SECRET

OAK RIDGE NATIONAL LABORATORY
CENTRAL FILES NUMBER
49-3-118

B-137

Date March 8, 1949

File Waste Disposal

Subject Status of Liquid Waste Disposal Program at ORNL

Those Eligible To Read The Attached

By F. L. Steahly/R. J. Morton

Copy # 13A

To

E. J. Murphy

Before reading this document, sign and date below:

CLASSIFICATION CANCELLED
DATE NOV 6 1958
Edgar J. Murphy
CO-ORDINATING ORGANIZATION DIRECTOR
OAK RIDGE NATIONAL LABORATORY

This document has been approved for release to the public by:

David C. Hamrin 4/14/95
Technical Information Officer, ORNL Site — Date

TRANSMITTAL DATED 3-9-49

CAUTION

This document contains information affecting the National Defense of the United States. Its transmission or the disclosure of its contents in any manner to an unauthorized person is prohibited and may result in severe criminal penalties under applicable Federal laws.

RESTRICTED DATA

This document contains restricted data as defined in the Atomic Energy Act of 1954.

SECRET

This document consists of 8 pages and 0 figures.
No. 13 of 20 copies, Series A.

STATUS OF LIQUID WASTE DISPOSAL PROGRAM AT ORNL

Introduction

The present waste disposal procedure at ORNL is inadequate as demonstrated by the fact that an average of five curies of radioactivity in a volume of 500,000 gallons of water are discharged per day from the Laboratory into White Oak Creek, which empties into the Clinch River.

A program is under way at ORNL for the development of more effective methods for the retention on the plant site of the radioactivity from liquid wastes by separation and decontamination from constituents. The Technical Division of ORNL is responsible for the development of chemical processes utilizing more economical methods of storing the bulk of the radioactivity and providing a reduction of the amount of activity discharged into the settling basin. The Health Physics Division is responsible for the control of the activity after it reaches the settling basin.

Concentration of the radioactive solutions by a factor of at least 10^4 less than the volume in which they are now discharged to storage tanks should be possible. For instance, the water can be removed by evaporation and the inactive salts may be removed by chemical means involving one or more of the following processes: crystallization, precipitation, ion exchange, solvent extraction, and volatilization. All of this chemical development is of local significance; however, certain aspects are of interest to other sites. A letter covering these external AEC interests will be written subsequently.

The general purpose of the Health Physics program is to plan and conduct a program of survey and experimental research designed to define the

problems of radioactive waste disposal in relation to water, air, soil, biological life, and other aspects; and, to study the factors that influence their extent and significance; and to aid in the development of measures for the alleviation or control of the existing problems here and at other AEC installations.

Technical Division Activities

The Present ORNL Waste System

The ORNL radioactive liquid waste is separated into only two classifications: metal waste containing a significant amount of uranium; and radiochemical wastes containing little or no uranium. Since the concrete ORNL storage tanks, in which these wastes are held are attacked by acid, all wastes are neutralized to a pH of about 11 with sodium carbonate or sodium hydroxide before storage. This procedure may be undesirable on a long-term basis because neutralization significantly increases the volume and the solids content of all the wastes.

In the radiochemical waste system, the solution is held up as long as existing tankage will allow for decay of the short-lived fission products before discharge to White Oak Creek.

The uranium in the metal waste tanks is now precipitated by the addition of sodium hydroxide, and the supernatant is discharged to the radiochemical waste storage system (after part of the Ru has been removed by a ferric hydroxide scavenging precipitation for radioisotope distribution) to make the solution alkaline and to provide increased metal waste storage capacity.

[redacted]

Radiochemical Waste Concentration

The average radiochemical waste at ORNL consists of three percent solids and 10^5 to 10^6 beta cts/min/ml and 10^2 to 10^3 gamma cts/min/ml. Since essentially all the available tank space for radiochemical waste is filled, a 4000 gallon per day capacity evaporator is now being designed as an initial step in alleviating this waste problem. This evaporator is expected to be in operation by June, 1949. With this system in operation, all the current waste should be concentrated and all the existing tanks emptied within a couple of years. A condensate decontamination factor of 10^4 (10 to 100 beta cts/ml) and a volume reduction of at least 20 has been demonstrated in a 10 liter semi-works scale evaporator.

Work is now underway in the laboratory on the problem of further concentration of the evaporator liquor and additional decontamination of the evaporator condensate. A concentration factor of 10 has been shown on a laboratory scale by crystallization of sodium nitrate from the evaporator liquor. The crystalline sodium nitrate obtained in laboratory scale experiments was essentially free of activity. This process is being checked on a 10 liter scale. If this procedure is successful on a large scale, the useful life of the present storage facilities should be extended several fold (without this step, the present tanks should be adequate for active concentrate storage for 5 to 10 years).

If the condensate from the evaporator (10 to 100 beta cts/min/ml) appears to be too contaminated for discharge, an additional decontamination of 10 to 100 is indicated by laboratory experiments using ion exchange columns.

[redacted]

Uranium Recovery from Metal Waste

Equipment for evaluating a uranyl ammonium phosphate precipitation process (developed by K-25) on a 50 gallon semi-works scale is being installed and should be ready for operation in May, 1949. In addition, the ORNL group is assisting K-25 in developing the process on a laboratory scale. The non-metal waste from this process will be concentrated by evaporation by much the same procedure as is used for radiochemical waste.

The development of a solvent extraction process for ORNL uranium recovery was recently started in the laboratory. Preliminary data indicate that this procedure might be best for the ORNL uranium recovery problem.

25 and Redox Waste Concentration

The waste solutions from the Redox and 25 solvent extraction process will contain a large amount of aluminum nitrate. Hence, appreciable volume reduction is not possible until the aluminum nitrate is removed. This has been accomplished on a laboratory scale by two procedures: ion exchange, preceded by a scavenging precipitation, as developed at ORNL; and an acid crystallization of aluminum nitrate, as developed at KAPL. Both of these procedures utilize an evaporation step for the volume reduction of the dilute waste. A semi-works scale ion exchange demonstration for this problem is planned for the near future.

Health Physics Division Activities

This program was developed in recognition of the importance of waste disposal in the atomic energy program and the scarcity of definite informa-

tion regarding the nature, extent, and means of control of health problems that exist or may result from radioactive wastes. On the recommendations of the Safety and Industrial Health Advisory Board and of other authorities, the Health Physics Division has adopted a basic sanitary engineering approach to the problem with the cooperation of the USPHS, TVA, AEC, and other divisions of the Laboratory in the provision of qualified personnel of various abilities and experience for a concerted attack.

In relation to the program of the Laboratory as a whole it is generally understood that the responsibility of the Waste Disposal Section is to study and develop methods for appraising and dealing with the problems of radioactive materials that escape or are discarded. Recovery or removal of radioactive materials at the source is recognized as essential in relation to the public health aspects of waste disposal.

As a rule, the levels of activity in the wastes are not high but investigations of their behavior and effects involve not only physics, chemistry, and sanitary engineering but also various collateral fields such as meteorology, geology, and biology. In order to make the program specific, yet broad, the functions of the Health Physics group are of two general types: (1) to make surveys and conduct experimental research and practical studies directly in the Health Physics Division; and (2) to encourage and assist with a broader program of studies in which various other agencies participate.

The problems of liquid waste disposal occupy a large proportion of the specific studies undertaken or in prospect. These include surveys of

streams and other waters of this vicinity to determine the extent, nature, and importance of local dispersal and to gain fundamental knowledge of the behavior of radioactive wastes. It is essential that cooperative work and effective inter-relationships be maintained with various agencies; for example, with the TVA in the stream survey program, with special studies of meteorology, geology, and biology in this region which have been initiated by AEC consultants, and with public health authorities who may be responsible for health protection in states and communities generally. Within the Health Physics Division the program is assisted by instrument development and other specialists and by analyses of data from the Area Monitoring Group whose monitoring and sampling activities are closely related to waste disposal research. Technical advice and consultation are obtained from other divisions of ORNL, particularly the Divisions of Chemistry and Biology, and special analyses and other services are utilized in the waste disposal studies program.

Jointly with the TVA, an extensive preliminary survey of Clinch River and Watts Bar Reservoir was carried out in September and October, 1948, including samples of water, mud, algae, and fish from various points for making ecological studies. These data have been assembled and reports are being prepared. Intensive studies of White Oak Creek and Lake are well under way and the first of a series of reports on this drainage stystem below the Laboratory has been prepared.

In addition to orientation of personnel and survey studies, a start has been made on laboratory experiments, research techniques, and instru-

mentation for the program. During the period from January to June, 1949, laboratory studies of the well-known water and sewage treatment processes and related methods will be carried on, and a more systematic survey program has been arranged in cooperation with the TVA. It is expected that during fiscal year 1950 the group, as now organized, will continue laboratory research and, in addition, should have available a proposed experimental plant and laboratory building for waste disposal research. This building will provide, in effect, an experiment station where studies of water and sewage treatment methods and other waste disposal processes can be carried through in logical sequence, including pilot plant tests to confirm laboratory results and to determine basic efficiency, capacity, and other design factors. The necessity and desirable scope of research concerning water purification, sewage treatment, and related processes have been considered in various proposals and reports and records of group discussions.

Chemistry Division Activities

At present the Chemistry Division is not engaged in any problems associated directly with the waste disposal program. However, much assistance and cooperation are rendered indirectly by furnishing fundamental data applicable in developing the various processes; consultation; and making chemical analyses.

ORNL Personnel

The Health Physics personnel on this problem include: four senior personnel (sanitary engineers and sanitary chemists), three junior

SECRET

scientific personnel (a chemical engineer, a chemist, and a research assistant with biological training), a secretary, and a laboratory assistant, all of whom are engaged full-time in the waste disposal studies program. Three of the senior personnel are provided by cooperative two-year loans, two from the U. S. Public Health Service, and one from the Tennessee Valley Authority. In addition, an officer trainee of the U. S. Navy Civil Engineer Corps has been assigned to work with this group approximately half-time for an indefinite period.

The Technical Division has three chemists, one chemical engineer, and two technician assistants assigned regularly to chemical process development waste problems. An average of two design engineers per year of the Division are called upon for design assistance. Sufficient personnel to operate the uranyl ammonium phosphate semi-works will be supplied.

F.L.Steahly/R.J.Morton/ebr

3-8-49

Distribution:

1 - 4. A. H. Holland
5. K. Z. Morgan
6. R. J. Morton
7. M. D. Peterson
8. F. L. Steahly
9. J. A. Swartout
10. F. Western
11. C. E. Winters
12. A. M. Weinberg
13-14. E. J. Murphy
15-20. Central Files

SECRET