goes to zero at neutron energy 840 k_0. Neutron distribution approaches equilibrium at T = 310°K with a relaxation time of 67μsec. (auth)

MODERATORS – REFLECTORS – Boron 4.03.02.05.02

5580 GEAP-3117
General Electric Co. Vallecitos Atomic Lab., Pleasanton, Calif.
BORIDES OF INTEREST FOR CONTROL MATERIALS. A. N. Holden. Jan. 29, 1959. 10p. Contract AT(04-3)-189. OTS.

Various boron compounds are discussed in relation to their properties as control materials for various types of reactors. The crystal structures of these compounds are presented along with other physical properties. (W.L.H.)

MODERAOTRS -- REFLECTORS – D_2O 4.03.02.05.03

8964 CF-51-10-33
Oak Ridge National Lab., Tenn.
ACTIVITIES IN D_2O IN REFLECTOR VESSEL. L. Cooper. Oct. 3, 1951. Decl. Feb. 6, 1956. 10p. Contract [W-7405-eng-26]. $3.30(ph OTS); $2.40(mf OTS).

Calculations were made to determine the level of radiation in the D_2O in the reflector vessel caused by formation of active atoms from dissolved salts, corrosion products and metal recoils. The important elements, from the point of view of high activity and appreciable half-life are Na^{24}, Mn^{56}, Fe^{55}, and Fe^{59}. The calculations indicate activities as high as 5 curies 10 days after shutdown. Plots of activity as a function of time after shutdown are given.

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DECONTAMINATION 4.03.01

MODERATORS – REFLECTORS – Graphite 4.03.02.05.04

8786 M-4615
Brookhaven National Lab., Upton, N. Y.
GRAPHITE STRUCTURE TESTS (MONSTROSITY TESTS). R. W. Powell. Nov. 30, 1949. Decl. Jan. 10, 1956. 79p. Contract [AT-30-2-gen-16]. $13.80(ph OTS); $4.80(mf OTS).

Detailed data are presented from the analysis of graphite structures for mechanical strength under conditions closely resembling pile operation. (C.H.)

5648
EFFECT OF FISSION RECOIL FRAGMENTS ON THE THERMAL CONDUCTIVITY OF GRAPHITE. L. P. Hunter (Oak Ridge National Lab., Tenn.). J. Appl. Phys. 30, 1969-75(1959) Dec.

The variation of the thermal conductivity of uranium-impregnated graphite is measured continuously while under neutron irradiation. The temperature is continuously monitored and results are reported which show the effects of the uranium oxide particle size as well as the effect of the neutron bombardment as separated from the fission recoil bombardment. (auth)

Safeguard Report on the Proposed Annealing of the ORNL Graphite Reactor. L. E. Stanford (ORNL-2725).

5134 IDO-16232
Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho.
NRX GRAPHITE. E. Fast. Oct. 20, 1954. Decl. Jan. 5, 1956. 5p. Contract AT(10-1)-205. (MTRL-54-99). $1.80(ph OTS); $1.80(mf OTS).

Radiation damage studies were made on a graphite sample taken from a thermal column in the NRX Reactor. It was concluded that differences in apparent exposures from stored energy and x-ray measurements of the sample were due in part to the irradiation temperature in the reactor. (C.W.H.)

7194 A/CONF.15/P/2485
THEORY OF ANNEALING KINETICS APPLIED TO THE RELEASE OF STORED ENERGY FROM IRRADIATED GRAPHITE IN AIR-COOLED REACTORS. A. H. Cottrell, et al. (Atomic Energy Research Establishment, Harwell, Berks, Eng.); and J. C. Bell and G. B. Greenough (United Kingdom Atomic Energy Authority, Sellafield, Cumb., Eng.). 56p.

The release of stored energy is due to the movement and elimination of lattice defects. A theory is presented of the factors which enable the rate and amount of release to be estimated, for a variety of reactor conditions, in terms of measurements made under a limited set of laboratory conditions. This theory is used to assess various possible methods for operating and annealing graphite moderated reactors so as to avoid both accidental releases of stored energy and unduly high temperatures during deliberate releases. (W.D.M.)

12685 HW-49626(Rev.)
General Electric Co. Hanford Atomic Products Operation, Richland, Wash.
DISTRIBUTION OF RADIATION DAMAGE IN GRAPHITE. R. E. Nightingale and W. A. Snyder. June 18, 1957. 12p. Contract W-31-109-Eng-52. $0.20(OTS).

Experiments were made to determine the annealing characteristics over a wide range of activation energies. A series of graphite samples with reactor irradiation exposure from 400 to 5700 Mwd/t was thermally annealed, and the changes in length of graphite samples were studied in relation to changes in C_0 the distance between alternate layer planes, and L_c, the crystallite size. Annealing was performed with temperature increases in 50 to 150°C intervals; the activation energy was calculated for each time-temperature annealing schedule. Changes in properties were compared through the exposure range. (R.V.J.)

14636 A/CONF.15/P/614
General Electric Co. Hanford Atomic Products Operation, Richland, Wash.
DAMAGE EFFECTS TO GRAPHITE IRRADIATED UP TO 1000°C. R. E. Nightingale, J. M. Davidson, and W. A. Snyder. 13p. $0.50(OTS).

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MODERATORS – REFLECTORS – H_2O 4.03.02.05.05

Prepared for the Second U. N. International Conference on the Peaceful Uses of Atomic Energy, 1958.

Irradiation effects at 500°C in experimental graphites with varied density, crystallinity, surface area, and pore distribution are discussed. Changes in macroscopic properties are dependent upon the initial crystallite structure; however, the mechanism by which the increase of interlayer spacing and decrease of apparent crystallite size effect these changes is not well understood. Macroscopic properties are also dependent upon the arrangement of crystallites and whole coke particles within the over-all structure which radiation may change slightly. Graphite irradiations in the Materials Testing Reactor extend exposure temperatures from 600 crystallite size. A damage mechanism is discussed which attempts to correlate and explain the changes in properties resulting from graphite irradiations at high temperature. Since the average crystallite does not contract (C_0 expands slightly) while the density of the graphite increases, reactor radiation at high temperature must result in a more efficient packing of the crystallites. Damage distribution curves of samples irradiated at a variety of temperatures can be understood in terms of a process whereby energetic carbon atoms transfer a large amount of energy to the lattice close to a crystal defect. In this way, the activation energy for annealing which is in excess of equilibrium lattice temperature is supplied to the damaged lattice. (auth)

3184

THERMAL INSTABILITY DUE TO GRAPHITE OXIDATION. P. J. Robinson and J. C. Taylor (United Kingdom Atomic Energy Authority, Sellafield, Cumb., Eng.). Nuclear Eng. 4, 400-3(1959) Nov.

Equations are given for determining the equilibrium temperature of graphite and air and the thermal stability of graphite under oxidation including the critical condition. Experimental results are given which confirm the theory. The ultimate course of a runaway is examined and the possibility of control over a runaway discussed. (C.J.G.)

7370

CATALYSIS OF GRAPHITE OXIDATION. G. Hennig (Argonne National Lab., Lemont, Ill.). p.265-71 of "Proceedings of the Third Conference on Carbon." New York, Pergamon Press, 1959.

A systematic study of hexagonal pitting in graphite single crystals was undertaken. It is shown that the initiation of pits depends upon several factors besides the presence of a suitable catalyst. By itself a catalyst such as iron, gold, silver, etc., did produce pits perpendicular to the carbon layers, but only etched figures in the direction of the carbon layers. In highly purified crystals, presumably free of catalytic impurities, the markings assumed preferred orientations during burning in oxygen. Preferential burning was suppressed by chlorine. Implication of these observations are discussed. (auth)

9889 ANL-5003

Argonne National Lab., Lemont, Ill.

THE USE OF THE ELECTRICAL CONDUCTIVITY OF GRAPHITE AS A RADIATION DAMAGE AND FLUX MONITOR. IMPLICATIONS OF THE RESULTS TO THE GENERAL THEORY OF RADIATION DAMAGE. W. L. Primak and L. H. Fuchs. July 13, 1953. Decl. Feb. 11, 1957. 58p. Contract W-31-109-eng-38. $0.40(OTS).

A method for monitoring radiation damage irradiations using the change of the electrical conductivity of graphite is described. Results of monitoring operations in a number of locations are given. An attempt is made to explain the damage rate found in the converter at CP-3'. An estimate of the flux spectrum in VT-4 and the converter of CP-3' is made and the damage rate is computed according to the theories of Seitz and James. It is found that the experimental results are more in accord with the predictions of Seitz. A number of corrections to James' report, ORNL-307, are noted in an appendix. It is shown that some information about the fast flux spectrum can be inferred from the radiation damage rate. (auth)

7136 A/CONF.15/P/1168

ETUDE GENERALE SUR LES GRAPHITES NUCLEAIRES PRODUITS EN FRANCE. (Some Aspects of Nuclear Graphite Production in France). A. Legendre, J. Gueron, and H. Hering (Commissariat à l'Énergie Atomique, Paris). 25p.

EFFECTS OF REACTOR ENVIRONMENT ON MATERIALS 4.03

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MODERATORS – REFLECTORS – H_2O 4.03.02.05.05

A summary and results on the C.E.A.-Péchiney purification process are given. Variations in the preparation of green pastes and their effects on graphitized material are described. Results are given on statistics of dimensional variation for products having square cross section, statistical variation of thermal expansion coefficients and of electrical conductivity, density of normals to carbon layer planes and their connection with thermal expansion, stress-strain cycles and conclusions drawn from them, and mechanical resistance and gas permeability of items for supporting fuel elements. Modifications under radiation of French graphites irradiated either in G_1 pile or in experimental piles, and thermal annealing of those modifications, are given. (auth)

6341 A/CONF.15/P/303
CHEMICAL STUDIES OF CARBON DIOXIDE AND GRAPHITE UNDER REACTOR CONDITIONS. A. R. Anderson and J. Wright, ed. (Atomic Energy Research Establishment, Harwell, Berks, Eng.); H. W. Davidson (General Electric Co., Wembley, Eng.); R. Lind (United Kingdom Atomic Energy Authority, Sellafield, Cumb., Eng.); D. R. Stranks (Univ. of Leeds, Eng.); and C. Tyzack (United Kingdom Atomic Energy Authority, Culcheth, Lancs, Eng.). 102p.

The results of five chemical studies of graphite and CO_2 which have received attention in connection with compatibility in Calder Hall Reactors are presented. The thermal reactions between C and CO_2 below 600°C are explained in terms of surface oxide formation. Three successful techniques which have been used to reduce the rate of reaction between graphite and CO_2 at higher temperatures are described. The reaction between graphite and CO_2 under pile irradiation at temperatures up to 350°C is studied. The results from experiments conducted during startup of the first two Calder Hall Reactors are given. Experiments on the radiation-induced exchange reaction between $C^{14}O$ and CO_2 are described. (W.D.M.)

7165 A/CONF.15/P/1805
BEPO WIGNER ENERGY RELEASE. J. L. Dickson, G. H. Kinchin, R. F. Jackson, W. M. Lomer, and J. H. W. Simmonds (Atomic Energy Research Establishment, Harwell, Berks, Eng.). 97p.

The second Wigner energy release in the 6-Mw air-cooled graphite-moderated research reactor BEPO took place on 14-15th March 1958. The release was fully instrumented, and a preliminary analysis of the results shows the release to have been very complete. The reasons for the chosen method of release, the analysis and interpretation of the graphite sampling data from which the maximum anticipated release temperatures were predicted, and the various safety considerations of graphite oxidation and uranium cartridge failure under these maximum temperature conditions are described. The engineering arrangement for the conduct of the release are described followed by a description of the release and the temperature data obtained. (W.D.M.)

1790
VARIATION OF GRAPHITE DIFFUSION LENGTH WITH TEMPERATURE. R. C. Lloyd, E. D. Clayton, and C. R. Richey (General Electric Co., Richland, Wash.). Nuclear Sci. and Eng. 4, 690-7(1958) Nov.

The graphite diffusion length was measured as a function of temperature in a 101-inch cube of graphite. A water-cooled BF_3 counter was used as the neutron flux detector, with additional measurements being made with gold and indium foils. The steady state neutron flux was furnished by means of four ½-gram, Ra-Be neutron sources. Measurements were taken over a range of temperature from 22 to 600°C at intervals of about 50°C. The variation of diffusion length with temperature change is in good agreement with the calculated variation assuming a $1/\nu$ cross section for graphite and a constant transport mean free path. (auth)

6376 CE-951
[Chicago. Univ.] Metallurgical Lab.
THERMAL WARPING OF GRAPHITE PILE. S. G. Bankoff, C. P. Cabell, and G. Rosner. Sept. 28, 1943. Decl. Dec. 12, 1955. 7p. (A-1347). $0.15(OTS).

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MODERAOTRS – REFLECTORS – H_2O 4.03.02.05.05

6149 NAA-SR-151
North American Aviation, Inc., Downey, Calif.
TENSILE STRENGTH OF URANIUM IMPREGNATED GRAPHITE. A. E. Miller and C. R. Malmstrom. Sept. 14, 1951. Decl. Dec. 5, 1955. 10p. Contract AT-11-1-GEN-8. $0.15(OTS).

The short time tensile breaking strengths of three grades of graphite impregnated with uranium in the form of UC_2 were measured as a function of temperature. Grade C-18 graphite impregnated with 235 and 424 mg of uranium per cc showed a considerable decrease in strength at the higher temperatures as compared with unimpregnated C-18. Grades ECA and AUF graphite impregnated with 147 and 9.25 mg of uranium per cc respectively showed no decrease in strength as compared with unimpregnated specimens. The decrease in strength exhibited by C-18 is attributed to its lower density and larger pore size. (auth)

PARAMAGNETIC RESONANCE ABSORPTION IN GRAPHITE. G. R. Hennig and B. Smaller (Argonne National Lab., Lemont, Ill.). pp.113-15 in Proceedings of the Conferences on Carbon, University of Buffalo, New York, 1956.

Graphite usually gives rise to an electron spin resonance, which is relatively weak and furthermore sensitive to thermal treatment of the graphite. The spin center concentration decreases as the measuring temperature is lowered. The concentration measured at room temperature is decreased by heating near 1200°C and restored by heating at 1500°C. The thermal stability of the centers is furthermore a function of the crystal size and perfection and is decreased by oxygen. The centers have tentatively been identified with irregularities in the mosaic and peripheral boundaries.

MODERATORS – REFLECTORS – Organic 4.03.02.05.06

21892
TOXICOLOGIC STUDIES ON POLYPHENYL COMPOUNDS USED AS ATOMIC REACTOR MODERATOR-COOLANTS. Thomas J. Haley, L. E. Detrick, N. Komesu, P. Williams, H. C. Upham, and L. Baurmash (Univ. of California, Los Angeles). Toxicol. Appl. Pharmacol. 1, 515-23(1959) Sept.

A study has been made of certain aspects of the toxicology of organic polyphenyl compounds proposed for use as moderator-coolants in atomic reactors. Only monoisopropylbiphenyl, irradiated monoisopropylbiphenyl, and terphenyl mixtures (OMRE) were irritating to the conjunctiva in rabbits and only the unirradiated moderator-coolants caused skin irritation in rabbits. Both the moderators and their components were highly damaging to guinea pig skin following intracutaneous injection. All the polyphenyl compounds except irradiated monoisopropylbiphenyl produced sensitization and chemical necrosis. The latter produced only necrosis. Monoisopropylbiphenyl and o- and m-terphenyl were the only polyphenyls that caused death after inhalation, although all of the compounds produced some of the following symptoms: nasal congestion with rhinitis, lachrymation, labored respiration, and erythema of the ears and paws. The following histopathologic changes were also observed: acute tracheal necrosis, acute tracheobronchitis, pulmonary edema, bronchopneumonia, atelectasis, and petechial hemorrhages. All such toxic effects can be prevented by protective clothing and respirators. (auth)

MODERATORS – REFLECTORS – Other 4.03.02.05.07

5638 KAPL-M-ECH-1
Knolls Atomic Power Lab., Schenectady, N. Y.
LONG TERM IRRADIATION OF NATURAL HAFNIUM. E. C. Hansen. Dec. 15, 1959. 50p. Contract W-31-109-Eng-52. OTS.

Due to the importance of hafnium as a nuclear reactor material (control rods, burnable poisons), it is of general interest to calculate the isotopic population of natural hafnium and its irradiation products, as a function of time, for long germ irradiations. The isotopic population is presented for times $0 \leq t \leq 50{,}000$ hrs, thermal fluxes $10^{12} \leq \phi \leq 10^{14}$, and epithermal to thermal flux ratios $0 \leq A \leq 8$. The above is equivalent to depletion of zero to 99% depending upon the thermal flux level. The major limitation to the presented results is the assumption of infinite dilution, i.e., no spatial or energy self shielding. These results are thus applicable to such cases as the surface of control rods or distributed poisons. It is felt that the error in the presented results should be of the order of ±30%. (auth)

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MODERATORS – REFLECTORS – Other 4.03.02.05.07

7371
THE REACTION OF CARBON WITH OXYGEN ATOMS. J. Streznewski and J. Turkevich (Princeton Univ., N. J.). p.273-8 of "Proceedings of the Third Conference on Carbon." New York, Pergamon Press, 1959.

Evaporated carbon films and carbon particles obtained by burning benzene in air were subjected to reaction with oxygen atoms produced in a discharge tube. The evaporated film reaction was followed using the optical transmission as a method of determining the rate of erosion of the surface. Rates of erosion of the surface were determined for atom concentrations up to 65%. The rate of erosion of the film is independent of temperature in the range 20 to 100°C and depends directly upon the oxygen atom concentration. The carbon black samples mounted on SiO films were also reacted with oxygen atoms and the change in size distribution was followed by the electron microscope. The means radius of the particles decreases linearly with time, the half-width of the particle size distribution remains constant. The rate is temperature independent and dependent directly on the concentration of oxygen atoms. Hydrogen atoms also react with carbon at room temperature while ozone shows no effect. (auth)

GENERAL 4.03.02.06

EFFECT OF NUCLEAR RADIATION ON STRUCTURAL MATERIALS. J. C. Wilson and D. S. Billington (Oak Ridge National Lab., Tenn.). J. Metals 8, 665-72(1956) May.

Properties of engineering interest in a wide variety of materials have been reviewed as they are known to be affected by irradiation. Some of the possible implications of the property changes have been noted and logical paths of research have been pointed out. (F.S.)

14608 A/CONF.15/P/715
Argonne National Lab., Lemont, Ill.
HIGH TEMPERATURE THERMODYNAMIC PROPERTIES OF REACTOR MATERIALS. R. J. Ackermann and R. J. Thorn. 11p. $0.50(OTS).

Prepared for the Second U. N. International Conference on the Peaceful Uses of Atomic Energy, 1958.

High-temperature thermodynamic properties of reactor materials are important to chemical engineers, ceramists, metallurgists, and reactor engineers in developing pyrometallurgical processing procedures, fabricating fuel assemblies, and designing high temperature reactors. A critical evaluation and discussion is to be presented so that reliable free energies and phase diagrams if possible are available to enable one to predict the behavior of various chemical systems which may be proposed for use at temperatures above 1000°C. One aspect which will become increasingly more important when systems are considered for high temperatures is the production of gases from condensed phase reactions. The behavior in this respect of two classes of compounds, oxides and carbides, of aluminum, beryllium, hafnium, magnesium, plutonium, tantalum, tungsten, thorium, uranium, and zirconium is examined. The oxides are of interest because of their high stabilities and the carbides because of their high conductivities and because of the desirable nuclear properties of carbon. (auth)

7040 A/CONF.15/P/29
THE EFFECT OF GASES PRODUCED IN REACTOR MATERIALS BY IRRADIATION. R. S. Barnes and G. W. Greenwood (Atomic Energy Research Establishment, Harwell, Berks, Eng.). 14p.

Neutron bombardment produces gases in reactor fuels and in some materials which may be used for cans, moderator, control elements, or coolant. The gas producing reactions of most significance are listed. Gas production can alter radically the properties of the material; if the material is brittle it will eventually fragment or, if plastic, its volume will increase. Some examples of fragmentation are given and its importance in reactor materials is discussed. Helium injected into plastic metals precipitates in a great number of small bubbles on subsequent heating. It is considered that these bubbles form when the helium atoms occupy vacancies which have migrated from nearby sources such as grain boundaries. The bubbles grow on further heating and though their number generally decreases there is a resultant increase in the volume of the material since the restraint imposed by surface tension is less

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for the larger bubbles. In metallic reactor fuels at about 800°C the volume increase agrees with that estimated from the creep strength of the material but at lower temperatures the volume increase is greater than that estimated on the same basis. It is suggested that a process of vacancy condensation occurs which enhances bubble growth. Several examples of the precipitation of gas bubbles in solid materials are given and the significance of this phenomenon for reactor materials is discussed. (auth)

7055 A/CONF.15/P/2052
IZMENENIE MEKHANICHESKIKH SVOISTV KONSTRUKTSIONNYKH METALLICHESKIKH MATERIALOV POD VOZDEISTVIEM NEITRONNOGO OBLUCHENIYA. (Change in Mechanical Properties of Structural Materials Under Neutron Irradiation.) N. F. Pravdyukh, S. T. Konobeevskii, et al. (U.S.S.R.). 30p.

The effects of pile irradiation on mechanical properties of structural metallic materials and on the internal friction of some metals are presented. Effects of irradiation temperature on tensile properties of austenitic stainless, carbon, and chromium steels, zirconium and some of its alloys, and nickel are presented. Effects of neutron flux at a constant temperature on tensile and impact properties of a number of structural steels are discussed. Irradiation hardening is shown to decrease with raising the irradiation temperature. Irradiation in a flux of 10^{20} n/cm^2 causes a considerable strength increase of all the materials investigated. Austenitic stainless steels maintain a rather good plasticity while the plasticity of carbon and chromium ferrito-perlite steels is strongly reduced. The recovery of the properties in the materials irradiated was investigated. The experiments to define the critical stress value at which a sharp increase of internal friction is observed in some metals before and after irradiation are described. The influence of plastic deformation and annealing on internal friction was investigated along with the study of the irradiation effects. The critical stress value for monocrystalline and polycrystalline zinc was measured. The experiments carried out with zinc suggest that the critical stress value can be related with the beginning of the dislocation movement. The increase of the critical stress value in irradiated metals should mean that dislocations are pinned due to the interaction with point imperfections. (auth)

7534 AERE-C/R-1575(1), AERE-C/R-1575(2) and AERE-C/R-1575(3)
Gt. Brit. Atomic Energy Research Establishment, Harwell, Berks, England.
SELECTED ABSTRACTS OF ATOMIC ENERGY PROJECT UNCLASSIFIED REPORT LITERATURE IN THE FIELD OF RADIATION CHEMISTRY and BIBLIOGRAPHY OF THE PUBLISHED LITERATURE. (Papers Noted up to March 1956). PART 1. THEORY, INTERPRETATIONS, WATER AND AQUEOUS INORGANIC SYSTEMS. PART 2. ORGANIC COMPOUNDS (INCLUDING POLYMERISATION REACTIONS). PART 3. GASEOUS SYSTEMS (EXCLUDING ORGANIC COMPOUNDS). R. W. Clarke, comp. (Papers Noted up to Dec. 1955 (Pt. 1). Jan. 1956. 98p.; Papers Noted up to Mar. 1956 (Pt. 2). Mar. 1956. 226p.; and (Pt. 3). Mar. 1956. 60p.).

These three parts were issued separately, but are cataloged as a unit.

3182
CALCULATION OF IRRADIATION AND GAMMA RAY HEATING ON STRUCTURAL MATERIALS OF BWR. [PART] I. I. Ichino, T. Ōmura, M. Tokizawa, and H. Andō (Nippon Atomic Industry Group Co., Ltd.). J. Atomic Energy Soc. Japan 1, 289-98(1959). (In Japanese)

Calculations are presented on the radiation damage of structural materials by fast neutron and gamma bombardment and gamma heating of the pressure vessel of a boiling water reactor of 10 Mw(e) output. Estimates are made of the neutron flux in and out of the core, gamma flux, and gamma heating of the pressure vessel. (C.J.G.)

8313
IRRADIATIONS IN THE MUNICH RESEARCH REACTOR. III. RADIATION DAMAGE FROM IRRADIATION IN THE REACTOR. W. Schilling. Kerntechnik 1, 119-26(1959) Oct. (In German)

In the last part of the article the formation of radiation damage is considered in the evaluation of the effects of reactor radiation. (tr-auth)

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4166
RADIATION DAMAGE. REPORT FROM BRITISH ASSOCIATION MEETING. C. S. Grace (Royal Military College of Science, Shrivenham, Eng.). Nuclear Energy Engr. 13, 596-9(1959) Dec.

Four papers, delivered at the annual meeting of the British Association for the Advancement of Science, on the different aspects of radiation damage are briefly reviewed. Emphasis is placed on radiation damage in reactors and the mechanisms of radiation effects in biological materials. (D.E.B.)

1114. ORNL-2778
Oak Ridge National Lab., Tenn.
FISSION PRODUCT POISONING DATA. N. J. Pattenden. Oct. 14, 1959. 28p. Contract W-7405-eng-26. OTS.

Recent measurements of the neutron cross sections and yields of fission products are summarized and compared with previous data. The effects of resonance and thermal absorption are compared. Proposals are made for further work to enable the evaluation of fission product poisoning of reactors to be more complete. (auth)

8255
TECHNOLOGIE DES REACTEURS NUCLEAIRES. TOME I. MATÉRIAUX. (Nuclear Reactor Technology. Volume I. Materials). Paul Ageron, Maurice Gauzit, André Bonaldi, and Thomas Reis. Paris, Eyrolles and Paris, Gauthier-Villars, 1959. 579p.

A review is presented on the nuclear, chemical, physical, and mechanical properties of materials used in reactors and of reactor structural materials. A brief resumé is given at first to make the later chapters useful to the unspecialized reader. A general treatment of radiation effects on matter is then given, followed by chapters on: fissile and fertile materials (U, Th, and Pu, and their chemical processing); non-fissile materials such as Be, BeO, D and D_2O, graphite and other moderators; coolants including Na, Mg, Al, K, Na–K, Rb, Zn, Sn, Ga, and Bi eutectics; neutron absorbers (lanthanides), Cd, B, Hf, and Pt family; shielding materials; and construction materials including Zr and its alloys, stainless steels, Al and its alloys, Mg, Be, Ni and its alloys, Ti, Ta, Mo, W, ceramics, and plastics. (T.R.H.)

7049 A/CONF.15/P/998
ON THE THEORY OF RADIATION DAMAGE AND RADIATION HARDENING. Alfred K. Seeger (Max-Planck-Inst. für Metallforschung, Stuttgart and Technischen Hochschule, Stuttgart). 52p.

A theory of radiation damage of nonfissionable material is developed, which attempts mainly to explain the phenomena of radiation hardening. It is shown that these can be accounted for quantitatively in the following way: each fast knock-on atom creates a disturbed "zone" at the end of its trace; these zones harden the material, since they have to be cut by dislocation lines; and this gives the observed temperature dependence of the critical shear stress of neutron-irradiated copper crystals and also the observed annealing behavior of radiation hardening. The recovery of electrical resistivity after irradiation is interpreted as follows (using copper as an example): the low temperature recovery (at about 40°K) after neutron bombardment is due to atomic rearrangements in the "zones," whereas after electron bombardment it is due to the recombination of very close pairs of vacancies and interstitial atoms; isolated interstitial atoms are able to migrate in the temperature region at about 240°K, whereas vacancies can migrate only above room temperature. (auth)

8662 DM-58
Atomic Energy of Canada Ltd., Chalk River, Ont.
THE RETURN OF ESCAPED FISSION PRODUCT GASES TO UO_2. W. B. Lewis. Jan. 21, 1960. 49p. (AECL-964). AECL.

Preliminary experimental results appear consistent with the hypothesis of J. A. Davies by which fission fragments passing through a space filled with escaped fission product gases knock on a certain number of the gas atoms with sufficient energy, 2 kev or more, to penetrate through solid surfaces and become trapped. The number of gas atoms knocked on is supposed proportional to the fraction of the fission fragment energy expended in the gas. If the kinetic energy of a pair of fission fragments were expended entirely in fission gas, the number of atoms knocked on with

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sufficient energy is set as K, but only a fraction G of these will remain embedded. By irradiating small pieces of sintered UO_2 in capsules filled with natural xenon at several pressures and analyzing the embedded xenon relative to the fission gas produced, Kelly, Morgan, and Jones obtained a series of results that indicate GK ≈ 100. In an earlier experiment, Hawkings, Morgan, and Jones irradiated a full-size UO_2 fuel rod in an atmosphere of natural argon, krypton, and xenon. Analyzing the gases embedded in oxide samples subsequently taken from various positions in the rod, led to complex results, but setting GK = 100 or possibly more, reveals an intelligible pattern that is discussed at some length. The mechanisms of fission gas escape are classed primarily as fission recoil, "knock-out," and diffusion. The last has commonly been related to the simple Booth model of diffusion from an aggregate of spheres, but evidence is presented from the experiments of MacEwan and Lawson of much more complex processes involving migration of voids up the thermal gradient by an evaporation process; other processes of grain growth and thermal diffusion are also postulated. To evaluate the behavior of fission gases in practical UO_2 fuel, the volume is divided into several zones, namely compacted or sintered oxide below 1000°C, oxide between 1000 and 1600°C, sintered and deformable oxide above 1600°C, closed porosity, interconnected open porosity, and extra spaces such as end gaps that are cool and axial voids that are hot. For the return of escaped fission gases, porosity in the oxide that is below 1600°C, and especially that below 1000°C, is shown to be valuable. (auth)

8761 NP-tr-343
THERMOPHYSICAL PROPERTIES OF SUBSTANCES. (Teplofizicheskie Svoistva Veshchestv). I. I. Ayzenshtat, ed. Translated from a publication of the Printing House of State Publishing House for Power Engineering, Moscow. 479p. OTS.

The physical properties of various gases at standard pressure and various temperatures and the thermophysical properties of gases at various pressures and temperatures are tabulated. The thermal properties of steam and water at 0 to 700°C and under pressure from 1 to 400 kg/cm^2 are given. The physical properties of steam in the supercritical region and water near the critical point are included. Physical properties of various liquids including water, heavy water, high-boiling organic and inorganic liquids, low-boiling liquids, molten salts, and liquid metals are tabulated. The physical properties of organic and inorganic compounds, pure metals, and steels are given. Thermal conductivities of dry and moist insulating materials, refractories, and various inorganic compounds and metal oxides are given. Standards for thermocouples and resistance thermometers including various grades of platinum are tabulated. The characteristics of thermocouples at temperatures above 1500°C under laboratory and industrial conditions are reported. (C.J.G.)

3137 ANL-6024
Argonne National Lab., Idaho Falls, Idaho.
DESIGN AND HAZARDS REPORT FOR THE ARGONNE FAST SOURCE REACTOR (AFSR). G. S. Brunson. June 1959. 65p. Contract W-31-[109]-eng-38. OTS.

The Argonne Fast Source Reactor is designed to operate at low power (nominally 1000 watts) to supply neutron fluxes, both fast and thermal, for laboratory experiments. It is built around a cylindrical core (with vertical axis) of solid, highly enriched uranium approximately $4\frac{1}{2}$ in. in diam. by $4\frac{1}{4}$ in. high. The blanket is of solid depleted uranium with a minimum thickness of eight in.; its outer form is cylindrical, $20\frac{5}{8}$ in. in diam. by $20\frac{5}{8}$ in. high. The reactor, contained in a shield of high density concrete of minimum thickness $4\frac{1}{2}$ ft, is freestanding on the floor of the reactor building. A graphite thermal column 4 × 4 × 6 ft is provided. All control and safety mechanisms are located in a pit beneath the reactor. The hazards associated with operation of the reactor have been analyzed. A number of potentially dangerous circumstances were studied to determine the probable severity of the resultant excursions. As an upper limit, a detailed study was made of the extreme case in which the reactor, overloaded by five kilograms of U^{235}, goes critical at the air cylinder speed of 18 in./min. It is estimated that the excursion would amount to 3.6×10^{17} fissions. This is expected to destroy the core and eject all core material into the pit where it burns, greatly adding to the total energy of the excursion. No rupture of reactor shield or building is expected. The reactor pit and reactor building will be heavily contaminated and some radioactive material will escape from the building. It is nearly certain that the maximum radiation dose to personnel outside the reactor building will not exceed 15 roentgens. (auth)

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4582 SCR-127
Sandia Corp., Albuquerque, N. Mex.
EFFECTS OF HIGH NEUTRON AND GAMMA FLUXES ON THE TRANSMISSION CHARACTERISTICS OF SOME OPTICAL GLASSES. J. L. Colp and H. N. Woodall. Nov. 1959. 17p. OTS.

The design of the Sandia Engineering Reactor Facility (SERF) presented a unique problem of finding a way to view the virtually unshielded 5 Mw reactor during operation. It was determined that periscope viewing was most feasible. The front optical elements of the periscope must withstand a total integrated radiation dose of 3×10^9 r of gammas, and 1.4×10^7 n/cm^2, without excessive transmission losses. A program started to study the effects of radiation at such rates and total doses on the transmission characteristics of available optical glasses is described. Curves plotted from the study are presented to show graphically the results of irradiation on these optical glasses. (W.D.M.)

6879 A/CONF.15/P/1714
A POSSIBILITY OF PREPARING OVERHEATED SOLID STATE IN REACTORS. T. A. Hoffmann (Central Research Inst. for Physics, Budapest). 17p.

In a theoretical calculation of the melting properties of solids, the size of the subcrystallite and the vacancy concentration are related to the energy-entropy diagram of a solid. It is theorized that if the sample is irradiated in a high neutron flux below the melting point to create the critical number of vacancies and the temperature is caused to rise very rapidly above the melting point, then the sample will remain stable without melting. (W.D.M.)

9892 HW-35284
Hanford Atomic Products Operation, Richland, Wash.
FLEXURE TESTS ON IRRADIATED TEFLON BELLOWS. P. B. McCarthy. Feb. 1, 1955. Changed from OFFICIAL USE ONLY Feb. 2, 1956. 4p. Contract W-31-109-Eng-52. $1.80(ph OTS); $1.80(mf OTS).

Although the published literature states that teflon is not damaged by radiation exposures below 10^6r, the results of flexure tests indicate that the radiation exposure limit for teflon bellows which are to be subjected to continuous flexing conditions is approximately 10^5r. Below this radiation exposure, other effects such as machining tolerance, teflon purity, and stress assume more importance to the life expectancy of the bellows than the effects of radiation. (auth)

THERMAL STRESSES 4.03.02.07

7134 A/CONF.15/P/1164
METHODES DE DETERMINATION DES CONTRAINTES THERMIQUES. QUELQUES EXEMPLES D'APPLICATION AUX REACTEURS. (Methods for Determining Thermal Stresses Values—Some Examples Relating to Nuclear Reactors). J. Bernard, A. Gautier, and A. Peres (Commissariat à l'Énergie Atomique, Paris). 83p.

As modern techniques develop more elaborate machines with higher temperatures and pressures, thermal stresses become a matter of major importance in the design of mechanical structures. In the first part of this paper, the problem of thermal stress is examined theoretically, and an attempt is made to evaluate the aptitudes and limitations of mathematical techniques in calculating thermal stress. Experimental methods of measuring thermal stress in steady and unsteady conditions are described in detail. Some examples relating to nuclear reactors are shown. (J.S.R.)

9184
THERMAL STRESSES IN NUCLEAR REACTOR VESSEL NOZZLES. J. S. Busch, A. J. Martenson, and S. W. Sinderson (Westinghouse Electric Corp., Pittsburgh). Nuclear Sci. and Eng. 7, 97-103(1960) Feb.

The thermal stresses in the nozzles of heavy-walled reactor vessels, caused by sudden changes in coolant temperature, are considered. An analysis was made of this problem for both high and low flows of cold water. The results show that the nozzle investigated (stainless steel clad nozzle) can endure a large number of cycles of the worst case analyzed. (auth)

6830 A/CONF.15/P/2190
EFFECT OF THERMAL CYCLING ON DIMENSIONAL AND STRUCTURAL STABILITY OF VARIOUS METALS AND ALLOYS. A. A. Bochvar, A. A. Gulkova, et al. (U.S.S.R.). 38p.

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Studies are reported on the effect of thermal cycling on the dimensional and structural stability of Al, Cu, Ni, Zn, U, Armcoiron, Alpax, Cu–Zn and Al–Zn alloys, carbon steel, and a number of creep-resistant alloys. Composition and structure of alloys, type of space lattice, and thermal cycle variable were also investigated as to their influence on the thermal cycling effects. (W.L.H.)

3143 NAA-SR-Memo-2213
Atomics International Div., North American Aviation, Inc., Canoga Park, Calif.
THERMAL STRESSES FROM RADIAL EXPONENTIAL HEAT GENERATION IN THE THERMAL SHIELDS, VESSEL WALL AND BIOLOGICAL SHIELD. Charles O. Peinado. Oct. 25, 1957. 11p. OTS.

Studies were made to determine the maximum thermal stresses from radial exponential heat generation in organic moderated reactor thermal shields, vessel wall, and biological shield. The maximum thermal stresses in the thermal shield and vessel wall at 45.5 Mw are: inside thermal shield, σ_p = 6,370 psi; vessel wall, σ_0 = 3,220 psi; and outside thermal shield σ_0 = 5,270 psi. The maximum thermal stresses in the biological shield at 45.5 Mw indicate the concrete will develop cracks near the inside or outside surface. (W.L.H.)

THERMAL STRESS IN A BARE CYLINDRICAL FUEL ELEMENT OF LARGE SIZE DURING HEATING. W. Kattwinkel. Atomkern-Energie 3, 394-6(1958) Oct. (In German)

Thermal stress distribution in a long cylindrical fuel element without canning is calculated during heating up. Maximum stresses appear in steady state at the surface of fuel element, where σ_Θ (R) = σ_z (R) and both of them are tensile stresses. The last two conditions are fulfilled also in nonsteady state of temperature distribution. (auth)

6393 CF-54-10-146
Oak Ridge National Lab., Tenn.
THERMAL STRESS IN THE TBR PRESSURE VESSEL. TBR MEMO NO. 5. J. R. McWherter. Oct. 28, 1954. Decl. Dec. 20, 1955. 19p. Contract [W-7405-eng-26]. $4.80(ph OTS); $2.70(mf OTS).

Calculations were made to determine the combined pressure and thermal stresses in the Thorium Breeder Reactor pressure vessel wall as a function of the vessel wall and thermal shield thicknesses. The magnitude of the thermal stress depends on the heat generation in the wall and the method of cooling the wall. Heat is generated in the vessel wall as a result of radiation absorption. The principal types of radiation which contribute to the heat generation include thermal neutrons, fast neutrons, and γ radiation. A sketch of the proposed vessel is included. (C.H.)

1391 WADC-TR-56-400(Pt. I)
Atomics International Div., North American Aviation, Inc., Canoga Park, Calif.
THERMAL PROPERTIES OF MATERIALS. PART I. PROPERTIES OF GRAPHITE, MOLYBDENUM AND TANTALUM TO THEIR DESTRUCTION TEMPERATURES. Period Covered: March 1955 to June 1956. N. S. Rasor and J. D. McClelland. Oct. 26, 1956. 58p. Project No. 2998. Contract AF33(616)-2909. (AD-118144).

Deleted version of the classified report AI-1672(Pt. I) bearing WADC-TR-56-400(Pt. I) as a secondary number.

Thermal expansion, specific heat, and thermal conductivity were determined from 2000°F to near the destruction temperature of molybdenum (M.P. 4700°F), tantalum (M.P. 5400°F), and four types of graphite (sublimes at 6600°F). To obtain and measure the temperatures required, a carbon tube furnace, a carbon helix furnace, and a photoelectric pyrometer were developed. The details of their construction and use are described. The thermal expansion data for the materials investigated show no grossly unusual features. The specific heat of the metals, particularly molybdenum, appreciably exceeded the Dulong-Petit value. However, their thermal conductivities closely followed the Lorenz (Wiedemann-Franz) relation for free electrons. At intermediate temperatures (2000 to 5000°F) the thermal conductivity and specific heat of graphite show no unusual features. However, at higher temperatures large and abrupt increases in specific heat and thermal resistivity occur which are consistent with the occurrence of thermally produced vacant lattice sites. A vacancy concentration of about 0.4 at.% at the sublimation temperature, and a formation energy in the vicinity of 7 ev are indicated. (auth)

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1388 ORNL-2619
Oak Ridge National Lab., Tenn.
THE FAILURE OF STRUCTURAL METALS SUBJECTED TO STRAIN-CYCLING CONDITIONS. R. W. Swindeman and D. A. Douglas. Nov. 7, 1958. 20p. Contract W-7405-eng-26. $3.30(ph OTS); $2.40(mf OTS).

Data showing the isothermal strain-cycling capacity of three metals, Inconel, Hastelloy "B," and beryllium, are presented. It is noted that at frequencies of 0.5 cycles per minute the data satisfied an equation of the form $N^{\alpha}\epsilon_p = K$, where N is the number of cycles to failure, ϵ_p is the plastic strain per cycle, and α and K are constants whose values depend on the structure and test conditions. Data on Inconel are given to establish the effect of grain size, specimen geometry, temperature, and frequency. It is found that at temperatures above 1300°F, grain size and frequency exert a pronounced effect on the rupture life. Fine-grained metal survives more cycles before failure than coarse-grained material. Long time cycles shorten the number of cycles to failure when the strain per cycle is low. Thermal strain cycling data for Inconel are compared to strain cycling data at the same mean temperature. Good correlation is found to exist between the two types of data. (auth)

8958 CF-50-4-115
Oak Ridge National Lab., Tenn.
THERMAL STRESSES IN HRE REFLECTOR TANK. H. C. Savage. Apr. 19, 1950. Decl. Feb. 8, 1956. 18p. Contract [W-7405-eng-26]. $3.30(ph OTS); $2.40(mf OTS).

Thermal stresses in the HRE reflector tank are calculated, consideration being given to geometry and temperature gradients. The influence of these stresses on tank cooling considerations is discussed. (D.E.B.)

9312 EES-060088F
Naval Engineering Experiment Station, Annapolis.
EVALUATION UNDER THERMAL SHOCK OF SMALL SIZE, WELDED BIMETALLIC PIPE JOINTS. W. E. Clautice. Mar. 12, 1956. 68p.

The results of the exposure of 10 bimetallic, welded pipe joints, of the type used in the newly developed nuclear power submarine propulsion plants, to repeated cycles of thermal shock are presented. The thermal cycle used was selected by a conference at the Bureau of Ships and was based on the expected service conditions for the Cres-Monel joints. Four joints were evaluated after the application of 250 thermal shock cycles. The remainder were subjected to 500 thermal shocks. All joints developed cracks under the test conditions. (auth)

6302 ORNL-473
Oak Ridge National Lab., Tenn.
THERMAL CYCLING OF A FUEL ASSEMBLY. H. C. Savage and F. Drosten. Sept. 29, 1949. Decl. Jan. 30, 1956. 10p. Contract W-7405-eng-26. $1.80(ph OTS); $1.80(mf OTS).

In a thermal cycling experiment on an Al-clad uranium – aluminum alloy core plate assembly, the dimensional stability showed no appreciable changes in dimensions, warping or blistering after 3925 cycles from ~17°C to ~100°C.

9314 EMRL-3
Brown Univ., Providence. Engineering Materials Research Lab.
FATIGUE OF METALS UNDER COMBINATIONS OF STRESSES. Technical Report No. 3 on BASIC RESEARCH ON FATIGUE FAILURES UNDER COMBINED STRESS. W. N. Findley. June 1956. 45p. DA Project 5B99-01-004. Contract DA-19-020-ORD-3520.

Analysis of available information suggests that the phenomenon of fatigue of materials results primarily from alternating shearing stress producing cracks along shear planes, and that the resistance to fatigue cracking is influenced by other factors. Some of these factors are: changes in structure of the material resulting from plastic and elastic stressing as well as heat treatment; the mode of crack propagation and the complementary normal stress on planes of shear stress. Several theories of failure under combined stress are examined and modified to account for observed facts. A general design expression is proposed. The influence of mean stress (including extreme compression), yielding, complementary normal stress, and anisotropy are considered. (auth)

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9313 EMRL-2
Brown Univ., Providence. Engineering Materials Research Lab.
FATIGUE OF METALS UNDER COMBINATIONS OF STRESS. Cover carries title: THEORIES RELATING TO FATIGUE OF MATERIALS UNDER COMBINATION OF STRESS. Technical Report No. 2 on BASIC RESEARCH ON FATIGUE FAILURES UNDER COMBINED STRESS. W. N. Findley. June 1956. 17p. DA Project 5B99-01-004. Contract DA-15-020-ORD-3520.

Analysis of available information suggests that the phenomenon of fatigue of materials results primarily from alternating shearing stress producing cracks along shear planes, and that the resistance to fatigue cracking is influenced by other factors. Some of these factors are: changes in structure of the material resulting from plastic and elastic stressing as well as heat treatment; the mode of crack propagation and the complementary normal stress on planes of shear stress. Several theories of failure under combined stress are examined and modified to account for observed facts. A general design expression is proposed. The influence of mean stress (including extreme compression), yielding, complementary normal stress, and anisotropy are considered. (auth)

EMERGENCY PROCEDURES 4.03.03

7427 HW-25457(Rev.)
Hanford Atomic Products Operation, Richland, Wash.
MANUAL OF RADIATION PROTECTION STANDARDS. Dec. 15, 1954. Changed from OFFICIAL USE ONLY May 10, 1956. 77p. Contract W-31-109-Eng-52. $12.30 (ph OTS); $4.50(mf OTS).

Policies are presented for the control of radioactive materials and radiation hazards at HAPO. (C.H.)

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CONTAINMENT 4.03.04.01

3493
CONTAINMENT OF RADIOACTIVE FISSION GASES BY DYNAMIC ADSORPTION. Robert E. Adams, William E. Browning, Jr., and Robert D. Ackley (Oak Ridge National Lab., Tenn.). Ind. Eng. Chem. 51, 1467-70(1959) Dec.

The release of radioactive fission product gases from a circulating fuel nuclear reactor is of such magnitude that direct disposal into the atmosphere is prohibited. A method for disposal of these gases was developed. The fission gases, krypton and xenon, are absorbed from a carrier gas stream onto the surface of a porous adsorbent. Although the adsorption process is reversible, it effectively hinders the passage of fission gases through the system while radioactive decay continually reduces the concentration. Operating parameters which affect the adsorption processes were studied, and the data obtained were found applicable for the design of future systems. (auth)

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7563
A STACK EFFLUENT RADIOISOTOPE MONITOR. R. A. Harvey (General Electric Co., Richland, Wash.). IRE Trans. Nuclear Sci. NS6, 20-28(1959) Dec.

A system for simultaneously measuring and indicating each of several different radioisotopes in the stack effluent of an atomic energy facility is described. Analog computer techniques are employed for the solution of simultaneous equations and for the counting and scaling. Two types of presentations are included for the output. The total amounts of the radioisotopes emitted to the atmosphere are indicated on registers, and marks are recorded on a moving chart each time specific quantities are emitted. The emission quantity of each isotope is indicated by a register and by a single channel on the chart recorder. (auth)

3676
A FISSION GAS MONITOR FOR GAS COOLED OR OFF-GAS EXPERIMENTAL SYSTEMS. J. F. Sommers and I. J. Wells (Phillips Petroleum Co., Idaho Falls, Idaho). Health Phys. 2, 213-15(1959) Oct.

The fission gas monitor is a very sensitive instrument for the detection of fresh fission products in gas cooled or off-gas systems. It is quite versatile so that it can be used on a wide variety of experiments either as a quick, positive, and sensitive detector of fission products or as a quantitative measuring device for release of fresh gaseous fission products. Installation costs are reasonable. The formula presented for quantitative analyses is adequate for constant production rates of fission gases where the delay time between filters F_1 and F_2 is not much greater than the half life of the daughter product to be collected and ana-

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lyzed on the F_2 filter. Examples of data obtained with a prototype monitor and curves illustrating calculated sensitivity of the monitor indicate the usefulness of the system for monitoring gas streams containing fresh fission gases and also illustrate a few of the many methods of making quantitative analyses to determine production rates of fission products in gas effluent lines. (auth)

544

ELECTRONICS IN DETECTORS OF CLADDING RUPTURES. J. Goupil and J. P. Graftieaux (Centre de'Etudes Nucléaires, Saclay, France) and J. M. Servent (L'Electronique Appliquée, Paris). p. 413-26 of "Nuclear Electronics. I." (In French)

The detectors for fuel element rupture used in the G-1, EL-2, and G-3 reactors are briefly described. The systems being developed include an ionic valve, evolumeter (instrument for measurement of the evolution of fission products), and analog study of radioactive decay chains. Each of these is described. (J.S.R.)

6480

IMPROVEMENTS IN FISSION PRODUCT DETECTION SYSTEMS. Gordon Vernon Hough and Denis Aliaga Kelly (to Plessey Company Ltd.). British Patent 818,685. Aug. 19, 1959.

A fuel element rupture detection system is described which is based on detection of the solids from gaseous fission product decay. Decay solids are precipitated from the coolant gas on a negative electrode by a radial electrostatic field. The electrode is withdrawn at suitable intervals to a counting chamber. A shielded proportional counter here measures beta activity of the electrode and alternately of an extension of the electrode. The difference of these measurements represents solid fission product activity. (T.R.H.)

7111 A/CONF.15/P/334

PROGRES RECENTS DE LA DETECTION DES RUPTURES DE GAINES DANS LES REACTEURS FRANCAIS, G1, EL2, G3, EL3 (Recent Progress in the Detection of Bursts in the Canning in French Reactors, G1, EL2, G3, EL3.) J. Goupil, M. Grenon, J. Raffailhac, and A. Roguin (Commissariat à l'Énergie Atomique, Paris). 46p.

In heterogeneous reactors the fuel is protected from contact with the coolant by a coating. Any fissure or break in this canning must be detected so that excess reactivity can be avoided. The methods and apparatus used in the gas-cooled reactors G-1, G-3, and EL-2 and in the water-cooled reactor EL-3 are described. The method is based on the detection of fission gases. An instrument named the evolution meter is designed to make the measurement of the activity of the coolant gas in the channels by a zero method, and it is independent of the activity of the coolant itself and of the uranium contamination of the canning. In the EL-3 the detection system is based on measurements by G-M counters of the activity of the fission gases carried by diluted helium into the heavy water and then extracted by hydrocyclones. (J.S.R.)

3211

FILTRATION IN REACTOR GAS CIRCUITS. P. J. Froggatt (Atomic Power Constructions, Ltd., London). Nuclear Eng. 4, 406-7(1959) Nov.

A sintered iron filter with a 5-micron characteristic was developed for use in reactor gas circuits. The filter has an over-all length of 12 in. and a diameter of 3.75 in. The complete filter will pass 2,050 ft^3 per minute of air at 17°C and 12 psi differential. A pressure differential indicator is provided to give warning when the build-up of dust on the elements is excessive. (C.J.G.)

7086 A/CONF.15/P/57

THE DETECTION OF BURST FUEL ELEMENTS IN NUCLEAR REACTORS. K. W. Cunningham, G. V. Hough, and D. Aliaga-Kelly (Plessey Nucleonics Ltd., Northhampton, Eng.). 25p.

A general survey is made of the current practice of burst fuel detection systems and the problems involved. A description is given of the Calder Hall equipment, followed by the improvements which are being introduced for the first stage C.E.A. nuclear power stations. The corresponding requirements for water cooled reactors are considered and some details given of apparatus which has operated successfully on a research reactor. An outline is given of some of the problems which confront future designs and some possible ways in which solutions may be obtained. (auth)

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14517 A/CONF.15/P/428
Convair, Fort Worth, Tex.
HAZARDS ASSOCIATED WITH FISSION PRODUCT RELEASE. B. P. Leonard, Jr. 25p. $0.50(OTS).

Prepared for the Second U. N. International Conference on the Peaceful Uses of Atomic Energy, 1958.

Current methods and assumptions used in predicting and extent of hazards from a reactor incident are described and analyzed. The effects of the choice of values of the important parameters are shown. Values for each are recommended to achieve realistic predictions while maintaining necessary conservatism. Particular attention is given to recent advances in predicting the release and dispersal of fission products. Experiments have shown that, in a reactor meltdown, only the volatile fission products will be released in significant quantities. Such a selective release is considerably less hazardous than a non-selective (vaporization) release because long life and bone seeking isotopes are retained in the reactor. (auth)

1141 ORNL-2851
Oak Ridge National Lab., Tenn.
A STUDY OF PROBLEMS ASSOCIATED WITH RELEASE OF FISSION PRODUCTS FROM CERAMIC FUELS IN GAS-COOLED REACTORS. J. A. Lane, L. L. Bennett, H. N. Culver, L. J. King, J. P. Sanders, J. L. Scott, and W. E. Unger. Oct. 28, 1959. 79p. Contract W-7405-eng-26. OTS.

The diffusion of fission products out of the fuel elements leads to increased shielding requirements, a greater hazard due to their possible release to the surroundings, and more difficult maintenance problems. Continuous processing of the contaminated coolant may alleviate the hazard and maintenance problems; however, extensive in-pile loop experiments are needed for a quantitative evaluation of methods. By proper design of major components such as heat exchangers and blowers, direct maintenance of contaminated equipment may be possible, with or without premaintenance decontamination. Such an approach is to be preferred to that of providing remote maintenance facilities which, in the case of the reactors considered, added from 0.7 to 1.8 mills/kwhr to the cost of power. (auth)

6067
CHALK RIVER EXPERIENCE WITH FUEL WATERLOGGING. A. J. Mooradian, G. M. Allison, and J. F. Palmer (Atomic Energy of Canada, Ltd., Chalk River, Ont.). Nucleonics 18, No. 1, 81-5(1960) Jan.

Two fuel types with which Chalk River has had waterlogging experience—aluminum-clad uranium metal (NRU type), and Zircaloy-clad uranium dioxide—are discussed. Methods are also discussed for detecting and localizing fuel defects involving waterlogging. Several tests were carried out to determine the cause for fuel rod bulging Following tests in which a bulge was punctured and the pressure and temperatures monitored, an hypothesis was formulated: A defect introduces water into the sheath upon cooling. The water reacts with the bulk uranium to give UO_2 and hydrogen. The speed of the reaction is temperature-dependent. The hydrogen subsequently forms uranium hydride. More water is introduced on the next cycle, there are two competing reactions—water with bulk uranium and water with uranium hydride. However, uranium hydride reacts more rapidly and causes further evolution of hydrogen. Thus, more uranium hydride is formed. This sequence continues with each temperature cycle until hydrogen pressure is sufficient to rupture the sheath. Upon testing this hypothesis, it was found that the hydrided-waterlogged rod bulged rapidly at a temperature similar to that encountered in previous tests. (B.O.G.)

16557 ORNL-2616
Oak Ridge National Lab., Tenn.
EXPERIMENTS ON THE RELEASE OF FISSION PRODUCTS FROM MOLTEN REACTOR FUELS. G. E. Creek, W. J. Martin, and G. W. Parker. July 22, 1959. 28p. Contract W-7405-eng-26. $1.00(OTS).

Experiments on the release of fission products in the controlled melting of irradiated fuel of the APPR, STR, and MTR types under conditions simulating the loss-of-coolant accident were performed. The results indicate that a moderate amount of heating in air or steam sufficient only to melt a specimen results in the partial volatilization of the rare gases, the halogens, and the alkali metals. In the presence of air or steam, little of the strontium and other fission products is released. In this type of experiment the only particulate activity observed was composed entirely of cesium. At the level of trace concentration of fission products, APPR plate melted at

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1525°C and released 50% of the rare gases, 33% of the iodine, 9% of the cesium, and traces of strontium. After 25% burnup the cesium value rose markedly to 41%, while the iodine value apparently declined to 12%. Aluminum alloy at 700°C released only 2% of the iodine and 10% of the rare gases. Zirconium alloy, after 15% burnup, melted at 1850°C in air and released all of the rare gases, 26% of the iodine, 10% of the cesium, and less than 1% of the strontium. When melted in steam, approximately 2% of the strontium and 0.5% of the barium were also released from zirconium alloy. Exploratory experiments were performed with Geneva-type aluminum-dispersion fuel, UO_2, and GE-HTRE fuel. (auth)

8241 KAPL-2061
Knolls Atomic Power Lab., Schenectady, N. Y.
URANIUM SURFACE CONTAMINATION ON NUCLEAR REACTOR FUEL ELEMENTS. W. M. Cashin, ed. Oct. 23, 1959. 67p. Contract W-31-109-Eng-52. OTS.

Surface U^{235} contamination on nuclear reactor fuel elements is considered. The nature of the contamination and the resultant hazards from plant contamination in the event of a primary system leak are discussed. Methods for detecting and measuring surface contamination are described such as alpha counting, activation analysis, delayed neutron detection, and precise, direct low-level uranium isotopic analysis. Various approaches to decontamination are considered, and the experimental results of several tests presented. (auth)

7184 A/CONF.15/P/2275
RADIATION INTENSITY LEVELS AND AIR AND WATER ACTIVITIES OBSERVED WITH THE IEAR-1 SWIMMING POOL REACTOR AT 5 MW. R. R. Pieroni, S. B. Herdade, Wilma S. Hehl, and C. R. Pereira (Inst. de Energia Atômica, São Paulo, Brazil). 5p.

Beta and gamma activities both in air and in airborne particulate were measured during the operation of the IEAR-1 swimming pool reactor at 5 Mw. The obtained results are presented and it is shown that the decay curve is characteristic of a fission product activity. The results are also compared with activities observed in the pool water. The possible causes of such an activity are analyzed and it is shown that the activities should be attributed to uranium contamination on the outside of the fuel cladding plates, most probably originated during the manufacturing process. The beta, gamma, and neutron levels in all the reactor building areas are presented. It is shown that a high activity is observable at the pool surface due to the turbulent motion of the water in the forced cooling regime. (auth)

7047 A/CONF.15/P/193
BEHAVIOUR OF URANIUM OXIDE AS A REACTOR FUEL. J. A. L. Robertson, A. S. Bain, A. H. Booth, J. Howieson, and R. F. S. Robertson (Atomic Energy of Canada Ltd., Chalk River, Ont.) and W. G. Morison (Hydro-Electric Power Commission of Ontario). 46p. (AECL-603). $0.25(AECL).

Observations on complete pellets, fractured surfaces, and polished sections showed that uranium oxide, irradiated at temperatures below its melting point, exhibits grain growth, cracking, void formation, and other mass movement. These phenomena are affected by the fuel diameter and density, the heat rating, the initial clearance between fuel and sheath, the atmosphere within the sheath, and the oxygen–uranium ratio of the oxide. The amount of fission-product gas that emanates from the oxide was observed by analysis of the gas released from a defected sheath during irradiation, and by analysis of the gas inside an undefected sheath after irradiation. In these irradiations and auxiliary laboratory studies the gas release was related to a simple diffusion model, characterized by a particle size. The program is directed towards reducing fuelling costs, and methods of fabrication are being explored that are cheaper than the established process of sintering in hydrogen. (auth)

TO ATOMSPHERE 4.03.04.04

14604 A/CONF.15/P/1834
General Electric Co. Hanford Atomic Products Operation, Richland, Wash.
METEOROLOGICAL FACTORS IN THE APPRAISAL AND CONTROL OF ACUTE EXPOSURES TO STACK EFFLUENTS. James J. Fuquay. 19p. $0.50(OTS).

Prepared for the Second U. N. International Conference on the Peaceful Uses of Atomic Energy, 1958.

A method is developed for use in the analysis and meteorological control of atmospheric pollution prob-

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lems resulting from gaseous emissions from tall stacks. Special attention is given to the dilution of the gas within the stack due to the addition of excess air. Control parameters are developed for cases in which short periods of high concentration are important, as contrasted to long-period average concentrations. Application of the method is demonstrated with a sample calculation. (auth)

8668 ORNL-2086
Oak Ridge National Lab., Tenn.
A METHOD FOR THE DISPOSAL OF VOLATILE FISSION PRODUCTS FROM AN ACCIDENT IN THE OAK RIDGE RESEARCH REACTOR. F. T. Binford and T. H. J. Burnett. Aug. 2, 1956. 11p. Contract W-7405-eng-26. $0.15(OTS).

The Oak Ridge Research Reactor is a fully enriched, heterogeneous, light-water-moderated and -cooled, beryllium-reflected reactor of the MTR-BSF type. It is designed to operate at a power level of 20 to 30 megawatts with a thermal-neutron flux of the order of 10^{14}. In this paper the maximum credible accident is postulated to be that situation in which the reactor suffers from a deficiency in cooling capacity sufficient to cause melting of the fuel elements and subsequent release into the building of all the volatile fission products. It is shown that with properly engineered ventilating and gas-scrubbing equipment the radioactive gas can be disposed of in such a way as to prevent harmful exposure to persons in the surrounding area. Direct radiation from the large mass of gas initially present in the building will be extremely intense in the immediate vicinity of the building. It is possible, however, through the use of a suitable alarm system, to evacuate this area in a time short enough to prevent serious over-exposure to personnel. (auth)

6685 A/CONF.15/P/316
DISTRICT SURVEYS FOLLOWING THE WINDSCALE INCIDENT, OCTOBER 1957. H. J. Dunster, H. Howells, and W. L. Templeton (United Kingdom Atomic Energy Authority, Eng.). 37p.

The sequence of events leading to the reactor accident at the Windscale Works, October 1957, is outlined. The design and location of the reactors are described. Following the accident, milk produced in the area was restricted for human consumption for a period of six weeks. The organization and technical problems involved in the radiological survey of the area are described. (C.H.)

3251 NAA-SR-Memo-3809
Atomics International Div., North American Aviation, Inc., Canoga Park, Calif.
HAZARD EVALUATION OF STACK EMISSIONS FROM THE HBR BURNING EXPERIMENT. G. W. Spangler. May 18, 1959. 5p. OTS.

Studies were made to investigate the stack emission problem connected with the High Boiler Residue (HBR) burning experiment at the Santa Susana site. The stack emissions from the HBR burning experiment could produce concentrations greater than MPC on the site if the emission rate for MFP exceeds 10^{-3} μc/sec or if the S^{35} emission rate exceeds 1 μc/sec. (W.L.H.)

3180
RADIOACTIVE ARGON RELEASED FROM REACTORS. M. Okano and M. Otsuka (Inst. of Physical and Chemical Research, [Tokyo]). J. Atomic Energy Soc. Japan 1, 95-102(1959) (In Japanese)

The conditions for monitoring large amounts of radioactive argon being continuously released from reactors were investigated. According to the present regulation the maximum permissible concentration of Ar^{41} in air is 5×10^{-7} μc/ml occupationally. It is commonly regarded as necessary to detect the concentration of Ar^{41} up to about 10^{-8} μc/ml in the case of monitoring for public living in the neighborhood of a reactor site. The possibility of monitoring for the public with γ detectors of the standard type is discussed. The possibility of detecting the contribution of Ar^{41} to the genetic dose of the population is discussed. (auth

488 UR-555
Rochester, N. Y. Univ. Atomic Energy Project.
FIELD STUDIES OF FISSION PRODUCT INHALATION. PART III. FISSION PRODUCT FIELD RELEASE TEST

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SERIES ONE (FPFRT-I). Robert G. Thomas and Robert H. Wilson. July 16, 1959. 146p. Contract W-7401-eng-49. OTS.

Rats and dogs were exposed to clouds of fission products released from the high temperature meltdown of reactor fuel element in the field. The primary goal of this biological program was attainment of good lung deposition values which could be used in the initial step of the biological counterpart of reactor hazards evaluation. There was a total of seven releases with biological participation, three from aged and four from green fuel elements, and each under various conditions of lapse or inversion meteorological condition. The chief biological observations are summarized. In the early releases, even with the animal sacrifice occurring shortly after exposure, the gastrointestinal (GI) tract values obtained were unrealistically high due primarily to licking. During the course of the Testing Program the GI tract-to-lung ratios in rats were reduced from > 30 to < 1 by altering such parameters as exposure, cage construction, degree of consciousness of animals during exposure, methods of sacrifice, and time of entry into the field for pickup and sacrifice. In both rats and dogs the median deposition of fission products in the lower respiratory tract appears to be between 30 and 35% of that amount of material breathed, and the estimated total deposition appears to be at least 70%. The fission products released from green fuel elements may be deposited in the lower respiratory tract somewhat more readily than those from aged elements. Limited metabolism data from dogs indicate a short effective half-time of elimination of fission products from the green elements via the urine, and also via the feces for the early period post-release. At later times the effective half-time of elimination of fission products from the lung increases and consequently the rate of fecal excretion decreases. The use of fall-out measurements for estimation of body uptake (lung deposition) can give misleading results unless the individual isotopes are well characterized. The external contamination-to-lung ratios for rats exposed to green releases (iodine) are 10 times the ratios of those exposed to aged releases (cesium). (auth)

11709 DC-53-5-14(Del.)

General Electric Co. Aircraft Nuclear Propulsion Project, Cincinnati.

A METHOD OF ANALYZING RAINOUTS. James H. Bick and John A. Weaver. [1953]. Decl. Apr. 22, 1959. 16p. $3.30(ph), $2.40(mf) OTS.

A method was developed for determining radiation doses resulting from a rainout of fission fragments from a reactor accident. Sample rainouts are calculated for three different values of the diffusion parameter in Sutton's equation. The basic conclusion drawn from a comparison of dosage from rainout or from over-head clouds is that rainout is not the most important contributing factor to radiation hazards. In certain marginal cases, rainout plus cloud radiation may lead to lethal doses. (W.D.M.)

13420 AECU-4138

Illinois Inst. of Tech., Chicago. Armour Research Foundation.

SCAVENGING OF PARTICULATE MATTER IN CONNECTION WITH NUCLEAR-POWERED SHIPS. Report No. 1 (Scientific Report). THEORETICAL DISSERTATION ON DIFFUSION AND DEPOSITION OF RADIOACTIVE PARTICULATE MATTER IN CONNECTION WITH NUCLEAR-POWERED SHIPS. John Rosinski. Jan. 24, 1958. 22p. ARF Project C 119. Contract AT(11-1)-586. $4.80(ph), $2.70(mf) OTS.

The behavior of the cloud formed by finely divided radioactive matter released from a nuclear-powered ship is discussed. Sutton's equation, with Chamberlain's correction for deposition, is used for four sets of parameters. The results calculated by using the IBM-650 computer are presented in a series of 76 graphs. Wind velocities of 5, 10, and 15 mph and velocities of deposition equal to 0, 1, 2, 5, 10, and 20 cm/sec were used in computation. The ranges of the Q/C and Q/R parameters are 10^7-10^{15} cc/sec and cc/cm^2, respectively. Variables calculated versus the Q/C or Q/R parameter were area coverage, maximum downwind travel distance, and downwind position of Ymax. The discussion shows the influence of particular parameters on the behavior of the cloud and the shape of the affected area. The influence of local meteorological conditions is discussed. The modification of classical diffusion equations for application to the local movements of ocean waters is proposed. (auth)

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1810 IDO-16453
Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho.
SOURCE STRENGTH INFORMATION FOR SHIELDING AND STACK EFFLUENT CALCULATIONS. A STANDARD PRACTICES GUIDE. L. H. Jones. Oct. 3, 1958. 23p. Contract AT(10-1)-205. $0.75(OTS).

Curves and methods are presented for determining gross fission product gamma energy in Mev/sec-watt, gross fission product beta decay in curies/sec-watt, delayed uranium fission neutrons in neutrons/sec-watt and N^{16} and N^{17} decay in photons/sec-cc of water. The data cover infinite irradiation and one second to several days decay. Source of the data used and methods of calculation are presented for each curve. (auth)

2542 NAA-SR-2938
Atomics International Div., North American Aviation, Inc., Canoga Park, Calif.
ORGANIC REACTOR WASTE GAS ANALYZER. H. M. Gilrey and R. J. Edwards. Oct. 15, 1958. 19p. Contract AT-11-1-GEN-8. $0.75(OTS).

The design of a waste-gas treatment system for organic moderated reactors requires a knowledge of reactor waste-gas composition, generation rate, and radioactivity. To obtain data on these variables a continuous stream analyzer was constructed to analyze the waste gas from the Organic Moderated Reactor Experiment (OMRE). The major components of this analyzer were: a vapor-phase chromatograph for gas composition, a vibrating reed ionization chamber for radioactivity measurements, a wet test meter for generation rate, and cold traps for condensable materials. (auth)

TESTING NUCLEAR-PLANT LEAKTIGHTNESS. J. P. Verkamp and S. L. Williams (Knolls Atomic Power Lab., Schenectady, N. Y.). Nucleonics 14, No. 6, 54-7(1956) June.

Although leakage control has been an important consideration in remote nuclear power plants, greater emphasis on leak tightness will be necessary for plants located in populated areas. Methods of leak control are reviewed and the leak testing of the KAPL-operated Na plant is evaluated.

14515 A/CONF.15/P/391
General Electric Co. Hanford Atomic Products Operation, Richland, Wash.
WIND PICKUP OF RADIOACTIVE PARTICLES FROM THE GROUND. John W. Healy and James J. Fuquay. 11p. $0.50(OTS).

Prepared for the Second U. N. International Conference on the Peaceful Uses of Atomic Energy, 1958.

Equations useful in predicting the air concentrations downwind from a source of radioactive particles deposited on the surface of the ground are derived. The rate of pickup by the wind is taken as proportional to the square of the wind speed and the dilution downwind as calculated from Sutton's equations. A correction for fall-out is made based on the gravity settling of the particles and the atmospheric turbulence. Integration of the point source equation leads to equations describing the concentration downwind from a line source, an area source of infinite extent and an area source infinite in extent in the cross-wind direction and of limited extent up-wind. The expression for the infinite area source derived in this manner is shown to be functionally similar to the one given by Bagnold in the Stoke's law region. The surface pickup coefficient used in the equations was evaluated from measurements of concentrations downwind from point sources of fluorescent particles of seven microns MMD on various surfaces. The influence of the nature of the surface and the nature of the particulate material is discussed and uncertainties in the derivation are analyzed. Some applications to the estimation of hazards resulting from the wind movement of radioactive particles are included. (auth)

6380 CF-48-9-126
Oak Ridge National Lab., Tenn.
RECOMMENDATION FOR IMMEDIATE SOLUTION TO AIRBORNE HAZARDS FROM THE PILE STACK. J. W. Gost. Sept. 8, 1948. Decl. Feb. 16, 1956. 3p. $1.80(ph OTS); $1.80(mf OTS).

Recommendations and the basis for such recommendations are listed and briefly discussed. (B.J.H.)

6379 CF-48-8-348
[Oak Ridge National Lab., Tenn.]
INFORMATION FOR REACTOR SAFEGUARD COMMITTEE MEETING. John R. Huffman and S. Untermyer. Sept. 9,

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1948. Decl. Jan. 7, 1956. 13p. Contract [W-7405-eng-26]. $3.30(ph OTS); $2.40(mf OTS).

Heat removal by water, natural convection, and air cooling was evaluated in a study of the danger, after shutdown, of fuel element melting which would release fission products into the air. (F.S.)

12151 TID-7551(p.17-23)

Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho.

TWO GAS CLEANING PROBLEMS AT THE IDAHO CHEMICAL PROCESSING PLANT SITE. D. M. Paige, P. N. Kelly, and E. S. Grimmett. p.17-23 [of] FIFTH ATOMIC ENERGY COMMISSION AIR CLEANING CONFERENCE HELD AT THE HARVARD AIR CLEANING LABORATORY, JUNE 24-27, 1957. 7p.

The original gas disposal arrangement for RaLa Process (stack disposal with storage for unfavorable meteorological conditions) not proving adequate, an off-gas scrubber system was studied. Experimental data are given. Gas cleaning problems associated with the fluidized bed calciner for radioactive waste solutions are discussed. (T.R.H.)

8670

ON THE DECAY OF ^{123}I. R. K. Gupta (Instituut voor kernphysisch Onderzoek, Amsterdam). Nuclear Phys. 14, 606-14(1960) Jan. (2). (In English)

The gamma rays from the decay of I^{123}, produced by alpha bombardment of enriched Sb^{121}, were investigated with a scintillation spectrometer. New gamma rays of 275 ± 10, 320 ± 10, 340 ± 10, 380 ± 10, 435 ± 10, 500 ± 10, and 530 ± 10 kev emitted in the decay of I^{123} were detected. From summing studies and from the direct gamma ray spectrum the existence of levels at 435 and 502 kev in Te^{123}, known from Coulomb excitation, was confirmed. In addition, the existence of new levels at 690 ± 10 and 320 ± 10 kev in Te^{123} is inferred. New gamma rays of 275 ± 10 and 320 ± 10 kev belonging to the decay of I^{121} were detected. (auth)

TO COOLANT 4.03.04.05

5359 AECD-4032

Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho.

PRODUCTION OF Xe^{131}, Xe^{135}, Kr^{85m}, AND Kr^{85} FROM PLATED-OUT U^{235} IN THE MTR CORE. Adrian V. Grimaud. Jan. 14, 1955. Decl. Jan. 12, 1956. 16p. Contract AT(10-1)-205. (PPC-15). $3.30(ph OTS); $2.40(mf OTS).

During the period following October 7, 1954 the MTR developed high process water radioactivity. Indications suggest that this activity results from the fissioning of U^{235} which has plated out upon reactor components with the subsequent release of fission products directly into the process water system during operation. Equations are presented from which the instantaneous rate of release (during operation) of Xe^{131}, Xe^{135}, Kr^{85m}, and Kr^{85} in curies/sec. from the process water system can be obtained. Curves are given showing the approximate rate of release of these gases during runs 43B to 43L inclusive.

7181 A/CONF.15/P/2256

FISSION PRODUCTS IN COOLING WATER OF THE BRAZILIAN SWIMMING POOL REACTOR. Fausto W. Lima, Alcídio Abrão, Laura Tognoli, and Constância Pagano (Inst. de Energia Atomica, São Paulo, Brazil). 22p.

The identification of the radioactive nuclides found in the water of the swimming pool Brazilian reactor is studied. The chemical procedures used are described. Identification of the nuclides was made by measurement of half life and gamma spectrometry. Evidence seems to indicate that diffusion of gaseous fission products into the cladding is the origin of fission products in the water. (auth)

21777 NAA-SR-Memo-3416

Atomics International Div., North American Aviation, Inc., Canoga Park, Calif.

PREDICTED ORGANIC COOLANT ACTIVITY IN A CONTROLLED FUEL CLADDING DEFECT EXPERIMENT. M. Dunenfield. Nov. 26, 1958. 7p. $1.80 (ph), $1.80(mf) OTS.

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A prediction is made of the ORME coolant activity which would result from operation of the reactor with an exposed fuel area. The variables considered include the length of reactor operation, the fuel area exposed, and fuel enrichment. (W.D.M.)

5983 AECU-4536
General Atomic Div., General Dynamics Corp., San Diego, Calif.
FATE OF FISSION PRODUCT GASES IN THE COOLANT STREAM. Leo Brewer. Aug. 4, 1959. 3p. Project No. 32. Contract AT(04-3)-314. (GAMD-903). OTS.

The quantity and characteristics of fission products in coolant gases due to leaking fuel elements are discussed. It is concluded that the rare gases, the alkali metals, the halides, and Sb may act as permanent gases to a considerable extent. The other fission products are expected to condense out completely on walls or as dust consisting of metals, carbides, and oxides. (J.R.D.)

4499 ANL-6048
Argonne National Lab., Lemont, Ill.
EXAMINATION OF JACKETED URANIUM SLUGS FROM THE LOS ALAMOS FAST REACTOR "CLEMENTINE." S. H. Paine, W. F. Murphy, and F. L. Brown. Oct. 1959. 17p. Contract W-31-109-eng-38. OTS.

Work done during period 1950–1953. Final Report of Metallurgy Division Program 6.1.5.

Examination of clad uranium reflector slugs which failed by rupture and swelling during the first year of operation of Clementine revealed no anisotropic damage to the uranium because of burnup or thermal cycling. The cladding was found to be of high-sulfur-free-machining steel, and it is postulated that thermal stresses caused welding flaws to open enough to permit seepage and corrosive attack upon the uranium cores by the reactor coolant (mercury). (auth)

4368 TID-7581(p.161-8)
Knolls Atomic Power Lab., Schenectady, N. Y.
DETERMINATION OF TOTAL AND ISOTOPIC URANIUM ON REACTOR ELEMENT SURFACES BY ISOTOPIC DILUTION, MASS SPECTROGRAPHIC ANALYSIS. Edwin L. Shirley. 8p.

The fission recoil range of uranium in Zircaloy requires that U^{235} in the Zircaloy cladding of fuel elements be at a minimum. Since the early detection of a fuel rupture is based on the observation of fission products in the coolant stream, uranium from other sources would limit the sensitivity of these fuel defect detectors. For this and other reasons, a method was developed for the detection and isotopic assay of minute quantities of uranium in Zircaloy, steel, and other reactor materials. (auth)

6377 CF-47-1-41
Oak Ridge National Lab., Tenn.
CALCULATION OF LEVELS OF RADIOACTIVITY TO BE EXPECTED IN THE COOLANT OF THE POWER PILE. J. A. Swartout. Jan. 15, 1947. Decl. Feb. 2, 1956. 4p. $1.80(ph OTS); $1.80(mf OTS).

Estimates of the minimum and maximum levels of radioactivity which might be present in the He coolant of the power reactor were calculated for the reactor in operation at the 40,000-kw level using jacketless fuel elements. Values are approximate but they do show that the presence in the He of at least 10^5c of activity originating from recoiled and/or diffused fission products is reasonable. (F.S.)

FUEL HANDLING 4.03.05

See also, under Shipping and Handling of Radioactive Materials — Criticality (4.02.03).

7198 A/CONF.15/P/37
PROBLEMS OF FUELLING IN INDUSTRIAL CALDER HALL TYPE REACTORS. R. R. Gallie and H. H. Gott (Atomic Energy Research Establishment, Harwell, Berks, Eng.) and F. C. W. Colmer (Central Electricity Generating Board, London). 33p.

The two main problems treated are the utilization of the initial fuel charge and the prediction of the statistical relation between bursts and burn-up and to draw the correct conclusions from this prediction. It is clear, however, that this prediction is largely a problem of the accumulation of operating experience and initial esti-

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mates are not likely to be precise. Attention is drawn to the practical problems, although the treatment is largely mathematical. (W.D.M.)

14916

NUCLEAR REACTOR FUEL ELEMENT HANDLING PLANT. W. R. Wootton and Babcock and Wilcox, Ltd. British Patent 802,285. Nuclear Eng. 4, 238(1959) May.

Details are given of a reactor servicing machine which facilitates the removal of a fuel element from its operational position by passing it down a disposal tube, in which a head of liquid is maintained in order to limit the velocity of descent. The lower end of the disposal tube is submerged in a liquid held in a pressurized chamber, and its position is adjustable to facilitate loading the discharged fuel element into a truck, by means of which it is withdrawn from the pressurized chamber through a pipe fitted with a gate valve to a general storage reservoir for disposal by normal transport.

8266

NEUTRONIC REACTOR. E. C. Creutz, L. A. Ohlinger, A. M. Weinberg, E. P. Wigner, and G. J. Young (to U. S. Atomic Energy Commission). U. S. Patent 2,910,418. Oct. 27, 1959.

A reactor cooled by water, biphenyl, helium, or other fluid with provision made for replacing the fuel rods with the highest plutonium and fission product content without disassembling the entire core and for promptly cooling the rods after their replacement in order to prevent build-up of heat from fission product activity is described.

10099

REMOVAL OF DECAY HEAT FROM A PLATE-TYPE FUEL SUBASSEMBLY IN THE ATMOSPHERE. R. E. Grimble and B. W. LeTourneau (Westinghouse Electric Corp., Pittsburgh). Nuclear Sci. and Eng. 3, 529-39 (1958) May.

An analysis is made in order to estimate how much heat may be removed from a fuel element subassembly in air. The two following cases are considered: (1) the reactor core as a whole is exposed to the atmosphere while the individual subassemblies remain in place; and (2) the subassembly in question has been removed from the core and is individually exposed to the atmosphere. (auth)

7114

INDEXING MECHANISM. L. J. Kock (to U. S. Atomic Energy Commission). U. S. Patent 2,905,338. Sept. 22, 1959.

A device is presented for loading and unloading fuel elements containing material fissionable by neutrons of thermal energy. The device comprises a combination of mechanical features including a base, a lever pivotally attached to the base, an indexing plate on the base parallel to the plane of lever rotation and having a plurality of apertures, the apertures being disposed in rows, each aperture having a keyway, an index pin movably disposed on the lever normal to the plane rotation, a key on the pin, a sleeve on the lever spaced from and parallel to the index pin, a pair of pulleys and a cable disposed between them, an open collar rotatably attached to the sleeve and linked to one of the pulleys, a pin extending from the collar, and a bearing movably mounted in the sleeve and having at least two longitudinal grooves in the outside surface.

7254 A/CONF.15/P/1201

LES PROBLEMES DU CHARGEMENT ET DECHARGEMENT DES ELEMENTS COMBUSTIBLES DANS LE REACTEUR E.D.F.1. (Loading and Unloading Problems for the Reactor E.D.F.1). Leo, Kaplan, and Segard (Electricité de France, Paris). 25p.

The EDF-1 reactor has two loading and unloading devices of completely different design. The main device, which operates when the reactor is shut down and the pressure vessel is under pressure, is the lower unloading system and it has a single arm which serves all the channels. The description of the lower system, its operation, and the details of its use are given. The upper unloading device, designed to operate when the reactor is shut down and the pressure vessel is without pressure, is used when the lower device fails. The loading and unloading is performed through the control rod holes. A detailed description is given of the upper device and its operation. (J.S.R.)

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3161 NAA-SR-Memo-4178
Atomics International Div., North American Aviation, Inc., Canoga Park, Calif.
NATURAL CONVECTION COOLING SYSTEM FOR THE FUEL HANDLING CASK. J. D. Wilde. July 27, 1959. 19p. OTS.

Studies were made to determine whether the present fuel handling cask design is adequate to protect the fuel element when power for forced circulation cooling is lost during transfer. The maximum temperatures in the fuel element and cask were determined. Also determined was the pressure drop and power consumption when monoisopropyldiphenyl is circulated through the system at the rate of 5 gpm. (W.L.H.)

IMPROVEMENTS IN NUCLEAR FUEL ELEMENT HANDLING APPARATUS. James Miller Nicol (to Babcock & Wilcox, Ltd.). British Patent 831,722. Mar. 30, 1960.

A reactor loading-unloading apparatus is described. A holder is pivoted to move from the receiving to the discharging position. (T.R.H.)

IMPROVEMENTS IN HANDLING PLANT FOR SPENT NUCLEAR REACTOR FUEL ELEMENTS. Richard Arthur Taylor (to Babcock & Wilcox, Ltd.). British Patent 831,323. Mar. 30, 1960.

A system for transporting irradiated fuel elements from reactor to storage pond is described. It has a rotor-container which can be positioned for receiving and discharging several fuel elements. (T.R.H.)

1826
EFFECTIVE-ENERGY METHOD FOR SPENT-FUEL SHIELDING. Ramon L. Ashley (Atomics International, Canoga Park, Calif.). Nucleonics 16, No. 10, 78-81 (1958) Oct.

A simple method which makes it possible to compute the effectiveness of spent-fuel shields with fair accuracy and a minimum of effort is described. It consists in finding an effective photon energy that can be used in place of the spectrum from the spent fuel. The method was applied to shielding of spent U^{235} fuels with four different shielding materials. The results indicate that the method is accurate for cooling times > 45 min, for irradiation times as short as 100 hr. Neglect of low-energy gamma rays limits the application to "thick" shields. (J.S.R.)

8974 CF-54-4-114
Oak Ridge National Lab., Tenn.
EMERGENCY CONDENSER CALCULATIONS. C. L. Segaser. Apr. 12, 1954. Decl. Feb. 7, 1956. 8p. Contract [W-7405-eng-26]. $1.80(ph OTS); $1.80(mf OTS).

Calculations were made for a condenser to dissipate heat released from radioactive decay of fission fragments in the fuel solution of the HRT following a dump to the outer fuel storage tank. (F.S.)

IRRADIATION EXPERIMENTS 4.03.06

EFFECTS ON REACTIVITY 4.03.06.01

5992 HW-59638
General Electric Co. Hanford Atomic Products Operation, Richland, Wash.
PRTR GAS-COOLED LOOP, HAZARDS SURVEY OF PRELIMINARY SCOPE DESIGN. N. G. Wittenbrock. Apr. 20, 1959. 24p. Contract W-31-109-Eng-52. OTS.

A gas-cooled loop is being designed for installation in the Plutonium Recycle Test Reactor. This loop will be used for studies of the effect of gas-cooled reactor coolants on graphite. In addition to graphite studies, fuel elements operating at powers up to 500 kw will be tested in the loop. The carbon dioxide coolant will be pressurized to 500 psig and the maximum test section outlet temperature will be 1500°F. Analysis of the preliminary scope design for the gas loop revealed no adverse effect on the nuclear safety of the PRTR. Insertion of the gas loop test section in the PRTR core will have a slight effect on the reactivity of the Core (5 milli-k). This negative reactivity will be compensated by charging one additional spike enrichment fuel element. Safety features incorporated in the design include: a calandria shroud tube cooling loop, an electric power backup, an emergency light water coolant injection, and reactor safety circuit trips. In the event of an accident in the gas loop any fission products released to the environs should result in no injury or crop damage. (auth)

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IRRADIATION EXPERIMENTS 4.03.06

EFFECTS ON REACTIVITY 4.03.06.01

7122 A/CONF.15/P/967
ON THE THEORY OF CYLINDRICAL AIR GAPS IN NUCLEAR REACTORS. F. Stummel (Reactorstation, Karlsruhe, Ger.). 16p.

An integral part of a research reactor is its central loop, whose design has an important bearing upon the inherent safety of the reactor. The resulting problem is twofold, at any rate in the case of heterogenous reactors. In all cases it is necessary to remove some fuel elements from the original lattice. This results in a large increase in the neutron flux at that point of the loop. With such a neutron flux value the geometry of the channel determines the number of neutrons leaking out of the reactor. The geometry of the channel is treated. (auth)

GENERAL PROCEDURES 4.03.06.02

OPERATING EXPERIENCE WITH IN-PILE LOOPS AT ORNL. J. A. Cox (Oak Ridge National Laboratory). Abstract of talk presented at the Meeting on High-Flux Testing Reactors, Mol, Belgium, Sept. 21-25, 1959.

A series of in-pile loops have been operated in the ORNL research reactors over the past fifteen years. Among these are loops cooled with water, gas, single-pass air, sodium, and helium. Fuel loops of aqueous uranyl sulfate and molten salt have also been operated. There has been no major difficulty, but a number of minor incidents have occurred, and these have been the basis for development of a safety system designed to prevent interference with reactor operation or hazards to personnel.

A small organization has been developed to evaluate hazards and to provide a continuing safety surveillance of loops and other experiments. It has been necessary to provide standards for containment, temperature and pressure monitoring , shielding, release of radioactivity, and other safety factors. These, together with reactor design features found desirable, are described. The instrument safety system used for loops is a double-channel type requiring response from only one channel to cause corrective action and having fail-safe features. With this system a very complex loop may cause spurious shutdowns of the reactor unless the instrumentation is reliable. Methods of improving the instrumentation and the results achieved are presented.

Operating and safety experience with various loops is described.

7087 A/CONF.15/P/58
EXPERIENCE IN THE DESIGN OF IRRADIATION EXPERIMENTS. H. Cartwright and B. E. Eltham (Atomic Energy Research Establishment, Harwell, Berks, Eng.) and R. F. Jackson (United Kingdom Atomic Energy Authority, Risley, Lancs, Eng.). 15p.

The design, testing, and installation of irradiation experiments for fissile and non-fissile materials are discussed. (A.C.)

14009 IDO-16507
Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho.
ETR HAZARD ANALYSIS OF THE KAPL-F10 EXPERIMENT. R. J. Flygare — F. L. McMillan and R. J. Nertney, eds. Dec. 18, 1958. 53p. Contract AT(10-1)-205. $1.25(OTS).

The experimental system and types of test specimens as well as safety features of the system are described. Descriptions of the possible accidents, including the maximum credible accident, are analyzed. (auth)

EFFECTS OF REACTOR ENVIRONMENT ON MATERIALS 4.03

IRRADIATION EXPERIMENTS 4.03.06

INDUCED RADIATION 4.03.06.03

1723
STUDIES OF PROTECTION. Bull. inform. sci. et tech. (Paris) No. 31, 36-40(1959) July-Aug. (In French)
Reactor experimental facilities and protective measures employed in connection with their use are discussed. (T.R.H.)

14889 IDO-16520(p.155-62)
Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho.
REACTOR AND EXPERIMENT SAFETY CONSIDERATIONS. D. R. deBoisblanc. p.155-62 [of] TEST REACTORS MEETING FOR INDUSTRY, IDAHO FALLS, IDAHO, MAY 13-15, 1959. PART I. CONSTRUCTION AND OPERATION OF TEST REACTORS. 8p.
In nuclear test reactor technology, advanced experiments require the establishment of conditions of high flux and usually high temperatures. The large reactivity effects which can accompany failure of such experiments in test reactors give rise to hazards not commonly associated with ordinary reactor operation. A discussion is given of the problem areas in test technology and of the requirements of hazards evaluation in order to assure safe, continuous operation of a complex nuclear testing program in high flux test reactors like the Materials Testing Reactor and Engineering Test Reactor. The relationship between reactor design, experiment design, and operational safety is discussed from the point of view of the experience and practices of the MTR-ETR Safeguard Committee. The factors that influence the feasibility of operation of various types of engineering tests is discussed. A discussion of recommended practices in relation to research and test reactors and experimental operation is given. (auth)

14888 IDO-16520(p.145-54)
Atomic Energy Commission, Washington, D. C.
CONSIDERATIONS INVOLVED IN THE SAFETY EVALUATION OF TEST REACTORS. Martin B. Biles. p.145-54 [of] TEST REACTORS MEETING FOR INDUSTRY, IDAHO FALLS, IDAHO, MAY 13-15, 1959. PART I. CONSTRUCTION AND OPERATION OF TEST REACTORS. 10p.
An attempt is made to identify the general considerations involved in the hazards evaluation of testing reactors. Heat flux, hydraulic stress, gamma heating, radiation effects, metal-water reactions, reactivity, control, experiments, accidents, and containment are discussed. (W.D.M.)

6722 A/CONF.15/P/1163
DISPOSITIFS EXPERIMENTAUX POUR ETUDES EN PILE DU FLUAGE DES MATERIAUX COMBUSTIBLES, ET DU MODULE D'ELASTICITE DES MATERIAUX DE STRUCTURE. (Experimental Apparatus for In-Pile Studies of: Creep of Nuclear Fuels, and Young's Modulus of Structural Materials). A. Gautier, P. LeBret, L. Alfillé, and P. Pesenti (Commissariat à l'Énergie Atomique, Paris). 53p.
Two experimental apparatusus for in-pile study are described. The first is for creep tests under compression of reactor fuels and the second is for the study of Young's modulus of metallic samples during irradiation. In the creep device, three samples are simultaneously tested with identical stress by an elastic membrane deformed under pressure by a carbon dioxide circuit. The length of the specimens is compared to a calibration standard before and after irradiation. The control and safety devices are emphasized. The apparatus for studying radiation effects on Young's modulus is described in detail. The principle used is discussed. (J.S.R.)

13048 GEAP-2064
General Electric Co. Atomic Power Equipment Dept., San Jose, Calif.
FINAL SUMMARY SAFEGUARDS REPORT FOR THE GENERAL ELECTRIC TEST REACTOR. R. K. Andersen and I. M. Jacobs. Feb. 20, 1958. 182p. $28.80(ph), $8.40(mf) OTS.
The maximum and minimum transient and steady state limits of operation for the reactor are set forth. Detailed discussions are presented on the site and environmental factors, the containment vessel and its design basis, the reactor description and performance data, proposed experimental facilities, reactor facility operating standards and procedures, and accident safeguards analysis and radiation hazards evaluation. (W.D.M.)

EFFECTS OF REACTOR ENVIRONMENT ON MATERIALS 4.03

IRRADIATION EXPERIMENTS 4.03.06

INDUCED RADIATION 4.03.06.03

13083 AECU-4104
Duquesne Light Co., Shippingport, Penna.
PERIODIC RADIATION SURVEY OF REACTOR PLANT CONTAINER AND COMPONENTS AFTER SHUTDOWN "C" SURVEY. SECTION III—2790 EFPH. SECOND PERFORMANCE. Test Results DL-S184 (T-612076). First issue, Mar. 24, 1959. 10p. $1.80(ph), $1.80(mf) OTS.

A study was made of the rate of radioactive decay of the hairpin loops after isolation and changes in radiation level resulting from continued operation of the reactor at power. Results indicated that the radiation decayed very rapidly after isolation of the hairpin loop. (J.E.D.)

RADIATION MONITORING 4.03.07

INSTRUMENTS 4.03.07.01

5338 ORNL-2587
Oak Ridge National Lab., Tenn.
THE LID TANK SHIELDING FACILITY AT OAK RIDGE NATIONAL LABORATORY. PART III. INSTRUMENTATION. D. W. Cady. Jan. 18, 1960. 63p. Contract W-7405-eng-26. OTS.

The instrumentation at the Lid Tank Shielding Facility (LTSF) is described. Drawings or photographs of the gamma-ray, thermal-neutron, and fast-neutron detectors are included, and these detectors are discussed. The methods of detector application at the LTSF are also described, as well as the calibration techniques. The electronics associated with each detector is presented with appropriate references. The range of sensitivity of each detector is also given, along with estimates of the reliability of data from the detection system. (auth)

4933 AECU-4512
Duquesne Light Co., Shippingport, Penna.
PERIODIC RADIATION SURVEY. SECTION I. EFPH-4182. FIRST PERFORMANCE. CORE I, SEED I. Test Results DL-S-231 (T-612394). First issue, Nov. 3, 1959. 7p. OTS.

Investigations were made to determine the radiation levels in the 1D Boiler Chamber during plant operation. The radiation level in the 1D Boiler Compartment with the 1A, 1B, and 1C main coolant loop in service at ~100% power ranged from 0.03 to 6.0 mr/hr. (W.L.H.)

8598
HIGH ENERGY RADIATION DETECTOR. (to General Electric Co.). British Patent 827,977. Feb. 10, 1960.

A transistor radiation detector is described. On an Al base a flash coating of Bi is applied to bond well with the p-type Se layer. The next layer is an n-type material such as CdSe(Ag) or CdS(Ag). Finally, a counter electrode layer of Cd or Zn is applied. Such a device is useful in the detection and measurement of x and gamma rays. (T.R.H.)

5327 M-1772
[Rochester, N. Y. Univ.]
A RADIATION DOSE INTEGRATOR OF HIGH SENSITIVITY. Gerhard Dessauer, Kenneth E. Davis, and Fred A. White. Sept. 13, 1945. Decl. Jan. 7, 1956. 8p. Contract W-7401-eng-49. $1.80(ph OTS); $1.80(mf OTS).

An unusually sensitive radiation monitor is described which can be calibrated to measure neutron and gamma radiation over a wide range of dose rates. The device employs a specially designed ionization chamber whose characteristics are changed by varying capacity, gas type, and gas pressure. The counter is a-c operated, is self-recording, and possesses high stability and reproducibility.

6460
EFFICIENCY OF SCINTILLATION COUNTERS FOR FAST NEUTRONS. Františěk Lehar (Inst. f. Kernphysik der Tschechosl. A.d.W., Prague). Czechoslov. J. Phys. 8, 586-91(1958). (In Russian)

A study of the preparation and efficiency measurement of scintillators for fast neutrons is described. The scintillators were prepared by dispersing ZnS(Ag) in paraffin, polymethylmethacrylate, and polystyrene. These scintillators have a sufficiently high efficiency for fast neutrons, and also a low efficiency for gamma rays. An RCA 6199 photomultiplier was used. (T.R.H.)

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RADIATION MONITORING 4.03.07

PROCEDURES 4.03.07.02

6718 A/CONF.15/P/977
A NEW DIRECT LOCALIZING AND MEASURING DEVICE FOR EXTENDED RADIATION. K. H. Lauterjung and W. Gruhle (Max-Planck-Inst. Heidelberg, Ger.). 6p.

A new method for localizing and measuring extended radiation, combining the principles of the scintiscanner and closely packed detectors, is described. The area is covered with detectors and their signals are displayed in a time sequence on a CRO screen. (W.D.M.)

7151 NP-8283
Lockheed Nuclear Products, Marietta, Ga.
NEUTRON AND GAMMA MAPPING WITH THE RADIATION EFFECTS REACTOR AT 1 MW. J. H. Wilson, H. H. Nichols, H. J. Jarvis, R. M. Thornton, J. K. Grant, and T. W. Ponder. Nov. 1959. 75p. Contract AF33(600)-38947. (NR-72).

Measurements were made at one megawatt to determine the gamma dose rate per watt (ergs sec^{-1} g^{-1}-$watt^{-1}$ in carbon) and the fast neutron flux per watt (neutrons cm^{-2}-sec^{-1} $watt^{-1}$ above 1.75 Mev) within the six irradiation volumes of the Radiation Effects Facility. Measurements were made at two reactor heights for each of five different reactor shield tank configurations. The data are presented in the form of curves, which show the measurements as a function of distance within the irradiation volumes. The methods and instrumentation used in obtaining these measurements are also presented. (auth)

8933 AECD-4220
Knolls Atomic Power Lab., Schenectady, N. Y.
NOTES ON PREDICTED FAST NEUTRON DOSE FROM THERMAL NEUTRON DATA IN WATER. Henry E. Stone. Mar. 9, 1953. Decl. Feb. 8, 1956. 29p. Contract W-31-109-Eng-52. (MEMO-HES-9). $4.80(ph OTS); $2.70 (mf OTS).

An approximate method has been applied to predict fast neutron dosimeter data from thermal neutron measurements. Results are compared with actual dosimeter data and it is concluded that the method presented gives a good approximation for fast neutron dose. This is important since in many previous experiments fast neutron dosimeter data had not been taken, but thermal neutron data had been obtained. (auth)

REACTIVITY CHANGES AND CONTROL 4.03.08

CONTROL RODS – Failure 4.03.08.01

7193 A/CONF.15/P/2469
OPREDELENIE EFFEKTIVNOSTI ORGANOV REGULIROVANIYA V TSILINDRICHESKOM REAKTORE. (Determination of the Efficiency of Control Elements in Cylindrical Reactors.) G. V. Sinyutin and V. G. Semenov (U.S.S.R.). 29p.

The efficiency of a finite number of controlling rods introduced for compensating reactivity variations in the active zone of reactors of finite dimensions was determined. (R.V.J.)

7157
CALIBRATION OF THE REGULATING RODS OF THE GEESTHACHT RESEARCH REACTOR. G. Röbert (Gesellschaft fur Kernenergieverwertung in Schiffbau und Schiffahrt m.b.H., Geesthacht, Ger.). Kerntechnik 1, 140-5(1959) Nov. (In German)

After a brief introduction to the principles of the method, a determination of the reactivity equivalents of the regulation, done by the "in-hour" method, is described. The single stages for the obtention of a calibration point on the differential reactivity equivalence curve of the regulating rods were shown. The reactivity equivalences of the fine control rod and of the three shim scram rods are given. The different values for the single rods are discussed. (tr-auth)

8664 NAA-SR-1567
Atomics International Div., North American Aviation, Inc., Canoga Park, Calif.
CONTROL ROD EVALUATION BY MEANS OF PERTURBATION THEORY. F. L. Fillmore. July 15, 1956. 30p. Contract AT-11-1-GEN-8. $0.25(OTS).

The reactivity of boron–nickel control rods in the SRE reactor is evaluated by perturbation theory. A simple procedure for obtaining reasonable approximation for the perturbed flux is given. The value of reactivity calculated by perturbation theory for the case of a black rod along the axis of the core is compared with the result obtained from an exact solution of the problem. A diffusion theory correction for semi-black rods is given. The value of a 4-rod pattern in the core is calculated by applying statistical weights. Conversion from a bare to a reflected reactor is given. The effect of moderator temperature on the reactivity controlled by the rod is discussed. (auth)

EFFECTS OF REACTOR ENVIRONMENT ON MATERIALS 4.03

REACTIVITY CHANGES AND CONTROL 4.03.08

CONTROL RODS – Calculation of Effects of 4.03.08.01.01

5969 WAPD-SFR-Ph-124
[Westinghouse Electric Co. Atomic Power Div., Pittsburgh.]
FURTHER COMPARISON AND SIMPLIFICATION OF CELL THEORY AND EXACT SOLUTION FOR CONTROL RODS.
L. Friedman. Nov. 15, 1955. 13p. $3.30(ph OTS); $2.40 (mf OTS).

The cell method of computing critical size for slab reactors was applied to a two-rod case and compared with the exact solution. The calculations are developed and the results plotted. Application of the cell method to more complex geometries is suggested by the very satisfactory agreement of the results. (D.E.B.)

CONTROL RODS – Composition 4.03.08.01.02

6810 A/CONF.15/P/1454
COMPOSITE NEUTRON-ABSORBING MATERIALS FOR CONTROL-ROD AND SCREENING APPLICATIONS.
E. J. Bradbury and D. K. Worn (Mond Nickel Co. Ltd., Birmingham, Eng.); and C. R. Sutton (International Nickel Co. Inc., New York). 24p.

The advantages offered by composite materials for neutron absorbing applications, namely, high neutron absorption characteristics combined with good mechanical and corrosion properties, are known, and various methods have been developed for producing materials based on Al/B_4C and Ti/Gd_2O_3. Two new powder metallurgy techniques for the production of stainless steel clad composite materials in the desired forms are described. The two techniques are the continuous rolling of premixed powders to produce sheet and strip and a tube drawing technique for the manufacture of tubular control rod elements to within fine dimensional tolerances. In describing them, special reference is made to the production of stainless steel clad copper-base material containing 50% by volume of boron carbide. Reference is made to work on other materials, such as iron and nickel/boron-carbide, iron/gadolinium oxide, iron/europium oxide, and nickel/cadmium-fluoride. The relative merits of these combinations are discussed from both the metallurgical and nuclear points of view and in this connection the importance of compatibility between the matrix and absorbing phase is explained. The extended possibilities of composite type materials are briefly discussed with reference to the combination of two or more absorbing elements in one material to achieve optimum 'blackness' and 'burn-up' characteristics and to the production of a material, for use in fast reactors, incorporating both a moderator and a thermal neutron absorber. (auth)

7116
CENTRAL CONTROL SYSTEM. L. B. Borst (to U. S. Atomic Energy Commission). U. S. Patent 2,905,612. Sept. 22, 1959.

A control element is presented for neutronic reactors. The element is longitudinally expansible and compressible and remains within the reactor core at all times. The effectiveness of the element as to neutron absorption is varied by longitudinally compressing or expanding the element, the effectiveness being greatest when the element is fully expanded and least when it is fully compressed. Two embodiments of the invention are described, one being a coiled spring and the other being an element formed from a plurality of interconnected links.

7099
CONTROL DEVICE FOR A NUCLEAR REACTOR. (to United Kingdom Atomic Energy Authority). British Patent 817,756. Aug. 6, 1959.

A reactor control rod and its manufacture are described. The rod is made up of concentric layers of a low danger-coefficient material with a neutron-absorber layer between. It can be prepared by wrapping Cd foil on a thin Al tube, placing inside another Al tube and drawing. Details of the drawing operation and equipment are given. A control-rod drive and position-indicating device are also described.

CONTROL RODS – Operation 4.03.08.01.03

3173
CONTACT VERIFICATION INDICATOR FOR SCRAM SAFETY RODS IN THE KARLSRUHE REACTOR FR 2.
N. Hemmer and N. Reinert. Arch. tech. Messen Lfg. 285, R101-16(1959) Oct. (In German)

An apparatus is described which, by purely electrical methods, gives very accurately the correct contact break point for the drive of the carrier magnet within the check

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CONTROL RODS – Operation 4.03.08.01.04

zone. With this apparatus the magnet drive does not approach the rotor. The apparatus also indicates whether the absorber part of the rods is still controlled by the magnet. The apparatus is monitored for current interruptions. (tr-auth)

4879 NAA-SR-3989
Atomics International Div., North American Aviation, Inc., Canoga Park, Calif.
GAMMA-RAY AND FAST NEUTRON ANNULAR STREAMING EVALUATION THROUGH SODIUM REACTOR EXPERIMENT (SRE) — MARK II CONTROL AND SAFETY ROD ASSEMBLIES. F. D. Anderson. Oct. 15, 1959. 30p. Contract AT-11-1-GEN-8. OTS.

An experimental program was initiated to determine the extent of fast neutron and gamma ray streaming through the SRE Mark II control and safety rods and to evaluate the adequacy of the shielding provided in these control and safety rods. The methods and procedures used to evaluate these problems are routine and proven for determining gamma-ray and fast neutron dosages using radiation sensitive films and gold foils. The final experimental results indicated that no excessive streaming of either gamma rays or fast neutrons is present above or around the SRE Mark II control and safety rods. The analytical attenuation methods used to calculate the fast neutron and gamma-ray streaming dose rates gave results that compared favorably with the experimental data. Even though the agreement was favorable, it cannot be concluded that these analytical methods would be equally valid for other annular geometries. Additional experimental work will be necessary in order to establish the validity for performing similar analysis, but the favorable agreement encourages the use of such methods until other methods are determined. (auth)

3151 NAA-SR-Memo-3304
Atomics International Div., North American Aviation, Inc., Canoga Park, Calif.
MEASUREMENT OF TOTAL FALL TIME AND DIFFERENCES IN ACCELERATION FOR A CONTROL ROD FALLING IN AIR AND IN ORGANIC, OMR CRITICAL EXPERIMENT. L. S. Beller. Dec. 4, 1958. 7p. OTS.

Measurements were made of the total fall time for control rods falling in air and in organic coolant for hazards calculations. Results of measurements of the time required for the entire instrumentation and safety system of the organic moderated reactor to function are summarized.

7150 NP-8247
Argentina. Comisión Nacional de Energía Atómica, Buenos Aires.
COMANDO DE BARRAS DE CONTROL Y SEGURIDAD PARA EL REACTOR EXPERIMENTAL R A-2. Informe No. 23. (Operation of Control and Safety Rods for the R A-2 Experimental Reactor. Report No. 23). Erico Spinadel. 1959. 7p.

The control rod drive mechanism for the RA-2 Reactor is briefly described. It consists of a motor transmitting motion across an electromagnetic couple to the rack and pinion gear. The control circuit for the rod position is given. (J.S.R.)

10710 AECU-4029
Duquesne Light Co., Shippingport, Penna.
ROD DROP TRANSIENT. SECTION I. Test Results DL-S-247 (T-641323). First Issue, Feb. 16, 1959. 21p. $7.80(ph), $3.30(mf) OTS.

An investigation was made to obtain data on plant performance after a single rod has been dropped with the plant at 13 Mw gross generator output. Results indicate that the operation of the plant after a single control rod had been dropped was within allowable limits. (auth)

CONTROL RODS – Failure 4.03.08.01.05

4901
MEASURING THE RELEASE TIME AND TOTAL DROP TIME OF A CONTROL ROD. Charles Zucker and Lewis Haring (Foster Wheeler Corp., New York). Nuclear Sci. and Eng. 6, 328-32(1959) Oct.

A method for measuring the total drop time and release time of a control rod is presented. The application of these measurements to the determination of specific reactor control characteristics is discussed. Experimental values for several control rods are reported. (auth)

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REACTIVITY CHANGES AND CONTROL 4.03.08

COOLANTS 4.03.08.02

5858
COOLANT BLOCK DAMAGES SRE FUEL. Robert W. Dickinson (Atomics International Div., North American Aviation, Inc., Canoga Park, Calif.). Nucleonics 18, No. 1, 107; 109-11(1960) Jan.

The Sodium Reactor Experiment (SRE) was shut down on July 27, 1959, to determine the cause of the wide temperature variations in the fuel channels. It was found that a leak of organic material from an auxiliary cooling system into the primary loop caused blocking of the coolant passages. Upon examination twelve fuel elements of the 43 initially installed were damaged. A further study revealed that a possible iron-uranium eutectic had formed. Although this takes place at about 1,340°F, the temperature monitoring system indicated a maximum of only 900°F. Some future plans for SRE operation are discussed. (B.O.G.)

8242 MSAR-60-6
MSA Research Corp., Callery, Penna.
PRESSURE BUILDUP IN THE VAPOR CONTAINER DURING LOSS OF COOLANT ACCIDENT. Technical Report 70. G. E. Kennedy and V. K. Heckel. Jan. 22, 1960. 15p. Contract NObs-77023.

Pressure build-up in a vapor container during loss of coolant was studied using a Bettis Test Facility (BTF) pressurizer (512 gal) to contain 500°F water under pressure (2000 psig) and then venting its contents to a 10,000 gal tank. A total of seven runs was made using four orifice sizes and two water-to-air volume expansion ratios. One run each was made using a $\frac{1}{4}$, $\frac{1}{2}$, $\frac{3}{4}$, and 1 in. orifice between the pressurizer and the tank and a water-to-air volume expansion ratio of 1.5. Two runs were made using the $\frac{1}{4}$ and $\frac{1}{2}$ in. orifices with a water to air volume expansion ratio of 4.5 lb water per cu ft of air, and one run with a $\frac{3}{4}$ in. orifice and 1.5 lb water per cu ft of air. For this run the tank was stacked with pieces of steel to increase the surface area. The highest pressure obtained, in which all of the water from the pressurizer was vented to the tank, was 38 psig. This was the repeat run where pieces of steel were used to increase the surface area of the tank. The time to reach this pressure was 150 seconds. (auth)

5457
A PROBLEM ON A COOLANT ACCIDENT IN THE EL-3 REACTOR. G. Bianchi, J. Brasseur, C. Caillet, and M. Thonnet (Centre d'Etudes Nucléaires, Saclay, France). p.85-90 of "Nuclear Electronics. II." (In French)

An analog study was made to predict the evolution of the mean uranium temperature during an accident to the coolant system of the EL-3. The accident was introduced in the computer by modification of the parameter which expresses the efficiency of the system in the thermal equations. Two studies were made—one corresponding to a half loading and the other to a full loading. The results are given. (J.S.R.)

2202 CF-59-10-76
Oak Ridge National Lab., Tenn.
PRESSURE AND TEMPERATURE IN THE EGCR EXPERIMENTAL LOOP CELL IN CASE OF ACCIDENTAL RELEASE OF MAIN REACTOR COOLANT. M. H. Fontana. Oct. 20, 1959. 24p. OTS.

The possibility exists that a failure of the EGCR experimental loop piping in the loop equipment cell can induce a failure of the loop piping within the main pressure vessel due to overheating of the experiment and the collapsing pressure exerted by the main coolant gas. Release of the main coolant into the experimental cell would cause the pressure to rise rapidly above the structural design value of 12 psig unless a pressure relief hole were provided. Accordingly, it is intended that each experimental cell be relieved to the containment shell. A study of cell pressure was undertaken on an IBM 704. This analysis showed that rupture discs or blow-out doors providing 4.29 ft^2 flow area per cell are sufficient to keep the pressure below 12 psig if 4.67-in.-diam. orifices are inserted in the loop piping. (auth)

9240 HW-60963(Rev.)
General Electric Co. Hanford Atomic Products Operation, Richland, Wash.
PRTR HAZARD ANALYSIS FOR VARIOUS MECHANICAL FAILURES. J. Muraoka. July 6, 1959. 14p. Contract AT(45-1)-1350. OTS.

Hazards associated with several mechanical failures were analyzed for the PRTR. Effects of ruptures in the 26 in. vent line and in the 4 in. drain line from the primary heat exchanger were examined along with results of a primary coolant pump shaft failure. Effects of process tube rupture were calculated together with effects of severe malfunctions in the 26 in. heat exchanger vent line or the HX-1 by-pass valve. (J.R.D.)

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COOLANTS 4.03.08.02

4875 HW-60899
General Electric Co. Hanford Atomic Products Operation, Richland, Wash.
REACTOR PIPING SEAL TESTING AND REACTOR PIPING STRUCTURAL INTEGRITY. Final Report on Design Tests PR-50 and PR-51. P. M. Jackson. June 26, 1959. 62p. Contract W-31-109-Eng-52. OTS.

A test program was conducted to develop high integrity piping and seal components for Plutonium Recycle Test Reactor installation. Methods of preventing leakage of D_2O coolant and maintaining operational safety were investigated. To find the most suitable seals and determine their leakage properties, a complete thermal cycling of prototype assemblies was conducted. Spiral-wound, stainless steel gaskets with asbestos filler were selected for all water seals. Gas seals were most effective with copper-jacketed, asbestos-filled gaskets, or those of solid copper. Jumper stresses developed by thermal expansion were investigated and came within ASA piping code requirements Jumpers were flexed, about twice the distance expected on the reactor, at ambient and 500 to 530°F temperatures. The 37-degree, flare-fitted jumper connections proved quite acceptable during all tests. The disadvantage of the flare fittings was the large tightening torques required. (auth)

6943 A/CONF.15/P/1367
GAS-LIQUID AND VAPOR-LIQUID MIXTURES AS COOLING AGENTS. M. Silvestri, S. Finzi, L. Roseo, M. Schiavon, and R. Zavattarelli (Centro Informazioni Studi Esperienze, Milan). 22p.

Physical properties of gas-liquid and vapor-liquid mixtures are suitable, in many cases, for forced convection heat transfer, all the more so because of the very high apparent heat capacity when the liquid component has a high latent heat of vaporization. Pressure drops were determined for different gas-liquid mixtures, in different experimental conditions, keeping the gas in turbulent flow and the liquid both in viscous and in turbulent flow. The following parameters were varied: tube diameter, total pressure, liquid and gas flow rates, and liquid viscosity. Experimental data can be correlated by quite simple relationships. Heat transfer properties were studied on steam-water and gas-water mixtures. In electrically heated tubings heat transfer coefficients for steam-water mixtures were determined at various pressures, at different specific flow-rates and for different liquid-to-steam flow-rate ratios, up to burn out conditions. Maximum values of the heat transfer coefficients are of the same order of magnitude as those obtained in pressurized water systems, whereas the density of the mixtures, also in the very high pressure range, are much lower than liquid densities. These properties seem to give to gas-liquid or vapor-liquid mixtures some interest as cooling agents for nuclear reactors. (auth)

7286 A/CONF.15/P/2486
INTENSIFICATION OF HEAT TRANSFER IN A GAS-COOLED NUCLEAR REACTOR. F. Berger and V. Stach (Czechoslovakia). 17p.

The possibility of utilizing the partial ionization of the coolant gas in a reactor to increase the heat removal rate from fuel elements is investigated. Results from an experiment conducted in a gas-cooled loop are reported. It is concluded that in a gas-cooled reactor a considerable increase of heat transfer from the fuel element may be achieved by applying an electric field. The magnitude of the increase depends on the density of gas ionization, applied voltage, and the flow rate of the gas. (W.D.M.)

3233 NAA-SR-Memo-4177
Atomics International Div., North American Aviation, Inc., Canoga Park, Calif.
COOLING REQUIREMENTS FOR THE PIQUA SOURCE ELEMENT. M. Starr. July 29, 1959. 7p. OTS.

Studies were made to determine the cooling requirements for the Piqua OMR neutron source. Natural convection will adequately cool the source if entrance and exit ports are provided in the source tube to allow for the circulation of organic coolants through the Sb_2O_4–Be annulus. A conceptual design of the source that would be acceptable from the heat transfer viewpoint is presented. Pertinent temperatures in the source during full power reactor operation are given. (W.L.H.)

1278 AECU-3853
Knolls Atomic Power Lab., Schenectady, N. Y.
OPERATIONAL PERFORMANCE OF MAGNETIC FLOW-

EFFECTS OF REACTOR ENVIRONMENT ON MATERIALS 4.03

REACTIVITY CHANGES AND CONTROL 4.03.08

COOLANTS 4.03.08.02

METERS ON A SODIUM COOLED REACTOR. E. R. Gasser. [1957]. 17p. Contract [W-31-109-Eng-52]. (M-6221). $3.30(ph OTS); $2.40(mf OTS).

The design and operation of a magnetic flowmeter for use in estimating sodium flow in cooling channels are described. The flowmeter requires minimum maintenance and is reliable. It is pointed out that the magnets must be carefully calibrated, and the meter should be installed in a clean, easily accessible location. (J.R.D.)

HYDRAULIC ANALYSIS OF SUDDEN FLOW CHANGES IN A COMPLEX PUMPING CIRCUIT. George E. Alves (E. I. du Pont de Nemours and Co., Inc., Wilmington, Del.). A.I.Ch.E. Journal 2, 143-7(1956) June.

A problem arose as to what would happen if there were sudden failures of power to one or more pumps of a large-scale complex pumping circuit composed of several individual pumping systems. The application of several published methods of hydraulic transient analysis to the problem is described. The performance of the system computed under several assumptions is discussed, and a comparison is made with experimentally determined values.

9880 CP-3061
Chicago. Univ. Metallurgical Lab.
PHYSICAL CONSTANTS OF PROPOSED COOLANTS. Robert Bentley, George Brown, and Richard Schlegel. June 23, 1945. Decl. Dec. 14, 1955. 48p. Contract W-7401-eng-37. $0.35(OTS).

Physical constants, including melting and boiling points, density, heat capacity, thermal and electrical conductivities, viscosity, and vapor pressure are given for a number of proposed liquid and gaseous coolants. Summary tables for quantities which determine heat transfer characteristics are also given. (auth)

THE USE OF SODIUM AND OF SODIUM-POTASSIUM ALLOY AS A HEAT-TRANSFER MEDIUM. I. W. B. Hall and T. I. M. Crofts (United Kingdom Atomic Energy Authority, Sellafield, England). Atomics 7, 167-72(1956) May.

The applications of liquid metals in heat-transfer problems are discussed, and comparisons are drawn between those metals whose melting points are sufficiently low to make them of interest in this respect. A number of Na and Na-K circuits which have been built and operated over the past three years are described; some of these were built in order to gain experience in handling the liquid metals, while others were for heat-transfer experiments. A general discussion on the design and construction of liquid metal circuits and the components which are commonly used in them is given. A brief discussion of forced-convection heat-transfer with liquid metals follows, and the results of some work on cavitation in Na-K eutectic flowing through a constriction in a pipe are summarized. (auth)

5376 CF-51-11-92
Oak Ridge National Lab., Tenn.
PILE SIMULATOR STUDY OF NEUTRON FLUX IN HRE FOLLOWING A DECREASE IN COOLANT FLOW. S. Hanauer. Nov. 12, 1951. Decl. Dec. 21, 1955. 9p. Contract [W-7405-eng-26]. $0.15(OTS).

CHANGES IN FUEL CHARACTERISTICS 4.03.08.03

6853 A/CONF.15/P/205
LONG IRRADIATION OF NATURAL URANIUM. D. S. Craig, G. C. Hanna, et al. (Atomic Energy of Canada Ltd., Chalk River, Ont.). 34p. (AECL-615). $0.25 (AECL).

The principal factors controlling the change of reactivity with irradiation are the destruction of U^{235}, the production of Pu^{239} and higher plutonium isotopes, and the accumulation of fission products. Cross sections appropriate to reactor neutron spectra were calculated from basic nuclear data. With increased irradiation, changes in the neutron spectrum in the fuel result from self-shielding in the resonance region and increased thermal neutron absorption cross section. The fission-product absorption cross section of irradiated fuel can be closely simulated by using three pseudo fission products with cross sections of 600, 300, and 25 barns. Measurements were made of the spatial distribution of U^{235}, plutonium isotopes, and Cs^{137} in an NRX rod irradiated to 3000 Mwd/ton. Precise mass-spectrometer analyses of the uranium and plutonium isotopes combined with chemical analyses for plutonium gave accurate values of the conversion factor and the effective capture cross sections of the plutonium isotopes. These results have been satisfactorily reconciled with the basic nuclear data and the calculated effects of changing neutron spectra. (auth)

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7238 A/CONF.15/P/1095
STATISTICAL ASPECTS OF THE KINETICS OF A CIRCULATING LIQUID METAL FUEL SUSPENSION REACTOR. J. J. Thompson (Atomic Energy Commission, Australia). 16p.

Estimation of the response of a nuclear reactor operating at power to fluctuations in the fuel concentration in a liquid metal suspension used as fuel carrier and heat removal medium is discussed. The particular example is micron size particles of uranium metal in liquid sodium circulating through a beryllium moderator. The fluctuations are assumed random, and the mean square neutron density, power, and temperature fluctuations are given by the integrals of the appropriate spectral densities which are derived from the transfer functions of the reactor in terms of the mean fuel channel inlet concentrations. A uniform reactor is considered in detail, the basic functions being given explicitly, and calculations are reported for the particular system which has statistically similar but independent mean inlet fluctuations, whose autocorrelation function is assumed to be obtained from a Poisson distribution of concentration changes. The results obtained are of a general nature owing to lack of experimental observations on the fuel concentration fluctuations in a dilute suspension of heavy particles to be expected at the inlet to a reactor core, and the very large number of reactor parameters involved. (auth)

6004
REACTIVITY ASSOCIATED WITH THE DECAY OF Np^{239} IN IRRADIATED NATURAL URANIUM DIOXIDE. S. B. Gunst (Westinghouse Electric Corp., Pittsburgh). Nuclear Sci. and Eng. 6, 376-8(1959) Nov.

In the calculation of irradiation-induced changes in reactivity in natural uranium the direct formation of Pu^{239} upon neutron capture in U^{238} is frequently assumed. The attendant error in reactivity during irradiation is shown to be significant for an illustrative case even after high exposure. This suggests that the consequences should be examined when the direct formation of Pu^{239} is assumed. (auth)

5988 CEA-1054
France. Commissariat à l'Énergie Atomique, Paris.
MESURE ET REGULATION DU NIVEAU D'UN REACTEUR HOMOGENE AU PLUTONIUM. (Measurement and Regulation of the Level of a Homogeneous Plutonium Reactor). F. Berger and J. Bertrand. Dec. 1958. 82p.

Reactivity depends strongly on disturbances of the level of the plutonium solution in the homogeneous reactor. Proserpine has a small cylindrical core, 250 mm diameter, and 10 liters volume. With a view to reducing the dangers due to corrosion and contamination, the solution level in the core is raised by pneumatic pressure. The level is stabilized by means of a regulating system. During critical experiments the variations of the level are less than one hundreth part of a millimeter. (auth)

4944 JAERI-1006-A
Japan. Atomic Energy Research Inst., Tokyo.
TEMPERATURE COEFFICIENT OF REACTIVITY OF CALDER HALL TYPE REACTOR. Kazuhiro Inoue, Masasi Iizumi, and Kazuo Nishimura. June 1959. 20p.

As the conversion ratio of the fuel is comparatively high for the Calder Hall type reactor, about 0.8, considerable amounts of Pu^{239} are built up in a relatively short irradiation time. As Pu^{239} has a large resonance absorption for the neutron energy of about 0.3 ev, the reaction rate of Pu^{239} increases as the temperature increases, in contrast with the reaction rates of U^{235} and U^{238} which show the opposite tendency. Though the temperature coefficient of reactivity is negative for fresh fuel, it changes to positive as the exposure proceeds and Pu^{239} is accumulated. The moderator temperature coefficient becomes zero at an irradiation of about 150Mwd/ton, and exceeds $+10^{-4}$/°C at about 2,000 Mwd/ton. The fuel temperature coefficient is almost constant, about -1.7×10^{-5}/°C, throughout the exposure. The fuel temperature coefficient is a prompt one, and the moderator temperature coefficient shows the delayed property owing to the large heat capacity of the graphite. Consequently, the negative fuel temperature coefficient is effective at first, although the over-all temperature coefficient is positive at high exposure, and the operation of the reactor is not so difficult essentially. A calculation of these changes of the temperature coefficient of reactivity is presented and an investigation on the effect of the increases of enrichment of U^{235} on the temperature coefficient is presented. (auth)

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5530 ✓ KAPL-2050
Knolls Atomic Power Lab., Schenectady, N. Y.
ESTIMATES OF THE EFFECT OF BUBBLE SIZE ON FUEL ELEMENT SWELLING. A. H. Willis. Sept. 30, 1959. 14p. Contract W-31-109-Eng-52. OTS.

Fission gases are a source of swelling in irradiated fuel materials; in a mechanically strengthless material only surface tension limits the amount of swelling. In such materials, the amount of swelling depends upon the operating temperature, fuel burnup, and the number of gas-filled bubbles per unit volume of material. Swelling is insensitive to the variety of sizes of the gas-filled bubbles, unless only a very small proportion of the bubbles have an extremely large diameter. (auth)

8944 LA-490
Los Alamos Scientific Lab., N. Mex.
FURTHER INVESTIGATION OF SPONTANEOUS FISSION IN PLUTONIUM. G. W. Farwell, E. Segre, A. Spano, and C. E. Wiegand. Apr. 25, 1946. Decl. Dec. 18, 1959. 59p. OTS.

The spontaneous fission decay rates of Pu^{238} and Pu^{240} are 7.7×10^6 and 1.66×10^6 fissions per gram hour, respectively. Comparison of spontaneous fission analyses of a number of samples of pile-produced plutonium with Hanford data on the plutonium concentration in the uranium from which they were extracted shows that, in pile material,

$$\frac{Pu^{240}}{Pu^{239}} = 71 \times \frac{Pu^{239}}{U^{238}}$$

The isotope Pu^{240} is almost entirely responsible for the spontaneous fission activity observed in pile-produced plutonium; other isotopes of plutonium and isotopes of elements 95 and 96 make no appreciable contribution. (auth)

6949 A/CONF.15/P/11
SOME NEUTRON CROSS SECTIONS OF IMPORTANCE TO REACTORS Tc^{99}, Nd^{143}, Nd^{145}, Sm^{149}, Sm^{152}, Eu^{151}, Eu^{153}, Gd^{155}, Gd^{157}, AND Pu^{240}. N. J. Pattenden (Atomic Energy Research Establishment, Harwell, Berks, Eng.). 24p.

Crystal spectrometer measurements on Tc^{99}, Nd^{143}, Nd^{145}, Sm^{149}, Eu^{151}, Eu^{153}, Gd^{155}, Gd^{157}, and Pu^{240} are described in detail. The measurements are combined with published resonance parameters to obtain convenient data from which effective cross sections in neutron spectra at different temperatures up to 2000°K may be estimated. (W.D.M.)

8281 HW-59758(Rev.)
General Electric Co. Hanford Atomic Products Operation, Richland, Wash.
A CALCULATION OF THE REACTIVITY WORTH OF PLUTONIUM AND URANIUM-235 AS ENRICHMENT IN THERMAL REACTORS. D. P. Granquist. Aug. 8, 1959. 34p. Contract AT(45-1)-1350. OTS.

A comparison is presented of the reactivity worth of Pu with the worth of U^{235} as a thermal reactor fuel. Calculations are based on data from four sets of Pu compositions (0, 50, 75, and 90% burned Pu^{239}) mixed with U^{238} and comparable cases with fuel elements enriched in U^{235}. The study was restricted to a single well-thermalized reactor lattice. Effects dependent upon the detailed shape of the thermal neutron spectrum, such as might be significant in close-packed lattices, were not considered. Calculations show that: (1) Pu^{239} has a greater reactivity worth than U^{235} in thermal reactors exhibiting low neutron losses; (2) Pu containing appreciable amounts of its higher isotopes exhibits a greater reactivity worth in low neutron loss thermal reactors than either U^{235} or Pu^{239}; (3) in reactors having high neutron losses ($\bar{k}_\infty/\epsilon = 1.30$), Pu containing appreciable percentages of the higher isotopes cannot attain as long exposures as the corresponding U^{235} enriched fuels; (4) also, in such high neutron loss reactors, U^{235} may have a greater reactivity worth than Pu^{239}; and (5) for intermediate cases ($\bar{k}_\infty/\epsilon = 1.15$ and enrichments of 1.0, 1.5, and 2.0 wt.%) there is little difference in reactivity worth between U^{235}, Pu^{239}, or "burned" Pu. (auth)

7017 A/CONF.15/P/2223
EVALUATION OF THE ABSORPTION CROSS SECTION OF U-235 FISSION FRAGMENTS IN THE $0.025 - 10^6$ ev ENERGY RANGE AND CALCULATION OF FRAGMENT EFFECTS IN INTERMEDIATE REACTORS. I. V. Gordeev and V. Ya. Pupko (U.S.S.R.). 29p.

The neutron absorption cross sections of those U^{235} fission fragments whose radiative-capture thermal

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cross section does not exceed 10^3 barns are evaluated. Non-stable fragments of half life less than 100 days were not considered. Results were used to calculate the effect of fragments on intermediate reactor reactivity. The calculations were carried out for non-reflected reactors in the diffusion-age approximation. (W.D.M.)

7255 A/CONF.15/P/1339
BURN-UP CALCULATION OF NATURAL-URANIUM GRAPHITE-MODERATED POWER REACTOR BY USING DIGITAL COMPUTER. Mochinori Goto, Tasaburo Yamada, Tadasu Takegoshi, Megumi Fujinaka, and Toshio Morita (Electrotechnical Lab., Industrial Science and Technology Agency, Tokyo) and Toshio Yoshioka (Kansai Electric Power Co., Ltd., Osaka). 72p.

In the natural-uranium graphite-moderated power reactor, fuel shuffling and continuous charge-discharge on load are necessary in order to obtain a higher burn-up factor. It is desirable to predict the change in characteristics of the reactor during operation and the effect of fuel shuffling and continuous charge-discharge. The diffusion equation in which the coefficients vary with position was solved for cylindrical geometry by using the Relay-type Automatic Digital Computer in the Electrotechnical Laboratory. (W.D.M.)

6954 A/CONF.15/P/149
GAMMA SPECTRA OF GROSS FISSION PRODUCTS FROM THERMAL REACTORS. Jan Prawitz, Kerstin Löw, and Rolf Björnerstedt (Research Inst. of National Defence, Stockholm). 20p.

Calculations of gamma spectra from products of thermal fission of U^{235} are presented. The fission yield values and decay data used are taken from literature published up to April 1958. The calculations cover seven different irradiation times from one day to two years and continuous cooling times from one day to 1000 years. The gamma activities were grouped in 0.2-Mev intervals. The composition of the fission product mixture is somewhat dependent on the absolute neutron flux in the reactor. This matter is discussed. The results are presented as a diagram for each irradiation time, showing the decay of the different energy groups with cooling time. (auth)

1827
REACTOR KINETIC FUNCTIONS: A NEW EVALUATION. G. R. Keepin and T. F. Wimett (Los Alamos Scientific Lab., N. Mex.). Nucleonics 16, No. 10, 86-90(1958) Oct.

The two reactor kinetic functions, the period-vs.-reactivity relation and the zero-power transfer function, were calculated in detail for the six fissionable nuclides U^{233}, U^{235}, U^{238}, Pu^{239}, Pu^{240}, and Th^{232}. Interpolation of the functions obtained for these limiting "pure-isotope" cases will allow estimates for the kinetic behavior of "mixed-isotope" systems. (auth)

1811 KAPL-M-GOM-3
Knolls Atomic Power Lab., Schenectady, N. Y.
A GENERALIZED EQUATION FOR DETERMINING FUEL ELEMENT TIME RESPONSES WHERE COOLANT TEMPERATURE REMAINS CONSTANT. Gerhard O. Mueller. Oct. 14, 1958. 20p. Contract W-31-109-Eng-52. $3.30(ph OTS); $2.40(mf OTS).

A generalized expression for a reactor fuel element time response was developed. The resulting expression, in the form of an infinite series, allows the variation of fuel (meat) thickness, clad thickness, and film resistance to determine the relative effect on the over-all response time. An example of the use of this expression is included, and the results are presented in graphical form.

5958 AERE-M/R-1889
Gt. Brit. Atomic Energy Research Establishment, Harwell, Berks, England.
FISSION-PRODUCT CONCENTRATIONS AND POISONING IN A HOMOGENEOUS REACTOR WITH CHEMICAL PROCESSING. W. H. L. Porter. Mar. 10, 1956. 51p.

Tables and graphs are presented giving the steady-state fission product concentrations and total capture cross sections in the core of a homogeneous reactor for various rates of chemical processing. The results are as general as possible, otherwise they are detailed for the specified system of a liquid metal homogeneous reactor based on U dissolved in Bi. Estimates are also given of the rate of production of inert gases in the main circuit. The transient condition when the reactor is first started up is not considered. (auth)

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8938 AECD-4226
Knolls Atomic Power Lab., Schenectady, N. Y.
SELF-SHIELDING MEASUREMENTS IN PPA-20. J. S. King. Sept. 9, 1954. Decl. Feb. 8, 1956. 51p. Contract W-31-109-eng-52. (MEMO-JSK-4). $7.80(ph OTS); $3.30(mf OTS).

The self-shielding characteristics of a number of absorbers and of U^{235} and U^{238} have been investigated in PPA-20 (66°). Most of the measurements have been made in ring 3 at the core mid-plane. The foil doubling technique was employed. Particular attention was given to "thin" foil regions for the purpose of extrapolating the data to zero thickness. In a few cases, namely Au, Ag, Cd, and B, theoretical self-shielding curves have been calculated and found to be in good agreement with the experimental data. Both reactivity coefficient and activation experiments were undertaken for Au for the purpose of evaluating changes in F_L with self-shielding. In a number of cases the zero-width reactivity coefficient has been calculated and compared with the extrapolated data. (auth)

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6995 A/CONF.15/P/1638
TRANSPORT CROSS SECTION OF THERMAL NEUTRONS IN SOLID MODERATORS. K. S. Singwi and L. S. Kothari (Atomic Energy Establishment, Trombay, India). 22p.

Calculations on the variation of transport cross sections with neutron energy in beryllium, beryllium oxide, and graphite at room temperature were made. Assuming the equilibrium distribution of neutrons in the moderator to be Maxwellian, the average value of the diffusion coefficient $\overline{D}_0$ was calculated, from which the average value of the transport cross section is deduced. In beryllium and beryllium oxide the contribution of the inelastic scattering to transport cross section has been taken into account, and it is shown that this makes a significant contribution to the average value of $\overline{D}_0$. In beryllium, the variation of $\overline{D}_0$ with the temperature of the moderator was studied. Transport cross section in graphite was calculated by taking only the elastic scattering into account and neglecting the contribution of the inelastic scattering, since the model chosen for the lattice vibrations of graphite makes the latter calculation rather unsatisfactory. (auth)

4898
ERRORS IN REACTIVITY MEASUREMENTS DUE TO PHOTONEUTRON EFFECTS. Charles Erwin Cohn (Argonne National Lab., Lemont, Ill.). Nuclear Sci. and Eng. 6, 284-7(1959) Oct.

In reactors having D_2O or Be moderators, the photoneutrons produced by gamma rays from long-lived fission products give rise to transient effects which could introduce appreciable errors into various types of reactivity measurements. Digital computer calculations of these effects in D_2O are presented for criticality measurements, subcritical multiplication measurements, rod drops, and rising period measurements. It is found that in some cases appreciable errors are possible even after one hour waiting periods. Since the Be photoneutron data cannot be resolved into groups, calculations for Be could not be done. However, the nature of the effects that could be expected is discussed. (auth)

6669 GEAP-3201
General Electric Co. Vallecitos Atomic Lab., Pleasanton, Calif.
RELATIVE EFFECTIVENESS OF REACTOR CONTROL MATERIALS. Richard A. Becker and John L. Russell, Jr. July 20, 1959. 50p. Contract AT(04-3)-189. OTS.

The boron equivalence of high cross section elements for slab geometries was measured. Data were obtained for several thicknesses of 19 elements. Because the measurement consists of conventional relative worth determination of slabs of various sample materials, the data are presented as relative worths vs. sample surface density, as well as sample surface density vs. equivalent boron surface density. (W.L.H.)

8271
NUCLEAR REACTOR INCLUDING A PACKAGE SAFETY DEVICE. W. H. Zinn (to U. S. Atomic Energy Commission). U. S. Patent 2,919,236. Dec. 29, 1959.

A safety device is presented for a nuclear reactor which consists of a tube having two chambers separated by a barrier comprising an annulus of stainless steel surrounding a copper disk and a mass of fissionable material in thermal

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contact with the copper disk. One of the two chambers contains a moderator and is adapted to be located in a region of high reactivity in the reactor and the other chamber contains under high pressure a gas having a high neutron capture cross section and is adapted to be located in a region of low reactivity in the reactor.

8256

CONTROL OF NUCLEAR REACTORS BY MEANS OF NEUTRON-ABSORBING LIQUIDS. Kurt Diebner. German Patent DAS 1,042,145. Oct. 30, 1958. Atompraxis 5, 502 (1959). (In German)

For reactor control, it was proposed to let a neutron-absorbing liquid flow through a system of pipes passing through a reactor. The concentration of neutron absorbers in the liquid could be raised or lowered according to the control problem. The advantage is that no kind of mechanical motion of solid parts must be accomplished within the reactor. (J.S.R.)

8593

IMPROVEMENTS RELATING TO THERMAL APPARATUS. Douglas Richard Chick (to Associated Electrical Industries, Ltd.). British Patent 818,776. Aug. 26, 1959.

A reactor control system is described in which neutron-absorbing material such as Sm is placed in the core to prevent runaway. The neutron capture cross section of the Sm increases steeply with temperature, thus preventing unsafe conditions in the core. (T.R.H.)

21719 IDO-16491

Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho.

SPERT II HAZARDS SUMMARY REPORT. G. O. Bright and J. E. Grund. Dec. 10, 1958. 68p. Contract AT(10-1)-205. $2.00(OTS).

Spert II will be a heterogeneous water-cooled and -moderated reactor designed for operation at pressures up to 300 psig and temperatures up to 400°F. The facility will provide for both static and flow tests with reactor cores employing either light or heavy water as a moderator-reflector, and also tests utilizing solid reflector materials. Its primary function is to provide a facility to permit study of the influence of various types of moderators and reflectors on reactor kinetic behavior. This report discusses the major hazards present in the operation of this facility, the precautions to be taken to reduce the probability of an accident, and the consequences of the maximum possible accident. Brief descriptions of the Spert II design and the site location are also presented. It is concluded that the proposed method of operation and the site location make possible the operation of the Spert II facility without hazard to the general public. (auth)

8218

NEW MATERIAL FOR THE SIMULTANEOUS SLOWING DOWN AND ABSORPTION OF NEUTRONS. (to Morgan Crucible Comp. Ltd.). German Patent DAS 1,043,534. Nov. 13, 1958. Atompraxis 5, 501(1959). (In German)

A shielding material for neutrons is described. It is composed of carbon and a boron compound and possesses at high refractoriness and heat conductivity a maximum moderating effect per unit space. Fast neutrons should be completely slowed down by the material and converted into heat energy and slow neutrons. Simultaneously the neutrons should be distributed homogeneously through the material and be absorbed. The material is formed from a mass of carbon, preferably graphite, in which a boron compound is distributed, which is present in the form in which it is solidified from the molten state in situ in this mass. The boron compound can be contained therefore in numerous pores in carbon matrix. A detailed method for the production of this material is given. (J.S.R.)

8269

NEUTRONIC REACTOR CONTROL. R. S. Dreffin (to U. S. Atomic Energy Commission). U. S. Patent 2,917,444. Dec. 15, 1959.

A control means for a nuclear reactor is described. Particularly a device extending into the active portion of the reactor consisting of two hollow elements coaxially disposed and forming a channel therebetween, the cross sectional area of the channel increasing from each extremity of the device towards the center thereof. An element of neutron absorbing material is slidably positionable within the inner hollow element and a fluid reactor poison is introduced into the channel defined by the two hollow elements.

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7126 CRRP-880
Atomic Energy of Canada Ltd., Chalk River, Ont.
SOME "FLUX PEAKING" EXPERIMENTS IN CLUSTER TYPE FUEL RODS. L. P. Robertson and R. E. Green. Nov. 1959. 48p. (AECL-925). AECL.

A group of experiments is described which was carried out to determine the flux rise in fuel bundles caused by spacers of scattering material placed between lengths of fuel. Measurements were made of the thermal flux distributions in clusters containing three types of fuel in cylindrical element 2.39 cm diameter UO_2, 1.32 cm diameter UO_2, and 1.31 cm U metal. Some of the clusters were similar to the proposed fuel charges of NPD-2. (W.D.M.)

MISCELLANEOUS AND COMBINED CAUSES –

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7990 ORNL-2088
Oak Ridge National Lab., Tenn.
OPERATIONAL SAFETY OF THE HOMOGENEOUS REACTOR TEST. P. R. Kasten. July 19, 1956. 33p. Contract W-7405-eng-26. $0.30(OTS).

The safety of the Homogeneous Reactor Test (HRT) is dependent upon the reactivity additions associated with physical operations. Physical operations were therefore limited, where necessary, so that the corresponding reactivity addition did not exceed a permissible value. The maximum permissible reactivity addition was determined from the relations between reactivity addition, physical and nuclear design values, and pressure rise and was considered to be that which increased the core pressure by 400 psi. At source power this pressure rise would be obtained if reactivity were added at a rate of 0.008 Δk_e/sec. The above relations are presented, and their usefulness in evaluating operational safety is illustrated. (auth)

7089 A/CONF.15/P/107
DYNAMIQUE DES REACTEURS A BASSE PUISSANCE. (Kinetics of Low Power Reactors.) Henri B. Smets (Belgium). 25p.

An analytical study was made of the transient behavior of low-power reactors. It is shown how the effect of six delayed neutron groups can be analyzed by means of an approximation which makes use of only one or two equivalent groups of delayed neutrons. Reactor kinetics is reviewed under the assumption that there is only one equivalent group of delayed neutrons. The transient response is determined for a pulsed variation, a linear variation, an exponential variation, and a 1/t variation in the reactivity. An indication is given of a method of extending the results obtained to the case of six groups of delayed neutrons. The case of a reactor in which the reactivity undergoes periodic oscillations is considered. It is shown that the neutron flux increases exponentially when the reactivity is a quasi-harmonic function of zero mean. (J.S.R.)

7151 A/CONF.15/P/1462
STABILITY CONSIDERATIONS IN THE DESIGN OF FAST REACTORS. R. T. Ackroyd, J. E. Mann, J. D. McCullen (United Kingdom Atomic Energy Authority, Risley, Lancs, Eng.), and G. H. Kinchin (Atomic Energy Research Establishment, Harwell, Berks, Eng.). 36p.

A theoretical study of stability considerations in the design of fast reactors is given and some experiments suggested. Reactor response to impressed sinusoidal, step and ramp additions of reactivity, and to pump failures is discussed. The influence of the magnitude and sign of individual reactivity coefficients on response is considered. The importance of the delay times of these coefficients is stressed and the possibility of self-excited oscillations and resonance instability is examined. Suggestions are made as to the possible sources of unacceptable types of coefficients and hence an indication is given of the design factors which should be kept in mind to ensure that such coefficients are eliminated or reduced to acceptable limits. It is shown that a negative power coefficient of reactivity does not, in itself, ensure stability and that oscillatory stability does not guarantee satisfactory over-all behavior. (W.D.M.)

7143 A/CONF.15/P/1282
LA PRÉDÉTERMINATION DU COMPORTEMENT DANS LES RÉGIMES TRANSITOIRES DU RÉACTEUR DE 2,000 kw DE L'INSTITUT DE PHYSIQUE ATOMIQUE DE BUCAREST. (The Predetermination of Transient State Behavior in the 2,000 kw Reactor of the Bucharest

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Atomic Physics Laboratory). I. I. Purica (Inst. de Physique Atomique, Bucharest). 19p.

The coefficients for the system of dynamic equations applicable to the reactor as a function of temperature were determined by using two suitably selected transient state situations in the range of small reactivity variations and medium powers. A separation was achieved between the temperature coefficients and reactivity for the moderator and metal, or active volume, respectively, as a function of the temperature. It is possible, by using the coefficients established in this fashion, to determine the behavior of the reactor in dangerous transient-state situations ahead of time and with an adequate degree of precision. A description is given of experiments conducted with the reactor for various transient-state operating situations. (auth)

7118 A/CONF.15/P/581
A MATHEMATICAL MODEL FOR CALCULATING BOILING REACTOR TRANSIENTS. J. A. Fleck, Jr. and J. Huseby (Joint Establishment for Nuclear Energy Research, Kjeller, Norway). 13p.

A mathematical model for calculating boiling reactor transients is presented. The model takes into account the hydrodynamics of a natural circulation boiling reactor in a simple way. The integral forms of the laws of conservation of mass, energy, and momentum in hydrodynamics are used to derive a set of equations coupling circulation velocity, void fraction, and reactor power. The system of equations is used in calculating sample transients for the heavy water boiling reactor being constructed at Halden, Norway. (auth)

7166 A/CONF.15/P/1815
ON THE NON-LINEAR STABILITY OF A NUCLEAR REACTOR WITH DELAYED NEUTRONS. Rui Pacheco de Figueiredo (Junta de Investigações do Ultramar, Lisbon). 6p.

A nuclear reactor with non-uniform distribution of delayed neutrons and constant power extraction is discussed, and it is shown rigorously that the non-linear differential equations that describe the system have no periodic solutions other than the trivial set of solutions corresponding to constant reactor power and temperature. (W.D.M.)

7121 A/CONF.15/P/960
ON THE EFFECTIVENESS OF DELAYED NEUTRONS IN A REFLECTED REACTOR. D. Emendörfer and K. H. Höcker (Germany). 18p.

The delayed neutrons are produced with less kinetic energy than the fission neutrons. They therefore get thermal inside the reactor with a higher probability than the prompt neutrons, i.e., their influence on the neutron multiplication is more important. The diffusion of prompt and delayed neutrons is treated in a group diffusion approximation. Deriving a single space- and energy-independent kinetic equation from the system of multi-group equations by means of the importance function, an effective fraction of delayed neutrons appears, which is different from the ordinary fraction of delayed neutrons by 20%. (auth)

7169 A/CONF.15/P/1896
DETERMINATION OF REACTOR TRANSIENTS AND TIME VARIATION OF CORE MATERIAL CONCENTRATION AND EXCESS REACTIVITY BY GRAPHICAL METHOD. P. Stiévenart and P. Erkès (Bureau d'Etudes Nucléaires, S. A., Brussels). 18p.

The graphical method described is a development of the Bergeron principle for the solution of the differential equations with variable coefficients which define the reactor transients, the variation of core material concentrations, and excess reactivity with core life. The precision of the results obtained is sufficient for the application of this graphical method to solve some problems encountered in reactor design. (W.D.M.)

7278 A/CONF.15/P/2186
SELF-REGULATION IN WATER-WATER POWER REACTOR. V. A. Sidorenko (Academy of Sciences, U.S.S.R.). 37p.

Various transient processes are investigated for the pressurized-water power reactor, caused both by variations of the external load and by variations in the working conditions of the circulating circuit equipment.

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With a rather high negative temperature coefficient of reactivity it is possible to count on reliable operation of the plant without special external power regulators. (auth)

9171 KAPL-M-NPA-2
Knolls Atomic Power Lab., Schenectady, N. Y.
FACTORS USED IN THE CALCULATION OF GAMMA SOURCES IN THE CORE AND PRIMARY SHIELD OF THE NCR. Melvin J. Leibson. Dec. 15, 1959. 38p. OTS.
Equations and data for calculating the gamma source strength in various material components in the reactor core and primary shield in the natural circulating Reactor (NCR) are contained. Flux factors F (thermal flux factor) and G (fast flux factor) for gamma sources were determined and used to determine the volumetric gamma sources in both core and shield. (C.J.G.)

2565 AEC-tr-3434
MEASUREMENT OF THE REACTIVITY OF THE G-1. (Mesures de Réactivité Sur G-1). J. Bernot, J. C. Koechlin, L. Portes, and A. Teste du Bailler. Translated by Liz Appleby (Hanford Atomic Products Operation) from Report CEA-670(F), 1957. 30p.
Methods of measuring the variations in the effective multiplication coefficient of the G-1 as a consequence of a given change in its geometry were investigated. (auth)

7978 AERE-R/R-1980
Gt. Brit. Atomic Energy Research Establishment, Harwell, Berks, England.
AN ANALYSIS OF POWER, TEMPERATURE AND REACTIVITY TRANSIENTS IN B.E.P.O. D. V. Wordsworth. Sept. 1953. Decl. with Amendments Feb. 2, 1956. 20p.
Revised version of AERE-E/R-1245.
A method has been found which enables power-temperature transients to be calculated with fair accuracy for a BEPO-type pile. Maximum power and minimum temperature estimates are satisfactory. (F.S.)

9827 AECD-3979
Oak Ridge National Lab., Tenn.
THE EFFECT OF GAPS ON PILE REACTIVITY. S. Tamor. July 14, 1952. Decl. with deletions Dec. 1, 1955. 18p. Contract W-7405-eng-26. $0.20(OTS).
The variation of the reactivity of a pile as a function of width of a transverse gap is obtained. The method involves first finding the boundary condition satisfied by the flux at the gap face. This, in principle, provides enough information for a complete solution of the pile equations. A method for calculating the reactivity change is presented. The calculated reactivity is compared with experiment and a brief discussion of the validity of the approximations is given. (auth)

9877 CF-55-10-45
Oak Ridge National Lab., Tenn.
PRESSURE RISE IN TBR FOLLOWING RAPID ADDITION OF REACTIVITY. M. W. Rosenthal. Oct. 14, 1955. Decl. Feb. 20, 1956. 25p. Contract [W-7405-eng-26]. $0.25 (OTS).
In order to provide information for evaluation of hazards associated with operation of the TBR, the peak pressure rise which would occur in the reactor core during a power excursion has been related to rate of reactivity addition and equivalent instantaneous reactivity addition. The reactivity increase engendered by a rapid reduction in heat-exchanger steam pressure has been obtained as a function of rate of change in boiling temperature. From these results, the magnitude of the core pressure surge that would follow a specified decrease in steam pressure can be estimated.

6988 WAPD-RM-187
Westinghouse Electric Corp. Atomic Power Div., Pittsburgh.
CVR PRESSURIZER SIMULATOR STUDY. W. M. Gajewski and J. N. Grace. July 1953. Decl. Nov. 22, 1955. 34p. Contract AT-11-1-GEN-14. $0.25(OTS).
The response of the primary coolant pressurizing system to rapid changes in steam plant load is studied by means of analog computer techniques. Results are plotted for a range of values of the pressurizer design parameters. (auth)

6390 CF-54-4-182
Oak Ridge National Lab., Tenn.
REACTIVITY EFFECTS OF NON-UNIFORM DENSITY

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MISCELLANEOUS AND COMBINED CAUSES –

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CHANGES IN HRT. V. K. Pare'. Apr. 26, 1954. Decl. Dec. 19, 1955. 26p. Contract [W-7405-eng-26]. $0.25(OTS).

Calculations and results are presented for reactivity changes resulting from varied non-uniform fuel and blanket density variations. (T.W.S.)

5362 AECD-4041
North American Aviation, Inc., Downey, Calif.
POISON TRANSIENT AFTER POWER CUTBACK AND ITS EFFECT ON REACTIVITY. C. Roderick. May 14, 1952. Decl. Jan. 16, 1956. 12p. Contract [AT-11-1-GEN-8]. (NAA-SR-Memo-314). $3.30(ph OTS); $2.40(mf OTS).

The Xe^{135} and Sm^{149} transients due to rapid power outbacks and the effects of these transients on reactivity are studied and presented in a general manner, so as to be applicable to the UPR for U- and Pu-producing cores.

MISCELLANEOUS AND COMBINED CAUSES –

Transients – Effects 4.03.08.05 .02

2550 GEAP-3073
General Electric Co. Atomic Power Equipment Dept., San Jose, Calif.
METAL–WATER REACTIONS. I. A METHOD FOR ANALYZING A NUCLEAR EXCURSION IN A WATER COOLED AND MODERATED REACTOR. E. Janssen, W. H. Cook, and K. Hikido. May 1, 1958. 50p. Contract AT(04-3)-189. $1.25(OTS).

An approximate method for analyzing the effects of a nuclear excursion in a water cooled and moderated reactor was developed. This analysis is based on idealized models of the reactor which represent the salient features of the system under investigation; and consists of simultaneously solving ten equations. The primary nuclear shutdown mechanism is the void generated in the liquid moderator due to vaporization and radiolytic gas formation. To evaluate this method of analysis it is applied to the Borax I and Spert I reactors. A comparison of the analytical and experimental results indicates reasonable agreement between calculated and experimental data, but suggests that refinements in the method and input parameters are required. This formulation was prepared as the first step in analyzing the effects of a serious nuclear incident in a water cooled and moderated reactor. The continuing program will consist of improving this model and applying the resulting techniques to particular reactor designs to determine the total weight, temperature, and dispersion of molten metal in the core as a function of time. These results will permit evaluation of the extent of a metal water reaction initiated by a nuclear incident. (auth)

2139 GEAP-3178
General Electric Co. Atomic Power Equipment Dept., San Jose, Calif.
METAL–WATER REACTIONS: II. AN EVALUATION OF SEVERE NUCLEAR EXCURSIONS IN LIGHT WATER REACTORS. J. I. Owens. June 15, 1959. 34p. Contract AT(04-3)-189. OTS.

An evaluation of the power and temperature versus time histories of three typical water-cooled and moderated reactors during a nuclear excursion was made by applying a previously reported method of analysis. These reactors are characterized by one of the following types of fuel elements: U–Al alloy, highly enriched, aluminum jacketted, flat plate; U–Zr alloy, highly enriched, zirconium clad, flat plate; and UO_2, slightly enriched, zirconium clad rods. The validity of the method of analysis was evaluated by comparing the results with experimental data derived from the BORAX I and SPERT I tests. The effects of varying some of the input data, such as heat transfer coefficients, and of considering various nuclear shutdown mechanisms were also obtained. (auth)

7122 ANL-4971
Argonne National Lab., Lemont, Ill.
TECHNICAL REVIEW OF ZPR-I ACCIDENTIAL TRANSIENT—THE POWER EXCURSION, EXPOSURES, AND CLINICAL DATA. R. O. Brittan, R. J. Hasterlik, L. D. Marinelli, and F. W. Thalgott. Jan. 26, 1953. Decl. Mar. 28, 1957. 132p. Contract W-31-109-eng-38. OTS.

On June 2, 1952, a large reactivity change was made manually in a ZPR-1 assembly causing a power excursion of about one kwh, which resulted in damage to the reactor core components and radiation exposure of some of the op-

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erating personnel to perhaps several hundred rep. A description is presented of the incident, estimates are made of the exposures, and early clinical data are summarized.

7080 IDO-16551
Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho.
MISCELLANEOUS TESTS WITH THE SPERT I REACTOR. G. O. Bright and S. G. Forbes. Oct. 23, 1959. 17p. Contract AT(10-1)-205. OTS.
Presented at American Nuclear Society Meeting, June 1957.
Several experiments were performed in the Spert I reactor which have not been reported elsewhere. These include the determination of the power coefficient of reactivity in the boiling reactor, the effect of changes in moderator properties, starting power, and static water head over the core on power excursion behavior; and the performance of a transient power excursion with a 5 msec period. Results of these tests are presented in descriptive and graphic form. (auth)

SYSTEM AND INSTRUMENTATION 4.03.08.06

6724 A/CONF.15/P/1207
NOUVELLE METHODE DE MESURE DES FLUX DE NEUTRONS DANS LES REACTEURS ATOMIQUES. (A New Detector for the Measurement of Neutron Flux in Nuclear Reactors.) Lydie Koch, Jacques Labeyrie, and Serge Tarassenko (Commissariat à l'Énergie Atomique, Paris). 16p.
The detector described is designed for the instantaneous measurement of thermal neutron fluxes, in the presence of high γ activity; this detector can withstand temperatures as high as 500°C. It is based on the principle that radioactive atoms resulting from heavy-nucleus fission in the detector are carried by a gas flow to a detector recording their β and γ desintegration. Thermal neutron fluxes as low as few neutrons per cm^2 per second can be measured. This detector may be used to control a nuclear reactor and to plot the thermal flux distribution with an excellent definition (1 mm^2) for fluxes higher than $10^8 n/cm^2/sec$. The time response of the system to a sharp variation of flux is limited, in the case of large fluxes, to the transit time of the gas flow between the fission product emitter and the detector; of the order of one tenth of a sec per meter of piping. The detector may also be used for spectroscopy of fission products older than 0.1 sec. (auth)

7085 A/CONF.15/P/56
NEUTRON FLUX INSTRUMENTATION FOR RESEARCH AND POWER REACTORS: A REVIEW OF PRESENT METHODS AND NEW DEVELOPMENTS. W. Abson, R. J. Cox, and A. L. Gray (Atomic Energy Research Establishment, Harwell, Berks, Eng.). 30p.
The range of applications and limitations of existing types of equipment used in the U.K.A.E.A. reactors is considered, and the extent is indicated to which new developments in the design of detectors and of d-c ionization chambers and pulse-counting equipment may improve the range of measurement and reliability of neutron flux monitoring systems. (W.D.M.)

6037 NAA-SR-4434
Atomics International Div., North American Aviation, Inc., Canoga Park, Calif.
COUPLED DIAPHRAGM SAFETY DEVICE FOR POWER REACTORS. L. E. Johnson. Jan. 15, 1960. 34p. Contract AT-11-1-GEN-8. OTS.
Laboratory experiments were performed in the development of a coupled diaphragm trigger for a power reactor safety device. The coupled diaphragm trigger is a neutron flux sensor which, at excessive flux levels, will trip the safety device and cause reactor shutdown. Experimental results indicate that mechanically coupled diaphragms can be employed in a safety device trigger to minimize the effects of ambient temperature on the trip point. Temperature tests of the trigger components indicated satisfactory performance at temperatures up to 1200°F. Tests of a prototype trigger at room temperature indicate a response time of about 1 second. On the basis of the component tests, a prototype safety device suitable for in-pile testing was designed and fabricated. Though additional testing is necessary, the coupled diaphragm trigger is quite promising as an acceptable and workable component of a safety device. (auth)

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8239 BMI-1231
Battelle Memorial Inst., Columbus, Ohio.
NEUTRON-FLUX MEASUREMENTS IN A FLAT PLATE FUEL ELEMENT. Walter R. Morgan, James N. Anno, Jr., and Joel W. Chastain, Jr. Oct. 31, 1957. Decl. Dec. 3, 1959. 50p. Contract W-7405-eng-92. OTS.

The equipment and experiments performed to measure the thermal-neutron-flux distribution in a fuel assembly of an experimental loop mock-up of a gas-cooled reactor at the Battelle Research Reactor (BRR) are described. The loop was located adjacent to the core of the BRR and contained one fuel assembly composed of seven flat fuel plates each containing approximately 29.5 g of U^{235}. The plates consisted of a core 0.050 in. thick of UO_2 dispersed in Type 347 stainless steel and clad on each side with 0.005 in. of Type 347 stainless steel. The measurements showed that with the present design of the loop system an average thermal-neutron flux of 4.09×10^{12} neutrons/(cm^2)(sec) or a power generation of 45 kw in the assembly can be conveniently obtained. The ratio of the peak thermal-neutron flux to average thermal flux in the entire element was found to be 1.87. At any horizontal cross section, thermal-flux depression from the edge of the element to the center of less than a factor of two was observed for the final loop-core arrangement. (auth)

6751 A/CONF.15/P/2084
BORON IONIZATION CHAMBERS FOR WORK IN NUCLEAR REACTORS. A. B. Dmitriev (U.S.S.R.). 9p.

Boron ionization chambers are used in nuclear reactor control and protective systems to measure the intensity of slow neutron fluxes. The ionization current in the chamber resulting from the $B^{10}(n,\alpha)Li^7$ reaction is the measure of the neutron flux intensity. The various instruments described fall into two groups: working chambers serving to control reactors within the nominal power measurement range and triggering chambers operating as the reactor power rises from zero to nominal. (W.D.M.)

7112
CONTROL DEVICE. J. J. Dickson (to U. S. Atomic Energy Commission). U. S. Patent 2,904,487. Sept. 15, 1959.

A bimetallic helix is described comprising a neutron-flux-responsive strip and a second strip having the same coefficient of thermal expansion for adjusting the extent to which an inner neutron-absorbing member protrudes from an outer hollow neutron-absorbing member.

NEUTRONIC REACTOR MEASURING AND SAFETY ROD OPERATING APPARATUS. L. B. Borst and H. W. Newson. (to U. S. Atomic Energy Commission). U. S. Patent No. 2,741,592, Apr. 10, 1956.

A simple, reliable safety device applicable to an air-cooled neutron reactor is described. A gas capable of sustaining a measurable radioactive half life, e.g., air, a suitable component of which is argon, is blown through tubes transversing a reactor, resulting in the formation of A^{41}. The radioactive level of the A^{41} is proportional to the neutron density within the reactor and may be accurately measured by normal means, for in instance, an ionization chamber. When the detecting indicator signals a rise of radioactive argon over a predetermined level a safety rod drive system is actuated shutting down the reactor. (auth)

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9603 ORNL-2121
Oak Ridge National Lab., Tenn.
REMOTE CONTROL OF THE LITR. J. A. Cox, L. C. Oakes, and W. H. Tabor. Aug. 15, 1956. 37p. Contract W-7405-eng-26. $0.30(OTS).

A remote control system has been installed which allows control of both the LITR and Graphite Reactor by one operator in the Graphite Reactor control room. Block diagrams of the system are given, and its operation is discussed. (D.E.B.)

6753 A/CONF.15/P/2103
COMPLETE AUTOMATION OF NUCLEAR REACTOR CONTROLS BY MEANS OF AN AUTOMATICALLY MOVED DETECTOR. P. Kovanic and M. Kulka (Czechoslovakia). 17p.

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An analysis is made of the properties of the safety and signalization circuits of reactors, based on the use of a detector automatically moved so as to be always in a position where there is a constant neutron flux, irrespective of the immediate power of the reactor. Such circuits may consist of simple elements and may by themselves check their own correct functioning. The properties of the control systems based on the principle of the automatic control of the reactor power according to the movement of the detector are examined. Systems are designed for the automatic starting of the reactor from subcritical state, for reaching the predetermined power by the chosen period, and for the control of the power. Compact schemes of automatic reactor control may be obtained by supplementing this equipment by independent signalization circuits with an automatically transferred detector. (auth)

7203 A/CONF.15/P/55
KINETIC AND CONTROL OF THE BERKELEY REACTORS. J. M. Yellowlees and P. R. J. French (AEI-John Thompson Nuclear Energy Co., Ltd., Knutsford, Ches., Eng.).

Requirements are listed for the over-all plant load control system. To meet these conditions the design of the over-all control system must be coordinated with that of the plant mechanical details, reactor protection system, and station electrical system. The design of the control and protection system of the Berkeley Nuclear Power Station is summarized, and certain characteristic reactor transient conditions are described. (W.D.M.)

7208 A/CONF.15/P/85
THE OVERALL CONTROL OF NUCLEAR POWER STATIONS OF THE GAS-COOLED THERMAL REACTOR TYPE. R. J. Smith (General Electric Co. Ltd., Erith, Kent, Eng.). 32p.

The location of control facilities is briefly discussed, and basic operational requirements are reviewed. The influence of the plant on part-load operating conditions and permissible transient performance is emphasized, and typical part-load characteristics are quoted. In a section on the main control elements, the choice of coolant circulator systems is discussed in some detail. Requirements to ensure trip-free operation and safe control apparatus are listed, and power cut-back advocated. Typical automatic control arrangements are analyzed. (auth)

8667 ORNL-2085
Oak Ridge National Lab., Tenn.
ADMINISTRATIVE CONTROL OF A RESEARCH REACTOR. J. A. Cox. Aug. 10, 1956. 7p. Contract W-7405-eng-26. $0.10(OTS).

In addition to instrument control over the reactor and experiments, safe operation requires strong administrative control. In 12 years of operation of the Graphite Reactor and five years of operation of the Low Intensity Test Reactor at Oak Ridge National Laboratory, no serious incidents have occurred. Administrative controls used to safeguard the reactors and personnel without undue interference with experiments are described, along with some of the hazards encountered in operation of research reactors. (auth)

5440
THE CHANGING PHILOSOPHY OF REACTOR SAFETY CONTROL. Frank Larin and Albert B. Van Rennes (Bendix Aviation Corp., Detroit). p. 371-6 of "Nuclear Electronics. I." (In English)

The four techniques or methods employed by reactor designers to improve control system reliability are failure-to-safety circuits, redundancy and coincidence circuits, monitoring and test circuits, and reliable components. These techniques are examined and some of the approaches made to improve reliability are illustrated. The development of power reactors has increased the need for reliability of safety control, but also requires that shutdowns be prevented except when necessary. These requirements of power reactors have shifted the reliance on failure-to-safety, redundant, and monitoring circuits to reliance on coincidence circuits, test circuits, and the use of solid state components. The interest of the designer in safety control has expanded to include the primary coolant system, the steam system, and the turbines. (J.S.R.)

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4966 HW-42552
General Electric Co. Hanford Atomic Products Operation, Richland, Wash.
HANFORD CONTROL INSTRUMENTATION AND PROCEDURES. G. C. Fullmer. Apr. 6, 1956. Decl. Oct. 7, 1959. 13p. Contract W-31-109-Eng-52. OTS.

Technical bases, operating standards, and instrumentation systems required to achieve the goal of nuclear safety in the operation of high-level reactors are discussed. Because of the relatively long neutron lifetime in a thermal reactor and the comparatively modest time rates of reactivity change associated with fission poison and temperature effects, the rod system used for compensating reactivity transients and for maintaining flux distribution control may be operated manually. Manual operation of the reactor and the prediction of pile reactivity status during outages of course involve factors of human error, normal reaction time, and judgment. Technical considerations used in developing safety standards for reactor manual control are discussed relative to monitoring and automatic trip devices. (auth)

5400
L'ELECTRONIQUE NUCLEAIRE. I. COMPTES RENDUS DU "COLLOQUE INTERNATIONAL SUR L'ELECTRONIQUE NUCLEAIRE" ORGANISE PAR LA SOCIETE FRANCAISE DES RADIOELECTRICIENS, PARIS, 1958. (Nuclear Electronics. I. Proceedings of the International Symposium on Nuclear Electronics Organized by the French Society of Radioelectricians, Paris, 1958). Vienna, International Atomic Energy Agency, 1959. 45p.

The proceedings of the symposium on nuclear electronics held in Paris in 1958 are presented. The session subjects were scintillation radiation detectors, ionization radiation detectors and gamma spectrometers, pulse technique: fast electronics, pulse technique: classical electronics, reactor control: measurements, reactor control: simulation, equipment for prospection and protection, centralization and exploitation of results, and transistorized equipment, standardization, and components. Separate abstracts have been prepared on each paper. (J.S.R.)

CONTROL OF NUCLEAR REACTORS AND POWER PLANTS. M. A. Schultz. New York-Toronto-London, McGraw-Hill Book Co., Inc., 1955. 313p.

Progress in nuclear control is treated in elementary servo form and language. For descriptive and illustrative purposes on the design of control systems, the solid fuel heterogeneous reactor is used for a model but the basic techniques for the solution are presented in such a manner that the design of control systems for other types of reactor plants may be obtained by extension of the methods presented.

3159 NAA-SR-Memo-4103
Atomics International Div., North American Aviation, Inc., Canoga Park, Calif.
INSTRUMENTATION AND CONTROL OF THE OMR CRITICAL REACTOR. H. W. Slocomb. July 9, 1959. 17p. OTS.

The circuits and control equipment used on the OMR Critical Reactor are discussed along with the considerations involved in the selection of these components, and the operating experience to date. (W.L.H.)

7140
CONTROL CONSIDERATIONS FOR HIGH BURN-UP. R. I. Vaughan ([Atomic Energy Research Establishment, Harwell, Berks, Eng.]). Nuclear Eng. 5, 10-13(1960) Jan.

Control considerations are discussed for high burn-up power reactors operable at steady states within a large power range. The power reactor is controlled primarily by moving the control rods, by varying the coolant flow rate, and by varying the settings of the governor valves which admit steam to the turbines. Characteristic instabilities introduced by each type of control are discussed, and moderator temperature coefficients, xenon burnup, and flux depressions are indicated. (B.O.G.)

8596
IMPROVEMENTS IN OR RELATING TO INSTRUMENTATION FOR NUCLEAR REACTORS. William Laws (United Kingdom Atomic Energy Authority). British Patent 827,436. Feb. 3, 1960.

A reactor safety device is described which co-relates signals from a neutron flux meter and a hot-wire anemometer in the coolant inlet duct. The anemometer has a Pt winding which, with a Manganin resistor, makes up a transformer the secondary of which provides output for

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amplifier positive feedback. The amplifier is a conventional type. The feedback causes oscillation in the amplifier which warms up the Pt winding so that its resistances approach that of the Manganin resistor. When the two resistances are equal, the loop gain in the oscillating circuit drops and the power supplied to the Pt coil is reduced until stable conditions obtain. With the temperature constant, changes in heat transfer between coolant and Pt winding cause changes in power supplied to the winding. A voltage corresponding to this power is combined with the flux meter output to produce a signal which is compared with an alarm signal. (T.R.H.)

9234

METHOD AND APPARATUS FOR NUCLEAR REACTOR SAFETY CONTROL. (to U. S. Atomic Energy Commission). British Patent 823,672. Nov. 18, 1959.

A reactor safety device is described. It consists of a means shaped like a fuel element to inject neutron absorbing fluid into the reactor when an unsafe condition exists. A vessel of BF_3 under pressure is connected to a low-pressure vessel by a solder plug. A uranium heater melts the solder plug at 221°C. In normal reactor operation a thermal resistance pad acts as a heat bypass so that the device is triggered only when the U heater heats up due to increased neutron flux. (T.R.H.)

7253 A/CONF.15/P/1200

LA REGULATION DE LA CENTRALE NUCLEAIRE E D F. 1. (Control of the EDF.1 Power Plant). Deloux and Laurent (Electricité de France, Paris). 21p.

The EDF.1 nuclear power plant was designed to supply the French general network with electrical energy. It operates, as a rule, at full power, but it was designed to be as versatile as a classical steam plant. This consideration imposes the use of an automatic control system to assure its correct functioning in normal operation, the utilization of automatic sequences to reduce the charge, and the placing in service of auxiliaries in the case of an incident. A survey is given of the way in which the problem is presented, the means used to study the problem, and the results obtained with respect to the control system adopted and the operations to provide for conditions created by incidents. (J.S.R.)

1642 ✓ ORNL-2787

Oak Ridge National Lab., Tenn.

INSTRUMENTATION AND CONTROLS DIVISION ANNUAL PROGRESS REPORT FOR PERIOD ENDING JULY 1, 1959. Nov. 2, 1959. 152p. OTS.

Instrumentation and controls development for various projects is summarized. Among the items reported on are a 2048 channel neutron time-of-flight analyzer, a versatile instrument camera with a microsecond electronic shutter, grid current in electrometer tubes, personal radiation monitor, systems analysis, additions and modifications to the instrumentation of the Fission Products Pilot Plant, instruments and controls for the Maritime Ship Reactor pressurized water experiment in the ORR, and Homogeneous Reactor Project instrumentation and controls. (For preceding period see ORNL-2647). (W.D.M.)

4895

THE OCCURRENCE AND CONTROL OF SPATIAL INSTABILITIES IN LARGE REACTORS. R. L. Carstairs and R. W. Taylor. G.E.C. Atomic Energy Rev. 2, 89-97 (1959) Sept.

The reasons for the possible occurrence of regional instabilities in large reactor cores are discussed. A review of the basic behavior and control concepts of a reactor is given, and the techniques of analysis available to describe the spatial effects are considered. These techniques are illustrated with a review of a modal analysis of radial and azimuthal core behavior, involving the use of a large analogue computer. The importance of a suitable reactor control system is emphasized. In general, analyses show that instabilities can occur, but they are of relatively long-term time behavior and can easily be controlled using existing techniques. (auth)

7098

REACTOR CONTROL. John Jerome Goett. British Patent 817,755. Aug. 6, 1959.

A reactor safety control device is described. It consists of a rotating flywheel which has neutron-absorbing balls arranged in buckets around the perimeter. When an unsafe

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condition in the reactor demands immediate shutdown, electrically operated gates on the buckets are opened allowing the balls to be centrifugally injected into channels in the reactor core. (T.R.H.)

5452

THE APPLICATION OF THE SECOND METHOD OF LIAPUNOV TO THE STUDY OF THE AUTOMATIC CONTROL SYSTEMS OF NUCLEAR REACTORS. M. Marinescc and V. M. Popov (Ecole Polytechnique, Bucharest). p.29-37 of "Nuclear Electronics. II." (In French)

Liapunov's second method is applied to the study of the stability of reactors and the study includes the supplementary automatic control system. The equilibrium state of a thermal reactor described by the equation $dn/dt = \rho/\tau\, n$, where n is density of thermal neutrons, ρ is reactor reactivity, and τ is the average thermal neutron life in a reactor with finite dimensions, is defined and the stability of this equilibrium state is examined. The non-linear oscillations appearing in the control, the effect of a corrector signal proportional to the reactivity, and the effect of delayed neutrons are examined. (J.S.R.)

5443

DEVELOPMENT OF THE CONTROL OF THE G-2 REACTOR. C. Di Giacomo. p. 401-11 of "Nuclear Electronics. I." (In French)

The G-2 reactor is a natural uranium reactor, graphite moderated and cooled with carbon dioxide. As it is a plutonium breeder, the neutron flux must be maintained near its maximum. The equations for the transfer functions are derived, and the control rods, the drive motor, and the control amplifier are discussed with reference to these functions. The development of the amplifier is considered. The safety circuits are given for manual and automatic control. (J.S.R.)

8267

NUCLEAR REACTOR CONTROL SYSTEM. E. P. Epler, S. H. Hanauer, and L. C. Oakes (to U. S. Atomic Energy Commission). U. S. Patent 2,911,344. Nov. 3, 1959.

A control system is described for a nuclear reactor using enriched uranium fuel of the type of the swimming pool and other heterogeneous nuclear reactors. Circuits are included for automatically removing and inserting the control rods during the course of normal operation. Appropriate safety circuits close down the nuclear reactor in the event of emergency.

5451

AUTOMATIC CONTROL OF A RESEARCH REACTOR. G. J. R. Mac Lusky (Atomic Energy Research Establishment, Harwell, Berks, Eng.). p.19-27 of "Nuclear Electronics. II." (In English)

The LIDO is a swimming pool enriched uranium research reactor. It became necessary to provide automatic control with minimum modifications to the existing units. A block diagram of the resulting system is given. The only added unit is the modulator-amplifier which takes d-c signals from both deviation amplifier and period meter and gives a-c output proportional to their sum. The circuit of the modulator-amplifier unit is given. The feedback circuit of the second amplifier in the deviation amplifier was modified. The performance of the system was tested and the results are given. (J.S.R.)

4762

NRU REACTOR NEUTRON LEVEL CONTROL SYSTEM. C. G. Lennox and A. Pearson (Atomic Energy of Canada Ltd., Chalk River, Ont.). IRE Trans. on Nuclear Sci. NS-5, No. 2(1958) Aug.

A control system was developed for the NRU reactor which performs automatic start-up as well as steady power control. The system characteristics and the circuits which determine them during start-up and under steady power control are described. (auth)

IMPROVEMENTS RELATING TO SAFETY SYSTEMS FOR NUCLEAR REACTORS. Anthony Edward Thomas Nye (to The British Thomson-Houston Co., Ltd.). British Patent 811,600. Apr. 8, 1959.

A relay system for shutting down a reactor in the event of an accident or failure is described. The system is so arranged that a power failure would not shut down the reactor. (T.R.H.)

5999

COOLANT INSTRUMENTATION FOR PRESSURIZED WATER REACTOR POWER PLANTS. J. J. Lihota and

EFFECTS OF REACTOR ENVIRONMENT ON MATERIALS 4.03

REACTIVITY CHANGES AND CONTROL 4.03.08

SYSTEM AND INSTRUMENTATION – GENERAL 4.03.08.06.02

C. B. Hoppa (Westinghouse Electric Corp., East Pittsburgh, Penna.). Commun. and Electronics No. 42, 131-6 (1959) May.

The advantages and problems encountered in the use of magneto-amplifier instruments in coolant control are described. Circuit diagrams are given, and the use of basic modules such as the bridge, demodulator, self-balancing amplifier, bistable controller, and summing modules are explained. Circuit diagrams are given for typical differential transformer instruments and master shutdown controller channels. The positioning of detectors for effective coolant system instrumentation is discussed. (C.J.G.)

AUTOMATIC PERIOD CONTROL OF THE RALEIGH RESEARCH REACTOR. Harold A. Lamonds (North Carolina State Coll., Raleigh). Nucleonics 14, No. 3, 88, 90-4(1956) Mar.

A special electronic circuit permits the reactor to be brought automatically up to any desired level of operation on one of several preselected periods. When the desired power level has been reached, the automatic control system holds the level constant. This circuit, called the "automatic period control" is described. (auth)

SYSTEM AND INSTRUMENTATION – Pressure Sensors 4.03.08.06.03

5672 NAA-SR-3867
Atomics International Div., North American Aviation, Inc., Canoga Park, Calif.
DIFFERENTIAL PRESSURE SAFETY DEVICE. R. Holland. Jan. 15, 1959. 34p. Contract AT-11-1-GEN-8. OTS.

A safety device was developed for power reactors that utilizes the differential pressure between two chambers as a triggering mechanism. Two contained volumes of gas are separated by a rupturable diaphragm. One volume is heated by a fission source. Although the pressure in both chambers is a function of ambient temperature, the differential pressure is a function of the output of the fission heat source only. Thus, the triggering mechanism is independent of ambient temperature, but directly dependent on neutron flux. Tests were conducted to demonstrate the feasibility of rupturing a diaphragm with the differential pressure between two chambers. An electrical heater in one chamber was powered by a generator, which provided a voltage exponential in time, to simulate the heat generated by a fission heater during reactor excursions. Diaphragms with up to 7-atm burst pressures were ruptured on simulated reactor transients. The device time response was investigated by measuring the device thermal relaxation time for several pressurizing gases. Thermal relaxation times were approximately $1\frac{1}{2}$, $2\frac{1}{2}$, and 4 sec for helium, argon, and carbon dioxide, respectively. Poison dispersal studies were conducted to measure poison distribution and transfer time. In a typical case for a powdered boron charge of 10.5 grams dispersed into a 3-in. diam. tube, the boron reached the end of a 3-ft tube 13 millisec after trip. A disadvantage of the basic differential pressure device is an inadequate supply of energy for an effective chamber volume. Two modifications of the basic design have evolved. One provides the propulsion energy from the exothermic reaction of boron and fluorine. The other utilizes the sum of the pressures of the two chambers rather than the difference to propel the poison. (auth)

1334
DIFFERENTIAL PRESSURE GAUGE FOR USE WITH LIQUIDS AND CORROSIVE FLUIDS. H. E. Flotow, B. M. Abraham, and R. D. Carlson (Argonne National Lab., Lemont, Ill.). Rev. Sci. Instr. 29, 869-70(1958) Oct.

A sensitive, rugged pressure gauge is described that was developed to determine the density (composition) and the viscous pressure loss in flowing streams of UO_2-NaK slurries. The differential pressure sensors are two metal bellows that are rigidly connected in opposition, the net displacement of which is detected by a linear variable differential transformer. The sensitivity of the unit is 0.05 mm Hg pressure and the range is 100 mm Hg with an accuracy of ±0.4%. By simply inserting various calibrated springs in the instrument it is possible to increase or decrease the range and maintain the sensitivity at 0.05% of the range. (auth)

8970 CF-53-2-112
Oak Ridge National Lab., Tenn.
BOILER REACTOR OPERATION: PART II–REACTOR

EFFECTS OF REACTOR ENVIRONMENT ON MATERIALS 4.03

REACTIVITY CHANGES AND CONTROL 4.03.08

SYSTEM AND INSTRUMENTATION – Pressure Sensors 4.03.08.06.03

GOVERNORS. P. R. Kasten. Feb. 12, 1953. Decl. Nov. 30, 1955. 12p. Contract [W-7405-eng-26]. $0.15(OTS).

Boiling reactors can be automatically regulated so as to satisfy varying power demand. A flexible control system consists of a shielded fuel reservoir maintained at constant pressure connected to the reactor core, in combination with a core-pressure-control valve which regulates the flow of steam by-passing the turbine. (auth)

SYSTEM AND INSTRUMENTATION – Temperature Sensors 4.03.08.06.04

7614

THERMAL COUPLE FOR MEASURING TEMPERATURE IN A REACTOR. W. Kanne (to U. S. Atomic Energy Commission). U. S. Patent 2,914,594. Nov. 24, 1959.

A thermocouple device for measuring the temperature of a flowing fluid in a conduit within which is positioned a metallic rod is presented. A thermocouple junction is secured to the rod centrally, and thermal insulating support disks having a diameter greater than the rod are secured to the end portions of the rod and adapted to fit transversely in the conduit.

7557

A GRAPHITE/GRAPHITE THERMOCOUPLE FOR HIGH TEMPERATURES. A. R. Ubbelohde, L. C. F. Blackman, and P. H. Dundas (Imperial Coll. of Science and Tech., London). Chem. & Ind. (London) No. 19, 595-6(1959) May 9.

The limiting value in the a-axis direction for ideal graphite crystals was determined to be $-3\mu v$ per °C at 20°C. The design of a thermoelectric power unit for high-temperature work is given. The thermo-junction at the hot end is formed between pyrolytic graphite highly oriented with respect to the a-axis and polycrystalline graphite which was exposed to 2500°C for several hours. The bulk density of the material is 1.6 g/ml. The voltage output of the apparatus is given for exposure of the hot junction of the couple to 0 to 2400°C. (C.J.G.)

4935 AECU-4515

Duquesne Light Co., Shippingport, Penna.

PERIODIC INTERCALIBRATION OF TEMPERATURE SENSING ELEMENTS. SECTION I. SECOND PERFORMANCE. Test Results DL-S-243 (T-641303). First issue, Nov. 9, 1959. 28p. OTS.

Studies were made to determine the direction and magnitude of any drift in the temperature sensing elements and the receiver-indicating units for the primary loop and pressurizer resistance thermometers. Studies were also made to obtain intercalibration data for various temperature sensing elements in the primary coolant system. Of the 62 core thermocouples observed 19 were either reading less than 400°F or were reading in excess of 20°F from the calibrating thermometer temperatures. In each case the thermocouple was considered defective. The remainder were reading within 2% of the calibrating thermometers. The primary loop resistance thermometers all read within 2% of the calibrating thermometers. No conclusions could be made for the pressurizer temperature instruments or the boiler T_h resistance thermometers, except that the 1A boiler temperature varied 10 to 20°F from the 1B and 1C boiler temperatures. The data obtained from the source range nuclear instrumentation were too erratic to form any conclusion. (W.L.H.)

8599

IMPROVEMENTS IN OR RELATING TO ENERGY-DETECTORS. (to Philips Electrical Industries, Ltd.). British Patent 828,307. Feb. 17, 1960.

A transistor radiation-heat detector and circuit are described. As radiation increases above a fixed level, the cut-off bias of the base of the transistor is exceeded and collector current rises sharply. The base of the transistor is connected through an impedance which is high with regard to base-emitter forward resistance, but low for base-emitter reverse resistance. The device may be used to operate a relay or a meter. (T.R.H.)

4912

IMPROVEMENTS IN OR RELATING TO NUCLEAR REACTORS Roy Jackson Smith (to General Electric Co., Ltd.). British Patent 822,415. Oct. 28, 1959.

A nuclear power plant control scheme is offered in which reactor temperature is maintained constant by regulation of neutron flux and coolant flow. The two signals for these regulations are adjusted with respect to one another by a manually operated trimmer control. This is accomplished by a pair of ganged potentiometers and a flux-flow recorder. Thus power output is adjusted in accord with power demand. (T.R.H.)

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SYSTEM AND INSTRUMENTATION – Temperature Sensors 4.03.08.06.04

732 NACA-TN-4383
Lewis Flight Propulsion Lab., Cleveland.
A COOLED-GAS PYROMETER FOR USE IN HIGH-TEMPERATURE GAS STREAMS. Lloyd N. Krause, Robert C. Johnson, and George E. Glawe. Sept. 1958. 33p.

An immersion-type pyrometer is described which utilizes the controlled cooling of a continuously aspirated sample of the gas whose temperature is to be measured. The gas is cooled as it is drawn through a tube, after which its temperature is measured with a thermocouple. Free-stream total temperature is then obtained by a relation involving internal heat transfer in the tube, gas properties, and certain readily measured temperatures and pressures. Experimental data were obtained with the cooled-gas pyrometer in a 2000 to 4000°R gas stream. (auth)

3149 NAA-SR-Memo-3241
Atomics International Div., North American Aviation, Inc., Canoga Park, Calif.
METHODS FOR CALCULATING THE HEAT GENERATED IN A REACTOR CORE. H. O. Whittum. Nov. 13, 1958. 14p. OTS.

Methods used to determine the heat generated in the structural materials of the Rover core are described.

XENON 4.03.08.07

6355 AECD-3816
Westinghouse Electric Corp. Atomic Power Div., Pittsburgh.
THE EFFECTIVE XENON CROSS SECTION. H. L. Garabedian and R. R. Schiff. Sept. 1954. Decl. with deletions Dec. 6, 1955. 43p. Contract AT-11-1-GEN-14. $0.30 (OTS).

The notion of effective xenon cross section, as previously defined has been reassessed in the light of several recent advances in reactor theory: (i) use of the window-shade theory in studying partially inserted groups of control rods, (ii) use of the one-dimensional multiregion analogue machine (the GODDESS) in solving criticality problems with a variable absorption cross section, (iii) use of new techniques in evaluating an improved formulation of the effective xenon cross section. The definition of effective xenon cross section appears not only in the maximum xenon override problem but also in the temperature coefficient problem at the time of maximum xenon override, and differences in the interpretation of the definition in these two problems are discussed in detail. Two examples are studied in detail which illustrate the improved techniques developed in this paper for the evaluation of the effective xenon cross section in the maximum xenon override problem. Both examples serve to illustrate the striking effect of the preshutdown power level on the thermal flux distribution at the time of maximum xenon override and reveal convincingly earlier misconceptions on the problem. (auth)

7495
SLIDE RULE SIMPLIFIES XENON COMPUTATIONS. David E. Dickey and John E. McEwen, Jr. (Westinghouse Electric Corp., Pittsburgh). Nucleonics 18, No. 2, 88; 90; 92-3; 95(1960) Feb.

Methods for the calculation of reactivity due to Xe^{135} build-up after reactor shutdown are presented. Differential equations and curves used in the calculations are illustrated along with a slide rule designed for these computations. Procedures are outlined for the use of the slide rule in calculating the reactivity values. Its accuracy is 1 to 2%, which compares favorably with other methods. (B.O.G.

6957 A/CONF.15/P/187(Rev. 1)
ABSOLUTE YIELDS OF THE ISOTOPES OF XENON AND KRYPTON IN THE NEUTRON FISSION OF Pu-239. K. Fritze, C. C. McMullen, and H. G. Thode (McMaster Univ., Hamilton, Ont., Can.). 11p. (AECL-597). $0.25(AECL).

Using isotope dilution techniques and mass spectrometry, absolute yields of the Xe and Kr isotopes in the neutron-induced fission of Pu^{239} were determined. Nine of these yields lead to cumulative yields of the respective mass chains 131, 132, 134, 136, 83, 84, 85, 86, and two give absolute independent yields of the shielded precursors in their respective mass chains, namely I^{128} and I^{130}. (W.D.M.)

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XENON 4.03.08.07

6741 A/CONF.15/P/1627
A XENON POISON COMPUTER. M. M. L. Gulati, V. Mahajan, A. W. Pereira, and J. Ranganath (Atomic Energy Establishment, Trombay, India). 14p.

In this computer, the variations of reactor power are recorded by a strip chart recorder, using conducting ink. On the occurrence of a shutdown, the chart is fed to an automatic curve follower, having a chart speed much higher than that at which the chart was recorded. The curve follower output, which is proportional to the recorded power variations, is used as the driving function of an electronic analog computer operating on an accelerated time scale and synchronized with the curve follower, and this computes the iodine-135 and xenon-135 concentrations as a function of time, up to the moment of shutdown. The computer time scale is then further accelerated, and using the iodine and xenon concentrations previously computed as initial conditions, the buildup and decay of xenon after shutdown is calculated. The results are presented as a curve of reactivity absorbed by the poison against time. (auth)

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7192 A/CONF.15/P/2458
SUR LA STABILITE INHERENTE DES REACTEURS NUCLEAIRES. (The Inherent Stability of Nuclear Reactors.) V. M. Popov (Rumania). 16p.

The most generalized conditions of inherent stability for homogeneous reactors are established. The nonlinear relation existing between the temperature and the reactivity is considered by taking into account the presence of six groups of delayed neutrons. The second method of A. M. Liapounoff is used to construct a function of variables of the system. The results are applied to a consideration of the inherent stability of heterogeneous reactors. (J.S.R.)

5438 ✓
ORIENTATION OF REACTOR CONTROL. CONTROL BY TEMPERATURE ONLY. J. Weill (Centre d'Etudes Nucléaires, Saclay, France). p. 335-42 of "Nuclear Electronics. I." (In French)

The possibility of controlling reactors by temperature alone is examined. Prompt divergence and a too rapid temperature rise are considered. (J.S.R.)

ESTIMATION OF HEAT SOURCES IN NUCLEAR REACTORS. Lloyd G. Alexander (Oak Ridge National Lab., Tenn.). A.I.Ch.E. Journal 2, 177-83(1956) June.

Knowledge of local heating rates is needed for estimation of operating temperatures, thermal stresses, and cooling requirements in nuclear reactor components. Heat is liberated by the dissipation of the energy of fission fragments, beta particles, fast neutrons, and gamma photons. Heating rates are formulated in terms of either neutron or gamma flux densities, the corresponding collision probabilities, and appropriate energy transfer coefficients, the forms of which are given. Special methods of estimating the flux densities are discussed. The data on the magnitudes of the various energy sources are reviewed. (auth)

3226 KLX-1809
Vitro Engineering Co., New York.
STUDY OF NUCLEATION AND BUBBLE DYNAMICS TO EVALUATE VOID SHUTDOWN MECHANISM IN A HETEROGENEOUS WATER MODERATED REACTOR. Vitro Job No. 1238. S. Kaminsky. May 4, 1959. 95p. For Westinghouse Electric Corp. Bettis Atomic Power Div. Subcontract 73-(14-1025). OTS.

A two-fold effort is described which was directed toward the ultimate formulation of a function which can be used to predict void volumes during the "runaway" of a pressurized water reactor. The available literature was utilized and extended in an attempt to resolve the numerous phenomena associated with transient void formations in nucleate boiling. Attention was directed to void formations which occur during nucleate boiling because it is speculated that they are the principal formations present during fast transients in a pressurized reactor. (W.D.M.)

6955 A/CONF.15/P/150
MEASUREMENTS AND CALCULATIONS OF THE TEMPERATURE COEFFICIENT OF THE EFFECTIVE RESONANCE INTEGRAL IN URANIUM METAL AND OXIDE. PART I. P. Blomberg, E. Hellstrand, and S. Hörner (AB Atomenergi, Stockholm). PART 2. S. Brimberg and J. Dahlström (ASEA, Västerås, Sweden). 41p.

The temperature coefficient of the effective resonance integral for U^{238} was determined in the range 20 to 600°C

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for the metal and 20 to 1000°C for UO_2. The samples, placed in a cadmium covered oven, were irradiated at different temperatures in the reflector of the Swedish heavy water reactor, R1. A quantity proportional to the resonance absorption in U^{238} was obtained by measuring the intensity of the 103-kev x-ray line in Pu^{239} following Np^{239} decay. As an S/M-dependence of the temperature coefficient cannot be ruled out from theoretical reasons, the measurements were made with metal rods and oxide pellets with three different diameters ranging from 8 to 28 mm. (auth)

9177

INFLUENCE OF TEMPERATURE ON REACTOR DYNAMICS. [PART] II. G. Kourim. Atomwirtschaft 5, 22-7 (1960) Jan. (In German)

The reactor temperature influences the chain reaction mainly through density changes consequent upon thermal expansion and through changes in the relative velocities of neutrons and atomic nuclei. This becomes evident in the differing course of the temperature dependence of the fission and capture cross-sections of the various reactor and fuel materials. The almost always non-linear relation between temperature and reactivity is described for a few completed installations. The variation with time of the temperature and the influence of temperature on reactor performance are investigated with the aid of a thermal flow diagram for which an electrical circuit diagram was substituted in order to simplify the equations. (auth)

7092

EFFECT OF TEMPERATURE ON REACTOR DYNAMICS. G. Kourim. Atomwirtschaft 4, 533-6(1959) Dec. (In German)

The reactor temperature influences the chain reaction mainly through density changes resulting from thermal expansion and through changes in the relative velocities of neutrons and atomic nuclei. This becomes evident in the differing course of the temperature dependence of the fission and capture cross-sections of the various reactors and fuel materials. The almost always non-linear relation between temperature and reactivity is described for a few completed installations. The variation with time of the temperature and the influence of temperature on reactor performance are investigated with the aid of a thermal flow diagram for which an electrical circuit diagram was substituted in order to simplify the equations. (auth)

9170 HW-63183

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

STEADY-STATE RECIRCULATING REACTOR STABILITY AND OPERATIONAL CHARACTERISTICS—WATER AND METAL TEMPERATURE COEFFICIENTS. C. Wesley Allen. Dec. 23, 1959. 26p. Contract AT(45-1)-1350. OTS.

Limits on the water and metal temperature coefficients are derived to assure stable operation in any recirculating reactor system in which the metal and coolant temperature govern the prompt reactivity feed-back. Within the region of stable operation, relationships between inlet temperature, outlet temperature, reactor power, steam temperature, and exterior reactivity control are derived. For all cases a positive metal temperature coefficient with a positive water temperature coefficient results in unstable operation. When both coefficients are negative, stable operation always results. In the region where the two coefficients differ in sign, the results may be either stable or unstable and analysis must be made to assure stability. (C.J.G.)

9169 DP-452

Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C.

MODERATOR TEMPERATURE COEFFICIENTS IN HEAVY WATER REACTORS. Daniel S. St. John. Dec. 1959. 7p. Contract AT(07-2)-1. OTS.

Reactors that are moderated with heavy water differ from those that are moderated with graphite in that (1) the moderator temperature is lower than it may be in graphite reactors, (2) when the moderator temperature is raised, the moderator-to-fuel ratio decreases, and (3) circulation in the moderator introduces local, random changes in reactivity that distort the flux distribution. The large negative contributions to the moderator temperature coefficient from leakage and resonance capture overshadow any positive contribution from eta that may accompany the buildup of plutonium with exposure. The effect of the coefficient on reactor safety depends upon the manner in which the D_2O circulation couples the reactor power to the moderator temperature. (auth)

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9192
A CRITERION FOR THE DETERMINATION OF REACTOR REGIONS WITH POSITIVE AND NEGATIVE VOID COEFFICIENTS. H. Dušek (Siemens-Schuckertwerke AG, Erlangen, Ger.). Nukleonik 2, 38-39(1960) Jan. (In German)

If a hollow space develops in a critical system (from overheating, for example), the sign of the combined void coefficients of reactivity depends upon the position of the voids in the reactor. In order to answer the question as to the regions with positive and negative void coefficients in the most general form, a reactor geometry with a fitted coordinate system is selected and it is assumed that the unperturbed neutron flux and its corresponding influence function are determined analytically within the limits of an n-group calculation. The calculations are shown. (T.R.H.)

7138
A SIMPLIFIED METHOD OF CALCULATING HEAT IN A PRESSURIZED WATER REACTOR. L. N. Muchnik (Inst. of Complex Transport Problems, Academy of Sciences, Moscow). Inzhener.-Fiz. Zhur., Akad. Nauk Belorus. S.S.R. 2, No. 12, 105-9(1959) Dec. (In Russian)

A method is described for the thermal calculation of a pressurized water nuclear reactor based on the use of nomograms. Formulas for the construction of nomograms are presented. The application of nomograms is illustrated by a concrete example. (auth)

7117 A/CONF.15/P/572
VOID EFFECTS IN BOILING HEAVY WATER REACTORS. V. O. Eriksen (Joint Establishment for Nuclear Energy Research, Kjeller, Norway). 12p.

The results of some experiments on the effects of voids in a heavy water moderated reactor, JEEP, are presented. The voids (air) are introduced into annular gaps around a cylindrical fuel element. The void content is varied with a fixed frequency, and the corresponding power modulation is measured and recorded by a reactor oscillator equipment. Using various positions within the core, the spatial dependence of the void coefficient has been determined. (auth)

7119 A/CONF.15/P/582
A METHOD FOR MEASURING STEAM VOIDS IN BOILING WATER REACTORS. H. Ager-Hanssen and J. M. Dødderlein (Joint Establishment for Nuclear Energy Research, Kjeller, Norway). 8p.

It was found that the thermal neutron flux at the surface of an absorbing rod in a water moderated reactor is highly dependent on the density of the moderator close to the rod. Some experiments to investigate the effect were carried out in a D_2O-moderated reactor. The results indicate the feasibility of utilizing the effect for the construction of a void meter. (auth)

8246
THE BEHAVIOR OF A REACTOR WITH TEMPERATURE SELF-REGULATION. V. N. Andreev, O. D. Kazachkovskiĭ, and N. V. Krasnoyarov. Atomnaya Energ. 7, 363-6(1959) Oct. (In Russian)

The behavior of a reactor regulated by temperature effects is analyzed. Neutrons were divided into two groups; prompt and delayed. It was assumed that in shutdown the contribution of delayed neutrons drops exponentially with the time. (R.V.J.)

7251 A/CONF.15/P/1196
POSSIBILITIES ET LIMITATIONS DU CALCUL ANALOGIQUE POUR LES ETUDES DYNAMIQUES DE CENTRALES NUCLEAIRES. (Possibilities and Limitations of Analogue Methods for Studying the Dynamics of Nuclear Power Stations.) Claude Caillet and Max Deat (Commissariat à l'Énergie Atomique, Paris). 46p.

The analog simulation of nuclear reactor problems except for the simulation of the kinetic equations is discussed. Various problems relative to temperature in a reactor, pipe, exchanger, and turbine are studied, and simulation techniques used by earlier workers are critically reviewed. It is shown the problem of pipe simulators can be solved by the use of specialized simulators which are described. The aspects of rotating machine simulators are discussed, and a simulator requiring both digital and analog methods is described. The thermodynamic problems of nuclear power stations are considered, and an example is given. (J.S.R.)

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3185
NEUTRON TEMPERATURE OF A MODERATOR COMPOSED OF SMALL AREAS OF VARYING TEMPERATURE. Eberhard Kern (Arbeitsgemeinschaft BBC-Krupp, Mannheim, Ger.). Nukleonik 1, 286-90(1959) Oct. (In German)

The moderator, which is present, for example, in a pebble-bed reactor, has the following properties. It is composed of numerous zones with various material temperatures. The zone diameters are smaller than or equal to the free path of the neutrons. With respect to their temperatures, the zones are mixed approximately homogeneously. For such a moderator a uniform neutron temperature is defined which represents the mean value of the material temperatures. In the mean value derivation the roots of the material temperatures are added. (tr-auth)

9876 CF-55-9-172
Oak Ridge National Lab., Tenn.
A PARAMETRIC STUDY OF RATE OF POWER REMOVAL FROM HOMOGENEOUS BOILING REACTORS. L. G. Alexander and S. Jaye. Sept. 20, 1955. 14p. Contract W-7405-eng-26. $0.20(OTS).

Power density for stable operation was calculated for a simple reactor model at pressures in the range from 500 to 2500 psi, reactor heights from 10 to 20 ft., mean density decreases from 0.2 to 0.5, and flow resistance "velocity-heads" from 3.0 to 9.0. At 2000 psi, height of 15 ft., mean density decrease of 0.4, head loss of 4.5, the power density predicted was 18.5 kw/liter for the case where the fission rate is uniform throughout the core. By suppressing fissions in the downcomer, this power density can be approximately doubled. (auth)

REACTOR CONTAINMENT 4.03.09

9836 CF-49-11-152
Oak Ridge National Lab., Tenn.
PRESSURE SHELL AND CLOSURE DESIGN FOR THE HOMOGENEOUS REACTOR. C. L. Segaser. Nov. 15, 1949. Decl. Feb. 14, 1956. 9p. $1.80(ph OTS); $1.80 (mf OTS).

The proposed design for a pressure shell based on a spherical internal shell of 19½-in. radius is analyzed for stresses, closures, and flange stress and leak detection.

5965 KAPL-1524
Knolls Atomic Power Lab., Schenectady, N. Y.
SAFEGUARDS ASPECTS OF REACTOR VESSEL DESIGN. W. E. Cooper and D. R. Miller. Mar. 30, 1956. 29p. Contract W-31-109-Eng-52. $0.25(OTS).

This paper deals with the problem of design for the high degree of structural reliability required in reactor vessels and with the theoretical evaluation of the mechanical effects of abnormal pressures due to chemical or nuclear incidents. The structural reliability required of reactor vessels exceeds that required of conventional pressure vessels. Furthermore, the existence of new problems or old problems of new significance must be recognized in the design stage of new high-performance reactor systems. Consequently, the extent of engineering effort expended in design and design evaluation must be substantially greater than is normally applied to design of conventional vessels. Similarly, the criteria for limitation of stresses, the quality of design details, and the degree of control of material and fabrication quality must be superior to practices normally used in design and fabrication of pressure vessels. (auth)

8810 AECU-4675
Illinois Inst. of Tech., Chicago. Armour Research Foundation.
STUDIES OF REACTOR CONTAINMENT. Monthly Technical Progress Report No. 32 covering Period: December 1, 1959 through December 31, 1959. T. A. Zaker. Jan. 15, 1960. 4p. Contract AT(11-1)-528. OTS.

A summary of activity during the period is presented. A systematic series of tests was completed on shock crushing of reactor shield materials such as celotex, redwood, pine, balsa, foamglass, and a foamed plastic material. Investigations of explosive decompression of water resulting from pressure vessel rupture were continued. The shock tube system was successfully proof tested under long-time internal hydraulic pressure up to 1100 psi. A series of diaphragm rupture tests are described in which "petalling" was found to occur with a soft aluminum material sample. Soft copper diaphragm tests are also reported. Progress in other task areas was limited to report preparation. (For preceding period see AECU-4600.) (J.R.D.)

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5985 AECU-4599
Illinois Inst. of Tech., Chicago. Armour Research Foundation.
STUDIES OF REACTOR CONTAINMENT. Monthly Technical Progress Report No. 29 for September 1, 1959 through September 30, 1959. T. A. Zaker. Oct. 23, 1959. 4p. ARF Project No. 4132. Contract AT(11-1)-528. OTS.

The general objectives of the program are to accomplish theoretical and experimental investigations of the loads to which external containment structures for reactors are subjected in the event of a violent incident at the reactor core, the evaluation of methods of reducing that loading, and the study of the response of design criteria for external containment structures as a result of such loading. Progress of technical effort during the report period is briefly summarized for each of the eight tasks of the program. (See also ARF-4132-11.) (W.D.M.)

1800 AECU-3850
Illinois Inst. of Tech., Chicago. Armour Research Foundation.
STUDIES OF REACTOR CONTAINMENT. Combined Monthly Progress and Financial Status Report No. 17. T. A. Zaker. Oct. 3, 1958. 6p. ARF Project D132. Contract AT(11-1)-528. $1.80(ph OTS); $1.80(mf OTS).

Progress of technical effort is summarized for each of the eight tasks of the program. The statement of financial status for the program as of Sept. 1, 1958, is given. (For preceding period see AECU-3820.) (W.D.M.)

13084 AECU-4109
Sargent and Lundy, Chicago.
COST OF CONTAINMENT FEATURES FOR BOILING WATER REACTORS FOR ARGONNE NATIONAL LABORATORY, LEMONT, ILLINOIS. Job 1957-1. Oct. 15, 1957. 40p. (SL-1443). $9.30(ph), $3.60(mf) OTS.

An analysis of the cost of containment features for nuclear power plants utilizing boiling water reactors was made. The two plants chosen for comparison were the EBWR at ANL and a hypothetical large-scale nuclear power plant with an electrical capacity of 180 Mw. In order that a cost analysis could be made for the plant designs, general arrangement drawings were prepared for each of the alternate arrangements considered.

2154 SRIA-10
Stanford Research Inst. Poulter Labs., Menlo Park, Calif.
CONTAINMENT OF FRAGMENTS FROM RUNAWAY REACTOR. Summary Progress Report [for] November 1, 1958 to April 30, 1959. G. B. Huber and N. R. Zabel. June 8, 1959. 86p. SRI Project No. GU-2164. Contract AT(04-3)-115, Project No. 2. OTS.

Small-scale simulation of runaway reactor power bursts can be accomplished with chemical energy sources, such as explosives. Pyrotechnics, consisting of mixtures of oxidants and metal fuels, constitute useful auxiliary sources, providing lower energy release rate and less gas evolution than explosives. Energy sources employing high explosives alone and high explosive-pyrotechnic mixtures were developed to simulate reactor excursions with periods in the 1 to 5-millisecond range. The simulated energy releases are scaled in rate, duration, and amount. Simple, scaled, reactor test models were designed and assembled to evaluate the effects of simulated reactor excursions. A model consists of a cylindrical steel vessel filled with water, a concrete shield, and a steel step plug for the assembly. Six models were tested, five of them with excursion power bursts. All concrete shields broke up. The shield thickness represented 8 feet of concrete in an actual reactor. Maximum excursion simulated had a 760 lb TNT equivalent and a 1 millisecond period. Minimum energy release had a 49 lb TNT equivalent. Two additional series of penetration experiments were carried out. As anticipated, size of hanging target plate for which edges no longer affect projectile energy requirements for penetration appears to be proportional to plate thickness. The second series, with inch-thick targets, indicated that abnormal grain structure, due to slightly excessive heat treatment of the steel in the targets, can appreciably reduce the resistance to penetration. (auth)

7100
IMPROVED CONSTRUCTION OF THE COVER OF A HETEROGENEOUS NUCLEAR REACTOR. (to Allmänna Svenska Elektriska Aktiebolaget). British Patent 818,667. Aug. 19, 1959.

An improved cover for a previously described reactor is presented. The cover includes a collector vessel for coolant for heat removal. This vessel is attached to the under side of the cover by bushings inserted in inlet holes for fuel elements in the main cover. (T.R.H.)

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7234 A/CONF.15/P/561
UNDERGROUND LOCATION OF A NUCLEAR REACTOR. N. G. Aamodt (Joint Establishment for Nuclear Energy Research, Kjeller, Norway). 22p.

A description of the civil engineering of the Halden reactor plant is given. Special design and constructional problems are discussed, based on experience from the erection of the plant. A technical economical comparison of the "rock housing" for the Halden reactor buildings of normal and gas-tight construction is also given. (A.C.)

7101
IMPROVEMENTS IN OR RELATING TO NUCLEAR REACTORS. Geoffrey Herbert Haines and Peter John Grant. (to General Electric Co., Ltd.). British Patent 818,779. Aug. 26, 1959.

A core cover plate for reactors is described which protects the pressure vessel from heat and radiation. This protective shield is formed of layers of mild steel and neutron absorbers. It has openings for fuel element and control rod passage. The cover is cooled by gas flowing in the space defined by it within the pressure vessel. (T.R.H.)

7212 A/CONF.15/P/172
ON THE DESIGN AND CONTAINMENT OF NUCLEAR POWER STATIONS LOCATED IN ROCK. L. Carlbom and H. von Ubisch (AB Atomenergi, Stockholm); and C.-E. Holmquist and S. Hultgren (Swedish State Power Board, Stockholm). 14p.

The differences in properties in underground structures and enclosures of a steel shell type are outlined. The advantages to be gained by building underground are discussed. An outlay of an underground station design and an estimation of the costs as compared to a station at ground level are given. (W.D.M.)

2585 NAVORD-5748
Naval Ordnance Lab., White Oak, Md.
AN INVESTIGATION OF STRAIN—ENERGY ABSORPTION POTENTIAL AS THE CRITERION FOR DETERMINING OPTIMUM REACTOR—VESSEL CONTAINMENT DESIGN. Comprehensive Progress Report for the Period January 9, 1956 to June 30, 1958. Walter R Wise, Jr. June 30, 1958. 177p. Task Number NOL-285: DAMAGE FROM EXPLOSION OF NUCLEAR REACTORS. $3.00(OTS).

It is postulated that strain-energy absorption, achieved through the medium of large plastic deformation, is a means for substantially improving the containment potential of nuclear reactors. It follows that strain-energy absorption potential is one of the important containment-design criteria. Consistent with the criterion of strain-energy absorption potential, the general strain-energy equation of dynamic equilibrium for a vessel subjected to internal dynamic loading has been derived in closed form. This general equation and its simplified working forms require knowledge only of the transient-pressure and strain-vector phenomena accompanying hydrostatic and dynamic dilatation. Scaled reactor-vessel simulants have been dilated in the laboratory using a hydraulic pump and solid propellant, respectively, as the hydrostatic and dynamic loading mechanisms. The internal pressures and external strain vectors corresponding to the dilatations were monitored, and comprehensive analyses of structural response data are presented in tabular and graphical form. The results obtained prove conclusively that the mechanism of strain-energy absorption can be very effective in improving the containment design of nuclear reactors. It is likewise concluded from the general results of the work that the approach to the problem is technically and economically sound and that it will yield the fundamental technology required to achieve optimum containment design of nuclear reactors. (auth)

8983 CF-54-12-100
Oak Ridge National Lab., Tenn.
A STUDY OF POSSIBLE BLAST EFFECTS FROM HRT PRESSURE VESSEL RUPTURE. Phillip M. Wood. Dec. 14, 1954. Decl. Dec. 19, 1955. 35p. Contract [W-7405-eng-26]. $0.30(OTS).

8670 ORNL-2091
Oak Ridge National Lab., Tenn.
CONTAINMENT PROBLEMS IN AQUEOUS HOMOGENEOUS REACTOR SYSTEMS. S. E. Beall. Aug. 8, 1956. 16p. Contract W-7405-eng-26. $0.20(OTS).

Containment problems in homogeneous reactors are discussed, with particular emphasis given to the manner in which they have been solved for the HRT. Bases for

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rigid leakage specifications on reactor components are explained. The design of the reactor enclosure is reviewed with respect to allowable leakage, as well as protection against fragments and internal pressures resulting from a reactor catastrophe. (auth)

6987 WAPD-CE-43
Westinghouse Electric Corp. Atomic Power Div., Pittsburgh.
DESIGN BASIS FOR REACTOR VESSELS. B. F. Langer. Oct. 18, 1955. 14p.
The design basis to be used for reactor pressure vessels for Naval service is specified. Type of loading and operating conditions are given. Methods of formulating stress and minimum stress values to be met are listed. (D.E.B.)

THICK-WALLED PRESSURE VESSELS. H. R. Voorhees, C. M. Sliepcevich, and J. W. Freeman (Univ. of Michigan, Ann Arbor). Ind. Eng. Chem. 48, 872-81(1956) May.
Changes in stress distribution in thick-walled pressure vessels under internal pressure at elevated temperatures are analyzed, and a procedure is developed for calculating the time of rupture from creep and stress rupture data.

9875 CF-55-5-166
Oak Ridge National Lab., Tenn.
HOLDING FORCE REQUIRED FOR HRT PRESSURE VESSEL. Paul R. Kasten. May 25, 1955. Decl. Feb. 20, 1956. 10p. Contract [W-7405-eng-26]. $1.80(ph OTS); $1.80(mf OTS).
A study has been made of the reaction force arising from breaking the inlet fluid flange nozzle of the pressure vessel, the initial pressure and temperature being 2000 psi and 300°C. Based upon reasonable assumptions, the maximum upward distance the pressure vessel could travel would be ~4 feet if no holding force were present. With a 10,000-lb additional weight, the maximum distance would be ~2½ feet and with a 20,000-lb additional weight the maximum distance would be ~1.6 feet. To ensure zero upward movement a holding force of 50,000 lbs would be required. (auth)

6003
FUEL ELEMENTS, FUEL ELEMENT CLADDING AND REACTOR CONSTRUCTION MATERIALS. II. REACTOR CONSTRUCTION MATERIALS. Jaroslav Pluhař and Jaroslav Vrtěl (Státni výzkumný ústav materiálu a technologie, Prague). Jaderná energie 5, 331-5(1959). (In Czech.)
Materials used for control systems are evaluated and main problems connected with the choice of reactor pressure vessel materials are indicated. Measures required for satisfying the material demands in our metallurgy are reported, and the main problems which are to be solved in Czechoslovakia, are indicated. (auth)

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See also, under Waste Treatment and Disposal, — Liquid Wastes (8.03.05).

8317 AEC-tr-3951
ELIMINATION OF WEAKLY RADIOACTIVE LIQUID EFFLUENTS BY DILUTION: THEIR CONSEQUENCES. (Elimination par Dilution d'effluents Liquides Faiblement Radioactifs: Leurs Consequences). P. Bovard and C. Candillon. Translated for Oak Ridge National Lab. from a publication of the French Atomic Energy Commission, 1959. 21p. JCL or LC.
Nuclear installations frequently have to resolve problems posed by the elimination of considerable volumes of weakly radioactive liquid effluents. The techniques used by all nuclear centers in France are to discard the effluents in natural or artificial hydrographic systems in such a manner that they are diluted to the maximum degree. Mechanisms of concentration of radioactivity were studied with the intention of perfecting sampling methods for control measurements. (W.L.H.)

8315 AEEW-M-24
United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Establishment, Winfrith, Dorset, England.
THE WINFRITH EFFLUENT PIPELINE. G. H. Palmer. Nov. 20, 1959. 9p.
The preparatory work leading to the design of the Winfrith pipeline is described. Details of the existing system are given, and some information on the predicted safe levels of radioactive discharge is included. (auth)

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SYMPOSIUM ON RADIOACTIVITY IN INDUSTRIAL WATER AND INDUSTRIAL WASTE WATER. Presented at the Sixty-first Annual Meeting, Boston, Mass., June 26, 1958, American Society for Testing Materials. ASTM Special Technical Publication No. 235. Philadelphia, American Society for Testing Materials, 1958. 73p. $2.50.

The increasing need for the control of contamination of water sources by radioactive waste from atomic energy installations is stressed. Procedures are described which are used for the disposal of radioactive wastes from the Pressurized Water Reactor of the Shippingport Atomic Power Station. To handle these wastes, the power plant must have as an appendage a rather complex chemical processing plant. Gases and water of low activity are disposed of in the environment. Radioactive ion exchange resins and ashes from incinerated wastes are stored in permanent underground storage tanks. Radioactive concentrate from the waste evaporators and miscellaneous solid wastes are fixed in cement for ocean burial. The spent fuel, which represents the bulk of radioactivity and is the only by-product of value, is shipped to a fuel reprocessing plant. Reasons for maintaining high-purity water in the primary coolant system of the Pressurized Water Reactor are reviewed. The problem of radioactivity buildup on components and piping in the primary system is discussed. Analytical methods are outlined which were developed to determine activity levels in various aqueous wastes. Similarities and differences between conventional water chemistry and the radiochemistry of water are brought out. The effects on the environment of released radioactivity is considered. It is pointed out that monitoring of waste disposal systems is not sufficient for control or prediction of environmental hazards since distribution, concentrations, solubilities, and translocation of radionuclides cannot be accurately predicted. Constant monitoring for activity in soil, air, vegetation, and potable waters is necessary. It is stressed that it is the responsibility of each user of radioactivity to assure that release to the environment is kept at a safe level. (C.H.)

11419

RADIOACTIVE LIQUID WASTE DISPOSAL FROM THE DRESDEN NUCLEAR POWER STATION. Presented at Nuclear Engineering and Science Conference, held at Chicago, March 17 to 21, 1958. Preprint 102, Session 16. C. F. Falk (General Electric Co., San Jose, Calif.). New York, American Institute of Chemical Engineers, 1958. 11p.

The Dresden Nuclear Power Station, a boiling water reactor, will produce wastes which are variable in quantity, radioactivity, and chemical concentration. Design of an economical liquid and solid waste disposal system is complicated by this variety. The paper presents the basis of design and criteria for safe disposal of these radioactive wastes. A description is given of the sources of waste, treatment processes, and disposal methods. Equipment arrangement and operating and control philosophy are also presented. (auth)

13043

RADIOACTIVE WASTE DISCHARGES FROM NUCLEAR REACTORS. James G. Terrill, Jr. (Public Health Service, Washington, D. C.). Sewage and Ind. Wastes 30, 270-82(1958) Mar.

Many types and quantities of radioactive material are potential wastes. These must be considered in terms of such groupings as sources, activity levels, chemical and physical properties, operating methods, and industrial and regulatory limitations. Concurrently constant efforts must be made to evaluate the individual situation in terms of the total radiation exposures of the population and in terms of necessary economic considerations. Over the long term the growth of the nuclear industry, medical uses, and military applications, when compared with current health standards, easily justify an alert attitude on the part of industry and governmental agencies. With the growth, research and development should continue to provide practical and more economical solutions to specific potential hazards, if waste handling, treatment, disposal, and evaluation are given sufficient priority by industry and government.

20080

RADIOLOGICAL HEALTH TRAINING FOR WATER MANAGEMENT PERSONNEL. Presented at Nuclear Engineering and Science Conference, April 6-9, 1959, Public Auditorium, Cleveland, Ohio. Preprint V-7. D. W. Moeller, D. A. Pecsok, and H. P. Kramer (Robert A. Taft Sanitary Engineering Center, Cincinnati). New York, Engineers Joint Council, 1959. 15p. $0.50.

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This paper describes the courses for water supply and water pollution control personnel and discusses the growing need for such training. (auth)

6683 A/CONF.15/P/296
SEA DISPOSAL OF LOW ACTIVITY EFFLUENT. P. Bowles, R. H. Burns, F. Hudswell, and R. T. P. Whipple (Atomic Energy Research Establishment, Harwell, Berks, Eng.). 30p.

A proposal was made to discharge mildly radioactive liquid effluent, arising at the new Atomic Energy Establishment at Winfrith Heath, into the sea off the Dorset coast. Experiments are described which were performed at sea from August to November 1956 to determine the rate of sea dilution of a tracer dye by sampling and analysis under varying weather and tidal conditions, to determine significant gradients capable of influencing dilution rates, to obtain data on tidal streams, to sample marine life and deposits from the sea bed, and to study the contour of the sea bed in the area. Results are summarized. (C.H.)

6674 A/CONF.15/P/60
SOME SPECIAL PROBLEMS IN HEALTH PHYSICS INSTRUMENTATION. Denis Taylor (Plessey Nucleonics Ltd., Northampton, Eng.). 7p.

The problems of measuring body radioactivity and the monitoring of the liquid and gaseous effluents from reactor plants are discussed. The measurement of body radioactivity can be important in the event of the accidental inhalation, ingestion, or absorption of alpha-active materials. In the case of Pu it is possible to take advantage of the 17-kev x-ray emissions, and the sort of sensitivity which may be achieved for the detection of Pu^{239} by this means and the possibility of producing a worth-while health physics instrument based on this technique are indicated. The measurement of the low activities (α,β,γ) in effluent streams is discussed with an indication of how some of the practical problems encountered in using these methods under factory conditions are solved. (auth)

7128 NAA-SR-Memo-2526
Atomics International Div., North American Aviation, Inc., Canoga Park, Calif.
PRELIMINARY ESTIMATES OF RADIOACTIVITY IN PROCESS WASTES FROM SENN 150 EMW ORGANIC REACTOR. A. R. Piccot. Mar. 3, 1958. 10p. OTS.

Proposed methods of hold-up, dilution, and discharge of routine organic wastes to the atmosphere and rivers are discussed. The evaluation is centered around problems related to the routine process wastes produced or present at various critical points in the proposed SENN reactor system. The methods used and general conclusions should be applicable to other OMR projects. Calculations and data on activities are included. (J.R.D.)

INVESTIGATION OF STACK GAS FILTERING REQUIREMENTS AND DEVELOPMENT OF SUITABLE FILTERS; REPORT NO. 8. Feb. 28, 1950. 38p. (ALI-23). O.T.S. $0.20.

The work done to-date on the production of a suitable paper filter for the high efficiency removal of an airborne dust particles is summarized. Suitable methods of evaluating the performance of efficient air filters and filter media are discussed, and the efficiencies of various air filter media are tabulated.

9250 CRB-658
Atomic Energy of Canada Ltd. Chalk River Project, Chalk River, Ont.
REPORT ON WASTE DISPOSAL SYSTEM AT THE CHALK RIVER PLANT OF ATOMIC ENERGY OF CANADA LIMITED. C. A. Mawson. July 1956. 16p. (AECL-344). $0.50(AECL).

Disposal methods now in use at the Chalk River Project are presented. Also discussed are new methods proposed and on test for disposal of waste. (W.L.H.)

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See also, for a more general treatment of materials and calculations, under Shipping and Handling of Radioactive Materials — Shielding 4.02.08

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BORON 4.03.11.01

5964 ORNL-2528
Oak Ridge National Lab., Tenn.
RADIATION TRANSMISSION THROUGH BORAL AND SIMILAR HETEROGENEOUS MATERIALS CONSISTING OF RANDOMLY DISTRIBUTED ABSORBING CHUNKS. W. R. Burrus. Jan. 18, 1960. 30p. Contract W-7405-eng-26. OTS.

Shields that consist of randomly distributed absorbing chunks in a relatively transparent matrix must contain a greater mass of absorber than homogeneous shields which provide the same attenuation. This is the result of radiation "channeling" between the absorbing chunks. Channeling is particularly important for heterogeneous materials when the mean free path for absorption is comparable to the chunk size. A newly developed method for calculating the transmission of radiation through such heterogeneous shields is described. The numerical results of a calculation of the transmission of thermal neutrons by boral (a B_4C-Al mixture) are given, including the effects of energy and angular distributions on the predicted attenuation. The calculated results are in reasonable agreement with available experimental results. (auth)

6800 A/CONF.15/P/1272
LES ACIERS A FORTE TENEUR EN BORE. (Steels of High Boron Content.) J. Hochmann and A. Desestret (Compagnie des Ateliers et Forges de la Loire, Paris). 18p.

Because of the high thermal neutron capture cross section of boron and the physical properties of steel, boron steel has many advantages as a shielding material. The fabrication techniques used for steels containing 1 to 2% boron are described. The mechanical properties of these steels are investigated with emphasis on impact strength. The possibility of fabricating steels with 4% boron is studied. (J.S.R.)

7336
PREPARATION OF VERY PURE BORON FOR USE AS NEUTRON ABSORBER IN NUCLEAR REACTORS. Angelo di Loreto (Université, Rome). Énergie nucléaire 1, 289-90(1959) Nov.-Dec. (In French)

A process for preparing boron is described. It is based on three reactions: formation of KBF_4 by the action of KOH on HBF_4, transformation of KBF_4 to BCl_3 by $AlCl_3$, and displacement of B from BCl_3 by Zn. (T.R.H.)

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7144 A/CONF.15/P/1326
STUDY ON THERMAL GROWTH OF VARIOUS CONCRETES CAUSED BY THERMAL CYCLES IN POWER REACTORS. Kenjiro Saji and Eigoro Homma (Nihon Cement Co., Ltd., Japan). 20p.

Startup or shutdown and increasing or decreasing the output of power reactors or high power research reactors cause thermal cycles in the concrete shields. When concrete is subjected to thermal cycling, a phenomenon of thermal growth is observed. Various thermal cycles were investigated for basalt, magnetite, barite, limestone, natural sands and gravels, and copper refinery slag concretes. A mechanism for thermal growth in concrete is proposed. The relations between thermal growth and types of thermal cycles, aggregates, manufacturing methods, thermal properties, and its components were investigated. (W.D.M.)

3120
THERMAL PROPERTIES AND HEATING AND COOLING DURABILITY OF REACTOR SHIELDING CONCRETE. J. Hosoi, K. Chūjō, K. Saji, and E. Homma (Nihon Cement Co., Ltd., Research Lab.). J. Atomic Energy Soc. Japan 1, 308-18(1959). (In Japanese)

A study was made of the thermal properties of various concretes made of domestic raw materials for radiation shields of a power reactor and of a high-flux research reactor. The results of measurements of thermal expansion coefficient, specific heat, thermal diffusivity, thermal conductivity, cyclical heating, and cooling durability are described. Relationships between thermal properties and durability are discussed and several photographs of the concretes are given. It is shown that the heating and cooling durability of such a concrete which has a large thermal expansion coefficient or a considerable difference between the thermal expansion of coarse aggregate and the one of cement mortar part or aggregates of lower strength is very poor. The decreasing rates of bending strength and dynamical modulus of elasticity and the residual elongation

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of the concrete tested show interesting relations with the modified thermal stress resistance factor containing a ratio of bending strength and thermal expansion coefficient. The thermal stress resistance factor seems to depend on the conditions of heat transfer on the surface and on heat release in the concrete. (auth)

8295 YAEC-88
Westinghouse Electric Corp. Atomic Power Dept., Pittsburgh.
BULK BIOLOGICAL SHIELDING ASPECTS OF THE YANKEE CORE. H. W. Graves, Jr., W. J. Eich, and H. T. Williams, Jr. Oct. 1957. 37p. For Yankee Atomic Electric Co. Contract AT(30-3)-222, Subcontract No. 1. OTS.
The analysis of the radiation sources within the primary concrete shielding of the Yankee Atomic Electric Plant is summarized. The dose due to these sources at a point on a transverse centerline and outside the plant container was calculated. The dose at two points on the axial centerline was found as well as the extent to which the water is activated during its passage through the pressure vessel. (auth)

4961
THE DESIGN AND CONSTRUCTION OF THE BIOLOGICAL SHIELD AT HUNTERSTON. PART I. S. Gill. G.E.C. Atomic Energy Rev. 2, 77-85(1959) Sept.
The function of biological shields for nuclear reactors is reviewed. Details and illustrations are given of the arrangement adopted for the reactors now under construction for the Hunterston nuclear generating station. A full discussion is given of the types of concrete used and the methods adopted for ensuring consistent quality. (auth)

8217
RADIATION-RESISTANT BUILDING BLOCK. Rudolf Alberti. British Patent 826,793. Jan. 20, 1960.
A radiation-resistant building-block design is presented. The block can be used for constructing walls, rooms, or chambers to prevent radiation from penetrating. The block is rectangular with a 120° notch on one end and a 120° point on the other end, making it especially suitable for constructing hexagonal containers. The material used is barite concrete to which a sheet metal casing can be applied with $BaSO_4$ filling. (T.R.H.)

5963 Hw-56593
General Electric Co. Hanford Atomic Products Operation, Richland, Wash.
TRANSVERSE STREAMING TESTS IN THE DR SHIELD TEST WELLS. D. E. Wood and E. G. Peterson. June 30, 1958. 9p. Contract W-31-109-Eng-52. OTS.
Past experiments on neutron attenuation of various materials conducted in the vertical shield test wells on top of the DR reactor has led to the question of streaming out of the well or up the edges of the wells. Horizontal traverses were taken in the DR vertical shield test wells to investigate the problem of neutron streaming. Both fast and thermal neutron traverses were taken to within three inches of the edge of the well. A temperature traverse showed that the concrete in the well was quite warm. (W.D.M.)

7081 WAPD-P-646
[Westinghouse Electric Co. Atomic Power Div., Pittsburgh].
THE THEORETICAL BUILD-UP FACTOR FOR ORDINARY CONCRETE. F. E. Obenshain. Mar. 1955. 6p. $1.80 (ph OTS); $1.80(mf OTS).
The build-up factor for ordinary concrete (2.3 gm/cm^3) was theoretically determined for gamma rays having the initial energy between 0.5 and 10 Mev. The result was found to be in excellent agreement with experiment at 6.1 Mev. (auth)

8050 AERE-R/R-1963
Gt. Brit. Atomic Energy Research Establishment, Harwell, Berks, England.
HEAT RELEASE IN CONCRETE REACTOR SHIELDS. D. B. Halliday. Nov. 17, 1954. Decl. May 15, 1956. 18p. (SWP/P-31).
Declassified version of SWP/P-11.
The heating in a reactor shield is due to a mixture of fast neutron, thermal neutron, and gamma irradiation, and once it has been split up into these separate groups, the heat released and temperature attained can be readily calculated by the above method. With the curves of temperature attained, due to a heat input of 1 mw/cm^2, a temperature distribution due to a mixture of fast, thermal neutrons and gammas of any intensity can be calculated and

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plotted. Experiments carried out in BEPO suggest that a concrete shield would have an irradiation life of at least 10 years in a flux of 10^{11} n/cm^2 sec. (auth)

GENERAL 4.03.11.03

8959 CF-50-12-104
Oak Ridge National Lab., Tenn.
HRE SHIELDING DESIGN REPORT-SUPPLEMENT. C. L. Segaser. Dec. 27, 1950. Decl. Dec. 16, 1955. 43p. Contract [W-7405-eng-26]. $0.30(OTS).

Studies were made to a supplement to CF-50-10-135 (HRE shielding design report) in which a proposed shielding structure was presented and analyzed from the standpoint of biological effectiveness. As a further precaution to reduce possible radiation hazards which may result from operation of the HRE, it is proposed to operate the shielding structure such that not less than 0.500 inches of water pressure differential between the process building and the inside of the shielding will be maintained. Thus, if there is any leakage from the high-pressure soup system, radioactive fission products cannot escape from the shield and contaminate the process building ambient air, but, rather will be discharged through a duct and fan system along with radioactive A^{41} generated in the air surrounding the reactor and, hence, out through a 100-ft stack to be disseminated in the upper air strata. A secondary benefit will be derived from such a system in that about 12 kw of heat will be generated in the shield concrete due to the absorption of leakage gamma and neutron radiation from the pile. The ventilating air induced through the shielding structure is distributed to effectively remove this heat, which, if not removed, would result in an excessive concrete temperature. A proposed system for inducing air through the HRE shielding structure is shown. The minimum requirements for this system are that it shall be capable of inducing at least 1000 cfm through the internal structure and shall be capable of maintaining 0.500 inches of water pressure differential over the outer masonry wall. An off-set duct arrangement may possibly be provided in the outer shield wall for control of air flow in order to assure 1000 cfm minimum flow with the available head, should this prove necessary. This differential pressure induces air to filter through openings in the structure wall such as the cracks around shielding plugs, pipe openings, etc. The air is made to flow through the various compartments to the bottom of the shielding structure which, effectively, functions as a plenum chamber. From here, the aid is drawn upward through a 1 inch cooling annulus in the concrete surrounding the reactor to the main air duct which is attached to the concrete at a distance of approximately 12 ft from the operating floor level. Air is induced through the main duct by means of a variable speed fan discharging up a 100 ft stack. Since the air flowing through the duct system is radioactive, the duct to the fan and stack is to be run underground. (auth)

4859
THE SHIELDING OF HELICAL DUCTS. C. C. Horton (Rolls-Royce Ltd., Derby, Eng.). Nuclear Sci. and Eng. 6, 525-9(1959) Dec.

The problem of radiation penetration through a shield containing a helical duct is considered by representing the duct by successive straight ducts joined at a fixed angle. Expressions for the emergent radiation flux are derived and illustrated for a typical case. It is shown that, in a representative example, the contribution from radiation scattered along the duct is a small fraction of the general increase in radiation level due to the reduced effective density of the bulk shield in the vicinity of the helix. (auth)

4890
CALCULATION OF TEMPERATURE AND MECHANICAL STRESS IN SHIELDS. E. Schröder (Deutsche Babcock and Wilcox-Dampfkesselwerke AG, Oberhausen, Ger.). Atomkernenergié 4, 442-5(1959) Nov. (In German)

Thermal neutron capture energy is released in the form of gamma rays. These gammas are absorbed and produce heat. The temperature- and stress-distribution in shields caused by this process is discussed. (auth)

7147 HW-60101
General Electric Co. Hanford Atomic Products Operation, Richland, Wash.
SHIELDING OF PRTR GAS LOOP AND FILTER. J. J. Regimbal. Apr. 23, 1959. 15p. OTS.

The equilibrium concentration of various fission gases associated with several possible fuel types in the Plutonium Recycle Test Reactor gas loop was determined as a function of the diffusivity of the fuel. An expression for determining the amount of radiation from a deposit of particulate fuel in the filter was derived. Graphs are presented which estimate the shielding necessary for the loop and filter. (C.J.G.)

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6039 NAA-SR-Memo-4445
Atomics International Div., North American Aviation, Inc., Canoga Park, Calif.
SECONDARY SHIELD REQUIREMENTS FOR OCR PRIMARY COOLANT AND PROCESS SYSTEMS. P. J. Legendre. Oct. 1, 1959. 209p. OTS.

A compilation of OCR primary coolant and process systems shielding requirements (material and thickness) is presented. The compilation relates the coolant pipe diameter and thickness, the average energy of the gamma emitters in the coolant and the resulting coolant specific activity, the pipe distance from the inside face of the secondary shield, the secondary shield material and thickness, and the dose rate on the face of the secondary shield. (W.D.M.)

7137 A/CONF.15/P/1190
METHODS AND EXPERIMENTAL COEFFICIENTS USED IN THE COMPUTATION OF REACTOR SHIELDING. J. Bourgeois, P. Lafore, J. P. Millot, J. Rastoin, and F. De Vathaire (Commissariat à l'Énergie Atomique, Paris). 38p.

The facility used, the computation method applied, and the results obtained in the measurement of the effective neutron stopping cross section are described. A stopping cross section as a function of neutron energy is defined. A computation method to determine the sources of captured gamma rays by the age theory is outlined, and an example of its application in a composite shield is given. (W.D.M.)

6011 A/CONF.15/P/1152
LES BETONS LOURDS. PROPRIETES PHYSIQUES ET ESSAIS MECANIQUES. (Heavy Concretes).
M. Tourasse (Compagnie Industrielle de Travaux, France). 25p.

The utilization of high-density substances for shielding against nuclear radiation has led to the use of heavy concretes in which the aggregates are iron or barite ores or iron shot. The physical and mechanical properties of these concretes were determined. The results obtained with some other concretes are briefly discussed. (J.S.R.)

2546 APAE-Memo-142
Alco Products, Inc., Schenectady, N. Y.
PRIMARY SHIELDING CALCULATIONS ON THE IBM 650 (ROC CODES). S. S. Rosen, P. V. Oby, and R. L. Caton. Oct. 15, 1958. 41p. Contract AT(30-3)-326. $6.30(ph OTS); $3.00(mf OTS).

Four programs written for the IBM 650 to calculate the gamma dose rates in the primary shielding of thermal reactors are described. Their functions are outlined as follows: Program 651-calculates the core attenuation coefficient and equivalent core gamma volumetric source values for a specific core. Program 652-calculates the activation gamma source data in the shield and prepares tabular data in machine storage for Programs 653 and 654. Program 653- calculates the gamma dose rates in the shield due to gammas arising from activation of shield materials. Program 654-calculates the gamma dose rates in the shield due to gammas arising in the core. Gamma photo source values are obtained on the basis of two group neutron flux distributions throughout the reactor core and shield. (W.D.M.)

NUCLEAR RADIATION SHIELDING. E. P. Blizard (Oak Ridge National Lab., Tenn.) Ann. Rev. Nuclear Sci. 5, 73-98(1955).

Radiation attenuation processes and neutron and γ sources are reviewed. Calculations of attenuation in simple homogeneous shields and associated problems of shield design are presented. 90 references. (C.W.H.)

9838 CF-50-12-86
Oak Ridge National Lab., Tenn.
SHIELDING REQUIREMENTS FOR THE PULSAFEEDER SOUP PUMP. C. L. Segaser. Dec. 20, 1950. Decl. Feb. 7, 1956. 8p. Contract W-7405-eng-26. $1.80(ph OTS); $1.80(mf OTS).

Since the soup in the entire pump system will ultimately become saturated with fission products, all parts of the system containing soup must be adequately shielded. Calculations were thus made to determine the thickness of concrete required to cover the pit in which the pump is located in order to reduce radiations from the soup to biological tolerance at the operating floor. It is concluded that a total thickness of iron-aggregate concrete shielding of not less than 3 ft should be used to cover the pit.

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5428 ORNL-748(Suppl.)
Oak Ridge National Lab., Tenn.
SHIELD CALCULATIONS FOR LEAD AND WATER MIXTURES. F. H. Murray. Dec. 11, 1950. Decl. Jan. 6, 1956. 7p. Contract W-7405-eng-26. $1.80(ph OTS); $1.80(mf OTS).

The penetration of neutrons through mixtures of Pb and H_2O is calculated. The general formulas given for 20% Pb, 30% Pb, 40% Pb include the contribution of the continuous spectrum; the calculations show the necessity of using this contribution for distances up to about half a meter from the source plane, so that a better fit with empirical data can be expected at small distances. When certain corrections for the high-energy theoretical curves, and other corrections to empirical curves are estimated, a fair agreement with the experimental results for 33% Pb is indicated.

9894 AECD-3978
Oak Ridge National Lab., Tenn.
EFFECTIVE NEUTRON REMOVAL CROSS SECTIONS FOR SHIELDING. G. T. Chapman and C. L. Storrs. Sept. 19, 1955. Decl. with deletions Dec. 2, 1955. 152p. Contract W-7405-eng-26. $0.75(OTS).

The effective removal cross section concept as applied in shield calculations is discussed and a method of determining the numerical value of this cross section from LTSF experimental data is presented. Radiation intensity measurements in water and the corresponding removal cross section values are reported. These values are useful in determining the relative shielding effectiveness of the various materials, but can be used with complete assurance for shielding calculations only when the geometry under consideration closely resembles that employed at the LTSF. A graphical comparison of the effective removal cross sections and the total cross sections at a high neutron energy (8 Mev) is also made and should be applicable to shield calculations. In addition, calculations are presented of correction factors for various values of the water thickness, sample thickness, and attenuation lengths in order to facilitate the calculation of the removal cross section from future measurements. (auth)

9895 AECD-4222
[Knolls Atomic Power Lab., Schenectady, N. Y.]
OBLIQUITY FACTORS FOR SHIELDS. Harvey Brooks. Aug. 15, 1947. Decl. Mar. 26, 1956. 5p. Contract W-31-109-Eng-52. (MEMO-HB-8). $1.80(ph OTS); $1.80(mf OTS).

Obliquity factors for spherical and cylindrical neutron shields are briefly discussed. (B.J.H.)

6378 CF-48-3-264
[Oak Ridge National Lab., Tenn.]
SHIELDING OF THE EXTERNAL WATER PIPES IN THE HIGH PRESSURE WATER PILE. Nicholas M. Smith, Jr. Mar. 4, 1948. Decl. Jan. 4, 1956. 13p. Contract [W-7405-eng-26]. $0.20(OTS).

Shielding requirements for LITR inlet and outlet H_2O ducts are calculated. The activities considered, 6.9-Mev β and 4.0-Mev γ, are products of the O^{16} $(n,p)N^{16}$ reaction. A cross section of 1 b and half life of 7.6 sec are used. (D.E.B.)

5379 CF-54-7-95
Oak Ridge National Lab., Tenn.
ORR SHIELDING STUDIES. I. BASIC DESIGN INFORMATION. N. F. Lansing. Aug. 9, 1954. Decl. Dec. 15, 1955. 16p. Contract [W-7405-eng-26]. $3.30(ph OTS); $2.40(mf OTS).

Basic design criteria which will be used in shielding studies on the ORNL Research Reactor are presented. These criteria include: reactor power level; radiation tolerance; γ-ray absorption coefficients and relaxation lengths; build-up factor; radiation intensities; permissible temperature differences in concrete; and thermal and mechanical properties of materials. (C.W.H.)

5429 TID-270
Technical Information Service, AEC.
SHIELDING. Reports from Session IV, General Information Meeting October 24, 25, 26, 1949, Oak Ridge, Tennessee. Decl. Jan. 12, 1956. 57p. $9.30(ph OTS); $3.60(mf OTS).

Included are papers on approaches to the design of a minimum weight shield, the theory of γ and neutron attenuation in shields, fundamental shielding information, bulk shielding tests, and the properties of shielding materials.

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THE THEORY OF THE PROPAGATION OF GAMMA RAYS THROUGH MATTER. V. I. Ogievetskii. Soviet Phys. JETP 2, 312-19(1956) Mar. (In English). Zhur. Eksptl.' i Teoret. Fiz. 29, 454-63(1955) Oct. (In Russian)

The angular and energy distribution of gamma radiation is found as a function of depth of penetration into matter, for an initial energy of the order of several Mev. (auth)

ANGULAR DISTRIBUTION OF GAMMA RAYS AT GREAT DEPTHS OF PENETRATION IN MATTER. V. I. Ogievetskii. Soviet Phys. JETP 2, 319-25(1956) Mar. (In English). Zhur. Eksptl.' i Teoret. Fiz. 29, 464-72(1955) Oct. (In Russian)

GRAPHITE 4.03.11.04

6435 A/CONF.15/P/326
FIXATION DU BROME ET DE L'HEXAFLUORURE D'URANIUM SUR LES CARBONES. (Fixation of Bromine and of Uranium Hexafluoride on Carbon). J. Maire (Societe "Le Carbone-Lorraine," France). 14p.

The fixation of bromine on pitch coke, paraffin coke, petroleum, coke, and various blacks was studied. The sorption curves were determined as a function of the bromine partial pressure. The results obtained with petroleum coke and pitch coke are analogous to those obtained with graphite. The paraffin cokes and blacks give isotherms sharply different from those of other carbons. In the study of fixation of uranium hexafluoride on carbon, it was found that the hexafluoride is adsorbed by graphites and graphitized carbons and gives a lamellar compound. The stability of this compound was determined. Uranium hexafluoride can be removed from a nitrogen stream by passage over graphite, and the hexafluoride is purified of traces of HF. (J.S.R.)

7039 A/CONF.15/P/28
THE EFFECT OF NEUTRON IRRADIATION ON THE MECHANICAL PROPERTIES OF GRAPHITE. H. W. Davidson and H. H. W. Losty (General Electric Co., Ltd., Wembley, Eng.). 24p.

The effect of neutron irradiation on the elastic modulus, breaking strength, internal friction, and specific resistance of amorphous and graphitized carbon artifacts was examined experimentally. Facilities made available by the U.K. Atomic Energy Authority have been used to obtain irradiation doses of about 10^{20} nvt at temperatures varying from 100 to 300°C. The effect of irradiation on spring specimens maintained at constant strains (of the order of 10^{-3}) are also described. These specimens were made from petroleum coke and examined before and after graphitization. The permanent sets induced cannot be accounted for by Simmons' 'locked strain' theory but are considered as a relaxation of stress. A few similar experiments on the relaxation of strain at constant stress are being carried out. Diagrams illustrating the thermal annealing of these irradiation effects and those of the 'permanent sets' are presented. These results are discussed against the background of stress-induced and thermally activated slip mechanisms studied under out-of-pile conditions. (auth)

SOME EFFECTS PRODUCED IN GRAPHITE BY NEUTRON IRRADIATION IN THE BNL REACTOR. W. L. Kosiba, G. J. Dienes, and D. H. Gurinsky (Brookhaven National Lab., Upton, N. Y.). pp.143-8 in Proceedings of the Conferences on Carbon, Univ. of Buffalo, New York, 1956.

The high concentration of lattice defects resulting from neutron bombardment in graphite produces important changes in the physical properties of this material. The following physical changes produced in graphite by irradiation in the Brookhaven reactor have been studied: 1) stored energy, 2) physical dimensions and 3) c-axis. These studies were made on samples exposed to an integrated neutron flux of $1.2-1.6 \times 10^{20}$ neutrons/cm^2. The temperature of exposure varied from 50°C to about 130°C. The results show that: 1) the stored energy (heat content) which was released at 200 and 400°C ranged from 0 to 50 cal/gm. 2) the physical dimensions increased from 0.09 to 0.18%. 3) the c-axis of the crystallites increased and this expansion was about nine times as great as the gross physical growth. 4) the changes in physical properties are more dependent on the temperature of irradiation than on the integrated flux at these levels of exposure. The effect of increasing the temperature of irradiation from 50 to 100°C is to decrease the changes in physical growth and c-axis expansion by about a factor of two. (auth)

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7088 A/CONF.15/P/84
SOME DESIGN CRITERIA FOR HYDROGEN–METAL REACTOR SHIELDS. C. Cooper and J. D. Jones (Atomic Energy Research Establishment, Harwell, Berks, Eng.), and C. C. Horton (Rolls-Royce Ltd., Derby, Eng.). 22p.

The detailed distributions of thermal flux were investigated for a series of multilayered systems of iron and water, and the experimental data were interpreted on the basis of a three-group model. This model attempts to describe the three basic features of neutron behavior in shields, viz. the flight of virtually uncollided neutrons (described in the model by "removal" theory), the slowing down of neutrons subsequent to scattering out of the uncollided group, and the diffusion of neutrons at thermal energies. For an adequate interpretation of the data on the basis of this model, however, it was necessary to obtain some of the three-group parameters empirically for iron and water. The three-group model described provides a prediction of the thermal flux (to an accuracy of better than 20%) and the epithermal flux. Ease of application to complex multilayered systems is achieved at the expense of using the empirical parameters. (auth)

8216
THE PASSAGE OF FAST NEUTRONS THROUGH LEAD AND IRON. D. L. Broder, A. A. Kutuzov, V. V. Levin, V. V. Orlov, and A. Z. Turusova. Atomnaya Energ. 7, 313-20(1959) Oct. (In Russian)

Results are presented from measurements made of the spatial distribution of fast neutrons in lead and iron from monoenergetic neutron sources (E_0 = 4 and 14.9 Mev) and from fission. A kinetic equation for neutron attenuating media is used for calculating the spatial energy distributions of fast neutrons at large distances from the source. The anisotropy of elastic scattering is evaluated. The neutron energy losses in elastic scattering are neglected. (tr-auth)

5080 ✓ ORO-80
Goodrich (B.F.) Co. Research Center, Brecksville, Ohio.
PLASTIC AND ELASTOMERIC MATERIALS AS SHIELDING COMPONENTS FOR NUCLEAR REACTORS. J. W. Born. July 2, 1952. Decl. Oct. 2, 1959. 23p. BFG Projects 17RB and 16RC. Contract AT(40-1)-1309. OTS.

Properties of elastomeric and plastic materials for use in reactor shielding were investigated. The materials selected for examination are described, and experimental results are tabulated. One hundred sixteen compounds were prepared and studied. The best material found for attenuating neutrons is a butyl gum rubber stock while the best for combination neutron-gamma shield material is a natural rubber compound containing TiH_2. (J.R.D.)

9896 CF-50-8-65
Oak Ridge National Lab., Tenn.
ANTIMONIAL LEAD AS A POSSIBLE GAMMA SHIELD. H. G. Duggan. Aug. 1, 1950. 7p. Contract [W-7405-eng-26]. $1.80(ph OTS); $1.80(mf OTS).

A study was made of the possible usefulness of antimonial lead as a γ shield. Advantages of antimonial lead over chemical lead include its wider temperature range for casting, hardness, and tensile strength. Its disadvantages include its density, higher cost, and the fact that Sb becomes radioactive when exposed to neutron radiation. It is concluded that there are some special applications where antimonial lead would be more suitable. (B.J.H.)

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14042 ✓
MEANS FOR SHIELDING AND COOLING REACTORS. E. P. Wigner, L. A. Ohlinger, G. J. Young, and A. M. Weinberg (to U. S. Atomic Energy Commission). U. S. Patent 2,873,243. Feb. 10, 1959.

Reactors of the water-cooled type and a means for shielding such a reactor to protect operating personnel from harmful radiation are discussed. In this reactor coolant tubes which contain the fissionable material extend vertically through a mass of moderator. Liquid coolant enters through the bottom of the coolant tubes and passes upwardly over the fissionable material. A shield tank is disposed over the top of the reactor and communicates through its bottom with the upper end of the coolant tubes. A hydrocarbon shielding fluid floats on the coolant within the shield tank. With this arrangement, the upper face of the reactor can be opened to the atmosphere through the two superimposed liquid layers. A principal feature of the invention is that in the event radioactive fission products enter the coolant stream,

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the superimposed layer of hydrocarbon reduces the intense radioactivity introduced into the layer over the reactor, and permits removal of the offending fuel material by personnel shielded by the uncontaminated hydrocarbon layer.

WATER 4.03.11.07

9891 MonP-283
[Clinton Labs., Oak Ridge, Tenn.]
PENETRATION OF FISSION NEUTRONS THROUGH WATER. E. P. Wigner and G. Young. Apr. 9, 1947. Decl. Jan. 10, 1956. 7p. Contract W-35-058-eng-71. $1.80(ph OTS); $1.80(mf OTS).

In order to determine the effectiveness of H_2O as a reactor neutron shield, calculations were made of penetration of fission neutrons through water. (B.J.H.)

8049 AD-46097
Purdue Univ., Lafayette, Ind.
EXPERIMENTAL INVESTIGATION OF THE WATER-TANK RADIATION SHIELD OF THE PURDUE CYCLOTRON (thesis). Clarence William Orr. May 1954. 50p.

Recent modification of the Purdue cyclotron, resulted in an increase in beam current, and the radiation field outside the water-tank shield has been investigated to determine the effectiveness of the shield. The fast neutron dose rate was measured with a proton recoil proportional counter; the slow neutron flux was calculated from the counting rate obtained with a BF_3 proportional counter; and the γ ray dose rate was determined from the counts recorded using a Geiger-Müller counter. Results presented are representative of typical cyclotron operating conditions, and show the present water-tank shield to be an effective radiation shield when accelerating alpha particles, for both internal and external targets and for internal irradiation with deuterons. For external bombardments with deuterons the shield has been found to be effective for neutrons, except at the cracks around the rolling tank on the north side. Future shielding in this area will help to eliminate this hazard. The shield is not adequate on the north side for γ rays. The addition of boric acid into the water tanks should reduce the γ-ray intensity by about 25%. (auth)

SITE SELECTION 4.03.12

6677 A/CONF.15/P/173
PRINCIPLES FOR DEALING WITH SAFETY AND LOCATION OF ATOMIC ENERGY PLANTS IN SWEDEN. T. Magnusson (Swedish Atomic Energy Board, Stockholm). 6p.

A short account is given of the rules and procedures concerning reactor safety and location embodied in the Swedish Atomic Energy Act of 1956 and in subsequent regulations issued under this Act. A description is given of the administrative machinery for licensing and for the supervision of the licensees. No general rules have so far been formulated for containment and location of reactors and other atomic energy facilities. Every application is dealt with according to the particular characteristics of the project. Consideration is paid to the normal operations of the proposed plant, as well as to the probable consequences of any conceivable accident. After a thorough analysis of the problems concerning the construction and the operation of the plant, an integrated estimate is made of the protective measures and the location of the plant. During this procedure certain conditions are prescribed to be attached to the license. The final specification of these must, however, very often be postponed to a later stage of the construction. Initially, there is only required such information that is considered necessary for an over-all assessment of the project. Some problems that will appear in the case of an accident are dealt with. A study has recently been started of the coordination and the responsibility of different authorities concerned with the consequences of an accident. Proper rules for managing these problems are supposed to be established before the first larger reactor in Sweden is taken into operation. (auth)

C. K. Beck, Criteria for Selection of Sites for Nuclear Reactors. TID-7554 (Book I) p 235-9. (1957)

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5989 CF-58-12-154
Oak Ridge National Lab., Tenn.
INSPECTION AND MAINTENANCE EXPERIENCE WITH HRE-2. J. S. Culver, D. M. Shepherd, and C. W. Collins. Dec. 26, 1958. 23p. OTS.

Presented at the Nuclear Engineering and Science Conference in Cleveland, Ohio, in April 1959.

Experience in replacement of highly radioactive components of Homogeneous Reactor Experiment No. 2 is discussed, with particular emphasis on containment of air-borne contamination and control of personnel exposure. The design and operation of tools and viewing devices developed to observe the hole in the HRE-2 core tank are described. (auth)

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1134 IDO-28537
Aerojet-General Nucleonics, San Ramon, Calif.
ARMY GAS-COOLED REACTOR SYSTEMS PROGRAM. PRELIMINARY HAZARDS SUMMARY REPORT FOR THE ML-1 NUCLEAR POWER PLANT. Apr. 22, 1959. 208p. Contract AT(10-1)-880. OTS.

With this is bound: Weather Bureau, Idaho Falls, Idaho. LOCAL CLIMATOLOGICAL DATA WITH COMPARATIVE DATA, 1958.

The ML-1 (mobile, low power) nuclear power plant is described with particular emphasis on the neutronic characteristics, the control and instrumentation system, equipment description, and plant safety considerations. The site is described with reference to geology, climate, and population density. Hazards which would result from both normal and abnormal operation are analyzed in detail with emphasis given to possible excursions and to the distribution of any resultant radioactive products. The hazards described include those arising from power plant operation at the ML-1 site and those involving transport of the shutdown reactor to other sites within NRTS for maintenance. It is concluded that a condition which would be hazardous to the surrounding area could only result from gross physical changes in the reactor core. The maximum credible accident would produce such a change and could only result from a catastrophic failure of the gas piping coupled with the unlikely procedural error of having clear water, rather than borated water, in the operating neutron shield. (auth)

8287 NP-8251
American Electric Power Service Corp., New York and General Nuclear Engineering Corp., Dunedin, Fla.
APPLICATION FOR USAEC LICENSES BY FLORIDA WEST COAST NUCLEAR GROUP. PART A. GENERAL INFORMATION. 40p. PART B. PRELIMINARY HAZARDS SUMMARY REPORT — VOLUME 1. CHARACTERISTICS OF SITE AND ENVIRONMENT. 71p. VOLUME 2. DESCRIPTION OF REACTOR AND PLANT. 181p. VOLUME 3. HAZARDS EVALUATION. 73p. Dec. 7, 1959.

The Florida West Coast Nuclear Group, Inc., plant will be an advanced, high temperature, gas cooled, heavy water moderated reactor of the pressure tube type to be fueled with slightly enriched uranium. The plant is to be designed as a prototype of a 200 Mw(e) nuclear plant which could operate on natural uranium. In order to construct and operate the plant, FWCNG has submitted a combined application for (1) a construction permit, (2) a class 104(b) facilities license, (3) a special nuclear materials license, and (4) a by-product materials license. (W.D.M.)

7109 A/CONF.15/P/324
EXTRACTION DE LA CHALEUR DES REACTEURS REFROIDIS AU GAZ. COMPARAISON DE DIFFERENTES FORMES DE GAINAGES. (Heat Removal from Gas Cooled Reactors. Comparison of Different Types of Claddings). P. Marien (Centre d'Étude de l'Énergie Nucléaire, Brussels). 33p.

The cooling of finned claddings by air was studied in an experimental channel outside the pile. The experimental arrangement is described with emphasis on the simulation of the heating of uranium and on the measurement of surface temperatures. The results obtained from coefficients of friction, Stanton numbers, and the quality indices are presented in a form which permits an easy comparison of all the results. Claddings with broken longitudinal fins appear to be the best for the cooling of gas-cooled reactors. (tr-auth)

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7205 A/CONF.15/P/73
CURRENT RE-DESIGNS OF CALDER HALL. J. B. W. Cunningham. Includes Appendix: LEAKAGE OF CO_2 FROM THE PRESSURE CIRCUIT OF THE CALDER HALL REACTORS. H. V. Disney (United Kingdom Atomic Energy Authority, Risley, Lancs, Eng.). 19p.

The first re-design of the Calder Hall reactors was carried out by industrial firms in Britain for U.K. electricity authorities. The U.K. Atomic Energy Authority collaborated with the electricity authorities in writing the specification for these stations and in assessing the designs. The method adopted for carrying out the assessment is described. It involved a detailed consideration of each design from a number of different aspects, namely: performance, safety, fuel elements, pressure circuit, control and instrumentation, graphite structure, burst cartridge detection, and civil engineering. This re-design, and later ones now current, led to a very great advance in performance and economy over Calder Hall. The various factors responsible for the improvement are discussed, including increases in the diameter and working pressure, and improved internal geometry of the main pressure vessel; increased rating and temperature of the fuel and new heat transfer surfaces for the fuel elements. Modifications to the design which have arisen from consideration of postulated fault conditions, and the development of major components such as main gas valves and bellows are considered. Work is reported on the leak tightness of the Calder Hall pressure circuit, and on the principles of design to be applied to similar circuits. (auth)

7223 A/CONF.15/P/267
SAFETY ASPECTS OF THE CALDER HALL REACTOR IN THEORY AND EXPERIMENT. G. Brown, H. Kronberger, F. M. Leslie, and J. Moore (United Kingdom Atomic Energy Authority, Risley, Lancs, Eng.) and P. W. Mummery (Atomic Energy Research Establishment, Harwell, Berks, Eng.). 39p.

The design specification, construction requirements, and inspection which ensure the soundness of the reactors at Calder Hall and similar power stations are discussed. The nuclear and thermal kinetics of these natural uranium gas-cooled graphite-moderated reactors are examined, and an account is given of relevant experiments, including those carried out on the Calder Hall reactors. This work takes into account the presence of plutonium and the consequent increase in moderator temperature coefficient with irradiation level. An outline is given of the results of compatibility studies and of the effect of irradiation on fuel elements, on graphite (with particular reference to stored energy), and on constructional steels. In the light of the information obtained on the nuclear and thermal characteristics of the reactor, a number of hypothetical fault conditions are examined. These include loss of reactivity control, blower failure, and loss of pressure. (auth)

7260 A/CONF.15/P/1518
INSPECTION AND MAINTENANCE OF LARGE REACTORS AT WINDSCALE WORKS AND CALDER HALL. T. Tuohy and G. D. Ireland (United Kingdom Atomic Energy Authority, Risley, Lancs, Eng.). 44p.

An account is given of the maintenance and remedial work which has been done within the biological shield of the Windscale reactors, and covers: (a) Retention of reactor fuel elements which were tending to blow out of the graphite channels. (b) Remote welding and cutting operations using oxy-acetylene equipment at distances of up to 20 feet from the operating position. (c) Repair work on the fuel element detection gear which involved the entry of personnel into the biological shield. Details are given of the health physics control and of radiation exposures received by personnel during the maintenance of the fuel element detection gear. No maintenance work has been necessary within the biological shields on Calder Hall Reactors, but both heat exchangers and gas inlet ducts have been entered for inspection. The result of such inspections and health physics data are given. (auth)

7282 A/CONF.15/P/2331
SAFETY CONSIDERATIONS FOR GAS COOLED THERMAL REACTORS OF THE CALDER HALL TYPE. F. R. Farmer and P. T. Fletcher (United Kingdom Atomic Energy Authority, Risley, Lancs, Eng.); and T. M. Fry (Atomic Energy Research Establishment, Harwell, Berks, Eng.). 10p.

The principles of reactor safety are considered, with particular reference to the Calder Hall type of gas-

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cooled thermal reactor. The need for codes of practice for engineering design in the atomic energy field is discussed, and the aims of such codes are defined. The limits of radiation exposure, both for occupational workers and the general public, are discussed. The principles of safety adopted in design to ensure that in normal operation the reactor is at all times operating within safe limits are considered, and the factors governing these limits are discussed. In assessing the safety of a reactor system, it is necessary to predict the cause and course of possible fault conditions and also to consider the possibilities of multiple failures. In particular, fault conditions occasioned by loss of coolant flow or by loss of coolant pressure are examined, and design considerations intended to minimize the effects of such failures are discussed. (auth)

4957 ORO-196 and Suppl.
Kaiser Engineers Div., Henry J. Kaiser Co., Oakland, Calif. and Allis-Chalmers Mfg. Co. Atomic Energy Div., Washington, D. C.
EXPERIMENTAL GAS-COOLED REACTOR; PRELIMINARY HAZARDS SUMMARY REPORT. May 1959. 268p. Contract AT(10-1)-925. OTS.

The EGCR is a combined experimental and power demonstration reactor which is to be constructed at Oak Ridge. It is fueled with enriched UO_2, clad in stainless steel, moderated with graphite, and cooled with He. The plant is designed to produce 85 Mw(th) and 25 Mw(e) at a gas outlet temperature of 1050°F. The core and vessel of the EGCR can accommodate eight tubes through the core, into which experimental loops will eventually be installed. Accidents analyzed include both reactivity accidents and component failures and malfunctions. The maximum allowable once-in-a-lifetime dose of 25r is not exceeded within 8 hr at the nearest uncontrolled land. (W.D.M.)

7230 A/CONF.15/P/314
THE POSSIBILITIES OF ACHIEVING HIGH TEMPERATURES IN A GAS COOLED REACTOR. L. R. Shepherd, R. A. U. Huddle, L. A. Husain, G. E. Lockett, F. Sterry, and D. V. Wordsworth (Atomic Energy Research Establishment, Harwell, Berks, Eng.). 36p.

Large natural uranium gas cooled power reactors have limitations with regard to core heat output density, which implies that they must be relatively cumbersome. They are also limited in maximum attainable coolant outlet temperature. There is an obvious incentive to develop compact reactors having core power densities as high as pressurised water reactors, but not possessing the coolant temperature limitations either of pressurized water reactors or of the more advanced natural uranium gas cooled systems. Coolant outlet temperatures in excess of 650°C are needed in order to exploit the most modern steam turbine generating equipment. A higher outlet temperature of 750°C is desirable for gas turbine application or for a mixed steam/gas turbine system. Some thought is being given to the possibility of a high temperature gas cooled reactor in which an enriched fuel is incorporated in a solid moderator to give fuel elements of greatly extended heat transfer surface area, thereby permitting a high density of heat output from the core. The core materials are in a highly refractory form (e.g., graphite and ceramics) and metal fuel element sheaths are avoided. These materials will be allowed to run to much greater temperatures than have been possible in metal fuel elements and, as a result, high gas temperatures can be obtained. (auth)

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7084 MIT-5001
Massachusetts Inst. of Tech., Cambridge. Nuclear Engineering Project.
CHEMICAL PROBLEMS OF NON-AQUEOUS FLUID-FUEL REACTORS. George Scatchard, Herbert M. Clark, Sidney Golden, Alvin Boltax, and Reinhardt Schuhmann, Jr. Oct. 15, 1952. Decl. Oct. 7, 1959. 99p. Contract AT(30-1)-1359. OTS.

The three main chemical problems of non-aqueous fluid-fuel reactors are selection of a fuel system which meets nuclear and thermal requirements, control of corrosion of structural materials, and development of an efficient and economical separation process. The problems of the fast-neutron reactor with a core of fused NaCl, $PbCl_2$, UCl_4 mixture and a blanket of fused UCl_4 are discussed, except for the separation process. Brief treatment is given the Bi–U–Pu fuel system for thermal reactors, including tentative flowsheets for the separation process. A detailed discussion of the experiments of Bareis at Brookhaven and related experiments on the distribution of various metals

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between liquid Bi and fused-salt solutions is given, the experimental results correlated. and application made to reactor problems. A general discussion is given of nonaqueous high-temperature separation processes. (L.M.T.)

2968 ✓ ORNL-1835
Oak Ridge National Lab., Tenn.
AIRCRAFT REACTOR TEST HAZARDS SUMMARY REPORT. W. B. Cottrell, W. K. Ergen, A. P. Fraas, F. R. McQuilkin, and J. L. Meem. Jan. 19, 1955. Decl. Oct. 9, 1959. 156p. Contract W-7405-eng-26. OTS.
The ART is to be a 60-Mw reflector-moderated circulating-fuel type whose basic design is suitable for use in aircraft. The new principle of design introduced in the ART consists of circulating the fuel through the reactor in a single, thick, annular passage and achieving the major portion of the moderation with a Be reflector which will also serve as an important portion of the shield. Descriptions are given of the reactor, reactor cell, test site, reactor controls, and operating plan. Three major categories of hazards are considered: accidents with an appreciable probability of occurring, accidents causing rupture of the pressure shell, and accidents causing rupture of the reactor cell. (W.D.M.)

4956 NAA-SR-Memo-902(Rev.)(Del.)
North American Aviation, Inc., [Downey, Calif.].
PRELIMINARY SAFETY EVALUATION OF THE SODIUM REACTOR EXPERIMENT. W. E. Abott, ed. Feb. 19, 1954. Decl. Nov. 9, 1959. 29p. OTS.
A description is given of the Sodium Reactor Experiment (SRE) facilities and program of objectives. The hazards associated with equipment failures and malfunctions, personnel errors, natural causes, and operation are evaluated. (C.J.G.)

6035 ✓ LA-2327
Los Alamos Scientific Lab., N. Mex.
LOS ALAMOS MOLTEN PLUTONIUM REACTOR EXPERIMENT (LAMPRE) HAZARD REPORT. E. O. Swickard, comp. June 1959. 115p. Contract W-7405-eng-36. OTS.
This report supersedes K-1-3425 and LA-2327(Prelim.).
The first experiment (LAMPRE I) in a program to develop molten plutonium fuels for fast reactors is described and the hazards associated with reactor operation are discussed and evaluated. The reactor description includes fuel element design, core configuration, sodium coolant system control, safety systems, fuel capsule charger, cover gas system, and shielding. Information of the site comprises population in surrounding areas, meteorological data, geology, and details of the reactor building. The hazards discussion considers the probable consequences of loss of coolant pumping, electrical power failure, and the malfunction of the several elements comprising the reactor system. A calculation on the effect of fuel element bowing appears in an appendix. (auth)

ORGANIC-MODERATED REACTORS 4.03.13.04

4953 ✓ NAA-SR-4065
Atomics International Div., North American Aviation, Inc., Canoga Park, Calif.
HAZARDS ANALYSIS OF THE ORGANIC MODERATED REACTOR EXPERIMENT. R. O. Williams, Jr., ed. Dec. 15, 1959. 259p. Contract AT-11-1-GEN-8. OTS.
An attempt is made to determine the behavior of the OMRE under extremely unlikely sets of conditions and to provide additional design information in the areas of reactivity coefficients, burnout heat flux, and reactor control. In establishing an upper boundary on the severity of an accident in the OMRE, three extreme cases were considered: (1) a loss of flow resulting from the simultaneous seizure of both coolant pumps; (2) a system rupture of varying proportions; and (3) an insertion of reactivity of varying amounts. The OMRE control philosophy is discussed, and a résumé of the stability analyses performed on the OMRE is given. (W.D.M.)

3163 ✓ NAA-SR-Memo-4223
Atomics International Div., North American Aviation, Inc., Canoga Park, Calif.
PROBLEM AREAS IN SAFETY ANALYSIS OF SGR AND OMR REACTORS. Roy A. Axford. [1959]. 14p. OTS.
Several problem areas relevant to the safety of SGR and OMR reactor systems and in which theoretical analysis is

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required are delineated. The subjects are varied and include not only detailed investigations of the basic physical phenomena pertinent to safe reactor operation, but also the interplay of the physical phenomena which govern the stability of the full reactor system. The range of topics comprise four categories: (1) a survey of the practical problems relating to the safety of those reactor types and existing critical facilities of interest, (2) the mathematical treatment of the kinetic mechanisms and phenomenology of the full reactor system, (3) the analytic treatment of the significant feedback mechanisms and of those portions of the fields of fluid dynamics and heat transfer particularly relevant to reactor safety considerations, and (4) the construction of fundamental theories of the basic physical effects which govern the kinetic behavior of various reactor systems. Each of these categories is discussed. (auth)

WATER-COOLED REACTORS 4.03.13.05

8273 ANL-5781(Add.)
Argonne National Lab., Lemont, Ill.
HAZARDS EVALUATION REPORT ASSOCIATED WITH THE OPERATION OF EBWR AT 100 MW. E. A. Wimunc and J. M. Harrer. Dec. 1959. 85p. Contract W-31-109-eng-38. OTS.

Basic modifications to the EBWR for increasing the operating design rating of 20 to 100 Mw(t) are covered. Changes and additions to the plant, core, reactor vessel, and other major components are shown. An analysis of the effect of these changes on the performance and safety of the reactor is presented. A re-evaluation of the previous hazards was made, and some additional hazards brought about by the increased power level modification are covered. (W.D.M.)

8307 NP-8308
Wisconsin. Univ., Madison. Coll. of Engineering and General Electric Co. Atomic Power Equipment Dept., [San Jose, Calif.].
PRELIMINARY HAZARDS ANALYSIS OF WISCONSIN POOL-TYPE REACTOR. Report No. 14. Max W. Carbon and E. G. Holzmann. Aug. 1959. 82p. OTS.

The characteristics and proposed installation of a 10-kw pool-type nuclear reactor at the University of Wisconsin are described. The reactor is being designed, constructed, and installed by General Electric Co. Experimental facilities include two complete 6-inch beam ports. Descriptions of the reactor and its operating characteristics, the building, the site, the operational procedures, proposed experiments, and an evaluation of the hazards involved are presented. (W.D.M.)

6490 GPI-14
Atomic Energy of Canada, Ltd. Chalk River Project, Chalk River, Ont.
THE ACCIDENT TO THE N.R.X. REACTOR. PART II. D. G. Hurst. Oct. 23, 1953. 33p. (AECL-233).

Problems which faced the operating staff as a consequence of the NRX accident are discussed. These include containment of active water, cooling of broken rods, and assessment of damage. Information is given concerning the state of the fuel rod assemblies and calandria. It appears that the major damage followed boiling of cooling water. Explanations are presented of some of the observed phenonema, in particular a sudden rise of the gasholder, and some details of fuel rod behavior. (auth)

5970 WAPD-SFR-Rs-444
[Westinghouse Electric Corp. Bettis Plant, Pittsburgh].
REVIEW OF THERMAL DESIGN CRITERIA FOR PRESSURIZED WATER REACTORS AT 2000 psia. [Feb. 1956]. 18p. $3.30(ph OTS); $2.40(mf OTS).

A review of the existing thermal design criteria for pressurized water reactors was made and new thermal criteria may be summarized as follows: (1) local and bulk boiling is prohibited during steady state operation; (2) local heat flux at any point and time shall not exceed the burnout heat flux, reduced by a factor of safety. Steady-state local or bulk boiling was not recommended because information on corrosion and deposition effects is not available. (F.S.)

TESTING OPERATING SAFETY OF A WATER-BOILER RESEARCH REACTOR. J. W. Flora and J. W. Shortall (California Research and Development Co., Livermore, Calif.). Nucleonics 14, No. 6, 58-62(1956) June.

Operational safety performance of the Livermore Research Laboratory water-boiler-type research reactor was investigated. Factors tested were temperature coefficient

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of reactivity, transient behavior, buildup and decay of volatile activity, danger coefficients, effect of loss of coolant, poisoning effect of an absorber placed in the core, control rod calibration, safety devices response time, and void effects in the reflector. (F.S.)

7240 A/CONF.15/P/1132
EXPERIENCE ACQUIRED DURING TWO YEARS OF OPERATION OF REACTOR G 1. de Rouville, Pascal (Commissariat à l'Energie Atomique, Paris); and Scalliet (Electricite de France, Paris). 16p.

On the 7th of January 1956 the G-1 reactor started up for the first time. Several experiments to define most of its operating data were conducted. It was found that suitable neutron flattening can be obtained from a mixed array which is composed of 2.556 uranium elements and 104 thorium elements, and the parameter limiting the power in the fuel element cans is the temperature. Several operating conditions from 30 to 40 Mw were tried. In addition, emergency cooling flows were defined. Other information gained from the operation included the following: fine adjustment of graphite reheating system brought about considerable difficulties in provision against the Wigner effect; the premature shutdowns owing to bad handling, unsuitable operations of control circuits and feed, and burst slugs are now clearly in regression; and the reactor is self regulated and very easy to operate. Numerous experimental tests have revealed the agreement of data given by the different measurements of temperature. Apart from the burnt element, about ten burst slugs were detected in the last two years. None of them had prolonged results, usually stopping the reactor for about 1 or 2 hours. The optical examination of every unloaded element revealed that the fitting margins were more important than the swellings. The permissible burnup levels have not been reached. The magnesium canning was more resistant than expected to corrosion, especially to steam. On the 28th of September, the energy recovering plant and the G-1 reactor were both linked onto the line for the first time. The adjustment of the recovered power is obtained with no difficulty and with remarkable stability only by adding water to head boiler. The heat regenerator has not had to bear any event. It means that the danger due to corrosion is not so important as foreseen. (auth)

7146 GEAP-3099
General Electric Co. Atomic Power Equipment Dept. San Jose, Calif.
DESCRIPTION AND SAFEGUARD EVALUATION OF TAIWAN OPEN POOL REACTOR. E. G. Holzmann. Mar. 20, 1959. 90p. (R-58-APE-18).

A description and safeguard evaluation of an open pool research and test reactor rated at 1000 kw are presented. The reactor is light water moderated and cooled, graphite reflected, and fueled with 3.8 kg of 20% enriched U^{235}. Forced convection cooling is used for power levels above 100 kw. Operating characteristics and procedures are given. (W.D.M.)

6382 CF-49-12-84
[Oak Ridge National Lab., Tenn.]
MTR SHUTDOWN COOLING REQUIREMENTS. J. A. Lane. Dec. 16, 1949. Decl. Feb. 2, 1956. 6p. [Contract W-7405-eng-26]. $1.80(ph OTS); $1.80(mf OTS).

Calculations are given to show the amounts of air and H_2O required to remove fission product heat generated after shutdown of the MTR. (B.J.H.)

9886 TID-10102
Oak Ridge National Lab., Tenn.
A HAZARDS SUMMARY FOR ROUTINE OPERATION OF THE BULK SHIELDING REACTOR AT ONE MEGAWATT. F. C. Maienschein. Dec. 20, 1954. Decl. Jan. 13, 1956. 62p. Contract W-7405-eng-26. $0.40(OTS).

The Bulk Shielding Reactor (BSR) consists of an assembly of modified MTR-type fuel elements suspended in a "swimming pool" filled with demineralized water. It has operated since 1951 at power levels up to 100 kw. This report, after describing the existing facility, suggests modifications which would permit part-time routine operation at 1 megawatt. Finally, the hazards associated with higher power operation have been considered. (auth)

3205 AECU-4444
Lockheed Nuclear Products, Marietta, Ga.
NUCLEAR TRAINING REACTOR. Preliminary Report and Hazards Analysis. Sept. 1959. 109p. For Ohio State Univ. (NR-63). OTS.

Complete descriptions of the reactor, building, and site are given. Reactor operation, hazards associated with the reactor, and the maximum credible accident are discussed.

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The reactor is a BSR swimming pool type with a design power level of 10 kw and a maximum thermal flux in the fuel region of 2.23×10^{11} n/cm^2-sec. (W.D.M.)

9213 YAEC-31(Suppl.)
Westinghouse Electric Corp. Atomic Power Dept., Pittsburgh.
YANKEE CRITICAL EXPERIMENTS; HAZARDS SUMMARY REPORT. D. F. Hanlen, D. Hunter, and J. Jedruch. May 1, 1958. 44p. For Yankee Atomic Electric Co. Contract AT(30-3)-222, Subcontract No. 1. OTS.

The hazards associated with a series of experiments in the Yankee Power Reactor in which the water-to-uranium metal ratio is 2.23 to 1 are evaluated. Descriptions are given of the site, reactor facility, and reactor control system. An accident and hazards analysis was made relative to failure or malfunction of components, hazards from human error, sabotage, and hazards occurring from nature. The maximum credible accident and its consequences are discussed. (C.J.G.)

9176 WAPD-SC-630
Westinghouse Electric Corp. Bettis Plant, Pittsburgh.
SUMMARY REPORT OF REACTOR HAZARDS ASSOCIATED WITH THE HIGH TEMPERATURE TEST FACILITY. W. A. Vogele, E. L. Humez, J. G. Wilhite, and D. S. Jones. Aug. 1959. 57p. Contract AT-11-1-GEN-14. OTS.

The title "High Temperature Test Facility" (HTTF) is the designation for the low-power pressurized water critical facility under construction at the Bettis site. A description of the Facility is presented with an analysis of the accident potential of the system and a description of the first fuel type with an evaluation of the risk associated with the operation of core assemblies utilizing this type fuel. A delineation is maintained between the Facility characteristics applicable to all experiments and the specific characteristics of the first fuel type. (W.L.H.)

4885
HEALTH PHYSICS PROBLEMS FOLLOWING A REACTOR ACCIDENT. J. M. White (Atomic Energy of Canada, Chalk River, Ont.). Am. Ind. Hyg. Assoc. J. 20, 478-81(1959) Dec.

The NRU reactor accident of May 1958 is reviewed. Health physics problems following the accident are discussed. Recommendations are included for additional equipment which would be useful during accidents of this kind. (C.H.)

9244 NP-8350
Georgia Inst. of Tech., Atlanta. and General Nuclear Engineering Corp., Dunedin, Fla.
SAFEGUARDS REPORT FOR THE GEORGIA TECH RESEARCH REACTOR. Jan. 1960. 233p. OTS.

The Georgia Tech Research Reactor is heterogeneous, heavy water moderated and cooled, and fueled with highly enriched Al–U plates. The descriptions given include: site characteristics, the reactor containment building, the reactor, instrumentation, reactor heat dissipation systems, reactor auxillary facilities, and radiation monitoring facilities. Two-group multi-region reactor calculations were performed to determine the reactivity, flux, and power distributions for various core sizes at room temperature. Calculations are presented for: fission product reactivity loss, void and temperature coefficients, reactivity worth of beam holes, reactivity effect on reactor period, reactivity requirements, and fuel burnup and refueling cycle. The experimental facilities are described and operating procedures are discussed. Reactor hazards were evaluated relative to operating hazards, loss of coolant, effects of assumed reactivity additions, reactivity release to surrounding area, and a maximum reactivity accident. Emergency and disaster plans are discussed.

MISCELLANEOUS 4.03.13.06

508
NUCLEAR SAFETY. Technical Progress Reviews, Vol. 1, No. 1. W. B. Cottrell, ed. Oak Ridge, Tenn., Oak Ridge National Laboratory, 1959. 53p. $0.55 (GPO).

This review is divided into six sections. In section one nuclear safety criteria are discussed which include: biological and economic considerations, site-selection criteria, safety and experimental systems, and fissionable material outside reactors. Section two is devoted to accident analysis and includes: Simulator studies of reactor accidents, analysis of reactor transients, col-

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lapse of parallel-plate fuel assemblies, and leak in the Homogeneous Reactor Test core tank. In section three reactor safety features are discussed. These include reactor fuses and reactor safety system design criteria. Section four discusses plant safety factors which include the evaluation of containment systems, structural integrity of containment vessels, and containment vessel leak detection. In the fifth section activity release and consequences are described. These include: activity buildup, fission product release, and environmental monitoring. The last section is devoted to current events. These include nuclear incidents, regulatory role of the Atomic Energy Commission, factors considered in reactor site evaluation, inspection objectives and criteria, license application and actions, and safeguard reports and bibliographies. (W.L.H.)

7989 ORNL-2087
Oak Ridge National Lab., Tenn.
CRITICAL EXPERIMENTS AND NUCLEAR SAFETY AT OAK RIDGE NATIONAL LABORATORY. A. D. Callihan. Aug. 2, 1956. 10p. Contract W-7405-eng-26. $0.15(OTS).

This paper considers two somewhat separate aspects of potential hazards in the nuclear reactor program. The first section describes the safety features of the critical-experiments program at Oak Ridge National Laboratory and reviews its operational experience. In these experiments, reactor prototypes are studied and the problems of fuel processing are examined. The second section of the paper presents some design bases for fuel processing equipment and discusses the administration of nuclear safetv at the Laboratory. (auth)

7655
RADIATION PROTECTION IN REACTORS AND IN NUCLEAR OPERATIONS. [PART] I. M. Oberhofer and P. Kienle (Technische Hochschule, Munich). Kerntechnik 1, 42-9(1959) Aug. (In German)

A survey is presented for the nuclear engineer of the radiation protection practices currently in use. In the first part of the article the origin of various radiations and the physical processes occurring in their passage through tissue are described. The incorporation of radioactive materials and radiological units and quantities are discussed. (J.S.R.)

7158
THE PRINCIPAL TESTING METHODS IN THE CONSTRUCTION OF THE KARLSRUHE RESEARCH REACTOR. Emil Berger (Technischer Überwachungs-Verein, Mannheim, Ger.). Kerntechnik 1, 157-60(1959) Nov. (In German)

The methods used for quality control during the fabrication of constituent parts of the Karlsruhe Reactor are briefly described. Quality control of the construction materials during smelting, testing of piping systems, shields, forged constituents, and cast iron weld inspection, inspection of pressure vessels, and non-destructive testing of finished constituents are considered. (J.S.R.)

6024 A/CONF.15/P/1536
METEOROLOGICAL ASPECTS OF THE PEACEFUL USES OF ATOMIC ENERGY. (World Meteorological Organization, Geneva). 37p.

The meteorological aspects of the safety and location of nuclear reactors are dealt with in some detail. The various uses of radioactivity in meteorology are discussed with particular reference to the value of C^{14} in various phases of meteorological work. (W.D.M.)

23066 TID-7579(p.45-52)
Division of Licensing and Regulation, AEC.
SAFETY FACTORS TO BE CONSIDERED IN REACTOR SITING. Clifford K. Beck. 8p.

It is exceedingly difficult to decide in advance what accidents might be credible for a given plant, and hence what situations must be safeguarded against, as against the conceivable accidents which in the limit would envisage the release of all the reactors' radioactivity inventory, regardless of all safeguards. Examples of types of accidents considered credible in various types of reactors are discussed. Where accidental release of significant amounts of fission products from a particular reactor is judged to be a credible possibility, it has become customary to provide some sort of external containment structure around the assembly as a barrier of last resort. Various types of such structures and the particular usefulness of each type are discussed. Design and evaluation studies on power reactors thus far authorized have led to certain practices in selection of reactor sites, and to patterns of site characteristics which are briefly described. (auth)

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5507 AEC-tr-3930
PROPOSAL FOR A METHOD OF REPORTING ON SAFETY. Translated for Atomics International from Energia elettrica 36, 367-8(1959). 9p. JCL.
An outline is presented for reporting on safety of a nuclear power station. (W.L.H.)

8806 AD-215506
Air Force Inst. of Tech., Wright-Patterson AFB, Ohio.
A TREATISE ON THE PRELIMINARY HAZARD SUMMARY REPORT FOR NUCLEAR FACILITIES (thesis). Gerald Bernard Connor. Mar. 1959. 120p.
A standardized routine and format are proposed for the writing of a preliminary hazards summary report for a nuclear facility. Each section of the suggested format is described in detail. What, why, and in what form items are to be included are discussed. (W.D.M.)

3177
SAFETY FACTORS IN NUCLEAR REACTORS. Francisco Oltra Oltra (Junta de Energia Nuclear, Madrid). Energia Nuclear (Madrid) 3, No. 11, 74-82(1959) July-Sept. (In Spanish)
The safety considerations in the design of nuclear reactors can be divided into nuclear considerations and engineering considerations. The nuclear and engineering factors are tabulated, and the method of calculating each is briefly indicated. The application and utilization of these factors in the calculations of reactors are discussed and examples are given. (J.S.R.)

3272
NUCLEAR POWER PLANT SAFEGUARDS AND CONTAINMENT. Robert H. Shannon (United Engineers and Constructors Inc., Philadelphia). p.60-89 of "Proceedings of the American Power Conference, March 31, April 1-2, 1959. Volume XXI." Chicago, Illinois Institute of Technology, 1959.
It is impossible to design, construct, and operate a nuclear power plant in such a way as to ensure or guarantee absolute safety. The material covered is limited to power reactors utilizing conventional heat-power cycles for producing electric power. Types of reactor accidents are discussed and the potential dangers of a reactor and associated facilities are treated. Items considered are control and safety systems, safety design philosophy, maximum credible accidents, design and construction codes, containment, site selection, radiation exposure, waste disposal, and fuel cycles. Current regulations and procedures covering permits and licenses for nuclear power plants are appended. (W.D.M.)

2549 GEAP-3068
General Electric Co. Vallecitos Atomic Lab., Pleasanton, Calif.
SUMMARY SAFEGUARDS REPORT FOR THE NUCLEAR TEST REACTOR. C. G. Andre. Oct. 7, 1958. 50p. $7.80(ph OTS); $3.30(mf OTS).
Appendix A of Amendment No. 2 to License Application for Nuclear Test Reactor.
The maximum and minimum transient and steady-state limits of operation for the reactor are set forth. The reactor, facility, and site are described. Reactor facility operating standards and procedures and safeguards and hazards evaluations are discussed. (W.D.M.)

4483 KAPL-A-RP-1
Knolls Atomic Power Lab., Schenectady, N. Y.
S3G RADIATION PROTECTION MANUAL. B. F. Knapp and W. H. Truran, eds. Oct. 15, 1959. 266p. Contract W-31-109-Eng-52. OTS.
A manual is presented which was prepared to serve as a training and operating guide for KAPL and USN personnel who perform radiation protection functions at the S3G facility. The S3G power plant, which consists of one reactor and one set of propulsion equipment, is used to evaluate the performance of the SSR(N)586 power plant in operation. The radiological hazards involved are summarized and instructions are provided for the operation of radiation protection instruments. Radiation exposure control limits, safe discharge limits for contaminated air and water, and methods of controlling and minimizing radiation hazards are included. (W.D.M.)

4127' HW-61236
General Electric Co. Hanford Atomic Products Operation, Richland, Wash.
PLUTONIUM RECYCLE TEST REACTOR FINAL SAFEGUARDS ANALYSIS. N. G. Wittenbrock, P. C. Walkup,

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and J. K. Anderson, eds. Oct. 1, 1959. 302p. Contract AT(45-1)-1350. OTS.

The Plutonium Recycle Test Reactor (PRTR) is designed to obtain experimental data on plutonium fuel technology and plutonium fuel cycle physics, and to produce irradiated fuel for the development of plutonium fuel chemical processing. Its main purpose is to provide a pilot scale demonstration of the economics and practicability of various plutonium recycle fuel concepts. The reactor complex is described in detail. The operating procedures, which are designed to maintain a high degree of reactor safety, are described. Reactor safeguards aspects of possible equipment malfunctions and failures are analyzed. (auth)

8306 NP-8299
Illinois. Univ., Urbana. Coll. of Engineering.
HAZARDS ANALYSIS FOR A TRIGA MARK II TRAINING AND RESEARCH NUCLEAR REACTOR TO BE INSTALLED AT THE UNIVERSITY OF ILLINOIS, URBANA. Oct. 1959. 123p. OTS.

A study of the elimination and control of potential hazards arising from a proposed reactor installation at the University of Illinois is presented. Criteria for the installation include maximum flexibility for experiments, inherent safety, and the capability for isotope production. Explanations of the safety and control features of the reactor (TRIGA), as well as the special precautions taken in building design to complete operational safety of the whole installation, are presented. (J.R.D.)

2559 NP-7041
North Carolina State Coll., Raleigh.
SUMMARY HAZARDS REPORT FOR NORTH CAROLINA STATE COLLEGE REACTOR NCSCR-4. C. M. Baldwin, Jr., D. B. Beman, H. B. Carter, H. A. Lamonds, J. W. Meeks, A. C. Menius, Jr., R. L. Murray, E. J. Story, and A. W. Waltner. Nov. 5, 1958. 103p. $16.80(ph OTS); $5.70(mf OTS).

An evaluation is presented of the hazards related to relocating the present Raleigh Reactor in a different building on the campus of North Carolina State College. Some of the experimental results on the present reactor are included which corroborate estimates made by the reactor staff prior to the initial critical experiment. Also the essential differences between the present reactor and the reactor in its new location are presented. These differences are primarily in the biological shield, the gas handling system, and the reactor building. (C.H.)

14890 IDO-16520(p.163-76)
Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho.
HEALTH PHYSICS PROBLEMS, MONITORING, AND DECONTAMINATION. J. W. McCaslin. p.163-76 [of] TEST REACTORS MEETING FOR INDUSTRY, IDAHO FALLS, IDAHO, MAY 13-15, 1959. PART I. CONSTRUCTION AND OPERATION OF TEST REACTORS. 14p.

An adequate health physics program at a test reactor is wholly dependent upon good design and construction; wholehearted support by management; competent technical and administrative health physics personnel; and sound financial investment and support. The fields covered include proper construction, monitoring instruments with alarms, waste disposal, special supplies and equipment, control procedures, personnel and equipment decontamination, personnel metering, minimum development facilities, and many related requirements. (auth)

8283 MND-M-1853
Martin Co. Nuclear Div., Baltimore.
PM-1 NUCLEAR POWERPLANT; HAZARDS SUMMARY EVALUATION. Oct. 15, 1959. 109p. OTS.

An evaluation was made of the potential hazards associated with the operation of the PM-1 Nuclear Power Plant at Warren Peak, Wyoming. It is shown that the plant operating personnel are protected from radiation hazards through properly designed radiation shielding. The use of detailed operating and maintenance procedures provides a further means of significantly reducing any potential hazards. The analysis of the hazards to the general public following an extreme accident is shown to be within generally accepted tolerances. In particular, the population of Sundance, Wyoming is sufficiently distant so as not to be jeopardized. As a result of these evaluations, it is believed that the PM-1 can be operated at the Warren Peak site without undue risk to the general public or to the Sundance Air Force Station personnel. (auth)

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7187 A/CONF.15/P/2297
DISASSEMBLY OF EXPERIMENTAL URANIUM-GRAPHITE ISOTOPE REACTOR AFTER FOUR YEARS OF OPERATION. B. B. Brohovich, F. I. Ovchinnikov, V. I. Klimenkov, P. V. Glazkov, and B. M. Dolishnyuk (U.S.S.R.). 29p.
The principal stages in the disassembly of the reactor (I.R.), the individual safety measures, the effectiveness of these measures, and the state of reactor design units are described. Particular attention was given to the state of reactor masonry in connection with the destruction of fuel elements. (W.D.M.)

9068 ANL-5574
Argonne National Lab., Lemont, Ill.
RADIATION SAFETY GUIDE. J. R. Novak, ed. June 1956. 74p. Contract W-31-109-eng-38. $0.75(OTS).
Work with radioactive substances may involve some danger, and safety precautions must be taken before the work is started. This Guide includes suggested precautions to provide adequate protection, as well as some general information concerning possible radiation hazards and the effects of radiation on the body. It also contains procedural information which will be an aid in coping with radiation safety problems as they occur. (auth)

14526 A/CONF.15/P/758
General Electric Co. Hanford Atomic Products Operation, Richland, Wash.
RADIATION PROTECTION RECORDS AT A MAJOR ATOMIC ENERGY FACILITY. A. R. Keene, J. W. Vanderbeek, and E. C. Watson. 9p. $0.50(OTS).
Prepared for the Second U. N. International Conference on the Peaceful Uses of Atomic Energy, 1958.
A system is described whereby the radiological exposure status of some 9,000 individuals and their environment is determined, evaluated, and recorded. The facility involved has a full spectrum of atomic energy activities. Included are the fabrication of radioactive fuel elements, the utilizing of these fuel elements in several water cooled reactors, the processing of the fuel after irradiation, plus the many supporting activities such as radiation laboratories, Van de Graaff generators, x ray machines, and waste disposal. The radiological controls and records of these work locations, (particularly the Radiation Zones) is detailed.

4917 ANL-5577
Argonne National Lab., Lemont, Ill.
SOME PROBLEMS IN THE SAFETY OF FAST REACTORS. R. O. Brittan. [May 1956]. 67p. Contract [W-31-109-eng-38]. $0.45(OTS).
A safety survey of fast reactor systems was begun at Argonne National Laboratory by studying the characteristic kinetic behavior of such systems. To make this study possible, the problem of programming and coding the solution to the equations describing this behavior for the available digital computer (AVIDAC) was undertaken. (auth)

3174
NUCLEAR PROBLEMS AND STRUCTURAL QUESTIONS IN THE CONSTRUCTION OF REACTORS. P. Eversheim (Vereinigten Leichtmetall-Werke GmbH., Bonn). Atompraxis 5, 362-7(1959). (In German)
The most important physical and thermal properties of the various structural elements of a reactor, which are exposed to nuclear radiation, are described, and the conditions for canning materials, properties of corrosion, and the effect of radiation on structural materials are discussed. Metallurgical problems are discussed in addition. (auth)

7078 AERE-R-2947
United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England.
THE ORGANIZATION AT A.E.R.E. HARWELL FOR SAFETY CLEARANCE OF REACTORS. N. G. Stewart and L. Wilson. Oct. 1959. 15p. BIS.
The methods developed and used by the U.K.A.E.A. Research Group Reactor Safety Clearance Committee on the design features and operational procedures necessary to ensure safety from nuclear hazards arising in connection with reactors are summarized. The conclusions to be drawn are pointed out. The need is stressed for preparation of a comprehensive safety document for each reactor or approach-to-criticality installation and for detailed scrutiny of it by independent experts. (auth)

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6691 A/CONF.15/P/1138
DONNEES DE LA SURVEILLANCE ET REGLES QUI EN RESULTENT EN WATIERE DE PROTECTION CONTRE LES RAYONNEMENTS. (Regulations Concerning Radiation Protection and Survey). Duhamel, Lavie, and [L.] Fitoussi (Commissariat à l'Énergie Atomique, Paris). 74p.

A comparative study of the radiation hazards to which the people working in installations of the Commissariat à l'Énergie Atomique are exposed was made and the results reported. The few contamination and irradiation incidents were discussed. Contaminating sources are classified according to the recommendations of the International Commission on Radiologic Protection. The dangers of irradiated elements are discussed. The controls and regulations used for radiation protection are described. (J.S.R.)

5508 ✓ AEC-tr-3931
RECOMMENDATIONS FOR PROTECTION AGAINST IONIZING RADIATIONS IN INDUSTRIAL OPERATIONS CONNECTED WITH THE GENERATION OF ELECTRIC POWER FROM NUCLEAR ENERGY. Translated for Atomics International from Energia elettrica 36, 243-9(1959). 16p. JCL.

Recommendations are presented for the protection of personnel against the hazards of radiation in industrial operations connected with the generation of electric power from nuclear energy. (C.H.)

7094
RADIATION PROTECTION IN REACTORS AND NUCLEAR INSTALLATIONS. [PART IV]. M. Oberhofer and P. Kienle (Technische Hochschule, Munich). Kerntechnek 1, 150-6(1959) Nov. (In German)

The bases of radiation protection measurement techniques are considered. The principles of radiation detection for charged and uncharged particles and for quantum radiations are illustrated. The operation of ionization chambers and their application to the measurement of integral doses and dose rates are described.

7149 MND-LFBR-2179
Martin Co. Nuclear Div., Baltimore.
PRELIMINARY HAZARDS REPORT FOR THE LFBR CRITICAL EXPERIMENT. Dec. 1959. 154p.

Information is given for an evaluation of the Liquid Fluidized Bed Reactor (LFBR) Critical Experiment Facility addition. The site description contains analyses of the location, population, meteorology, geology, hydrology, and seismology of the CRF site. A description of the addition to the existing CRF includes a complete description of the internal and external features of the addition. The operative safeguards to be incorporated into the facility are health physics, fuel element handling and storage, exhaust air control, waste disposal, and background monitoring. An evaluation was performed to determine the potential hazards to personnel in the facility and the residential population. A 2% step input analysis is presented and shown to produce a maximum 900-Mw sec energy release. (W.D.M.)

9193
NUCLEAR SAFETY. Technical Progress Reviews, Vol. 1, No. 2. W B. Cottrell, ed. Oak Ridge, Tenn., Oak Ridge National Lab., 1959. 70p. $0.55(GPO) domestic; $0.70 foreign.

The first section is devoted to nuclear safety criteria and discusses the AEC reactor safety program, site selection criteria, safety in the handling of fissionable materials, and atomic energy hazards. Accident analysis is discussed in the second section and includes fission product release from UO_2, chemical reactions of reactor materials, release of Wigner energy from graphite, and reactor kinetics calculations. In the third section reactor safety features are discussed and include aseismic reactor design, auxiliary and emergency electric power systems, and xenon instability. Plant safety features are presented in section four and include decontamination hazards, concrete pressure vessels, and fuel-reprocessing hazards. Section five is devoted to activity release and consequences and includes contamination of the lithosphere, radiation monitoring of large areas, and personnel exposures following accidental release. The last section presents current events and includes nuclear incidents, activities of the Advisory Committee on Reactor Safeguards, Experimental Gas-cooled Reactor safeguards review, and safeguards reports and bibliographies. (W.L.H.)