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ORNL-NSIC-55
Vol. III

DESIGN DATA AND SAFETY FEATURES OF COMMERCIAL NUCLEAR POWER PLANTS

Vol. III
Docket No. 50-397 Through 50-449

FRED A. HEDDLESON

NUCLEAR SAFETY INFORMATION CENTER

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ORNL-NSIC-55
Vol. III

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Nuclear Safety Information Center

DESIGN DATA AND SAFETY FEATURES OF COMMERCIAL NUCLEAR POWER PLANTS

Vol. III

Docket No. 50-397 Through 50-449

Fred A. Heddleson
Reactor Division

APRIL 1974

OAK RIDGE NATIONAL LABORATORY
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TABLE OF CONTENTS

INDEX BY DOCKET NUMBER

INDEX BY NUCLEAR POWER STATION PLANT NAME

INDEX BY UTILITY NAME

FOREWORD

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6. Reactor Transients, Kinetics, and Stability
7. Fission Product Release, Transport, and Removal
8. Sources of Energy Release under Accident Conditions
9. Nuclear Instrumentation, Control, and Safety Systems
10. Electrical Power Systems
11. Containment of Nuclear Facilities
12. Plant Safety Features — Reactor
13. Plant Safety Features — Nonreactor
14. Radionuclide Release and Movement in the Environment (inactive September 1973)
15. Environmental Surveys, Monitoring, and Radiation Exposure of Man (inactive September 1973)
16. Meteorological Considerations
17. Operational Safety and Experience
18. Safety Analysis and Design Reports
19. Radiation Dose to Man from Radioactivity Release to the Environment (inactive September 1973)
20. Effects of Thermal Modifications on Ecological Systems (inactive September 1973)
21. Effects of Radionuclides and Ionizing Radiation on Ecological Systems (inactive September 1973)

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Oak Ridge, Tennessee 37830

Telephone 615-483-8611, Ext. 3-7253
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DESIGN DATA AND SAFETY FEATURES OF COMMERCIAL NUCLEAR POWER PLANTS

Vol. III

Docket No. 50-397 Through 50-449

ABSTRACT

Design data, safety features, and site characteristics are summarized for 33 nuclear power units in 17 power stations in the United States. Six pages of data are presented for each plant consisting of Thermal-Hydraulic and Nuclear Factors, Containment Features, Emergency Core Cooling Systems, Site Features, Circulating Water System Data, and Miscellaneous Factors. An aerial perspective is also presented for each plant. Those covered in this volume are Hanford No. 2, Docket Number 50-397, and all subsequent plants finishing with Douglas Point, Docket Number 50-448, 50-449.

INTRODUCTION

The data summaries for this report were taken from the Preliminary Safety Analysis Reports (PSAR), Final Safety Analysis Reports (FSAR), and the Environmental Report generated for the U.S. Atomic Energy Commission licensing authorities by applicants wishing to build and operate nuclear power plants. These reports consist of 800 to 2000 pages of information which describe the reactor, the reactor site, the power generation system, auxiliaries, and other aspects of importance in the safety assessment of reactor design, construction, and operation. Unless a person is familiar with the organization of the reports, finding specific information therein can be very time consuming. Even when the organization is understood, it can still be difficult to find data because of variations in the style of the reports. This compilation of summary data is intended to make the more important information readily available.

The U.S. Atomic Energy Commission has issued a guide for organization of material, and this guide is generally followed now for all PSARs and FSARs. The suggested organization is as follows:

I. Introduction and General Description of the Site
II. Site Characteristics
III. Design of Structures, Components, Equipment and Systems
IV. Reactor
V. Reactor Coolant System
VI. Engineered Safety Features
VII. Instrumentation and Controls
VIII. Electric Power
IX. Auxiliary Systems
X. Steam and Power Conversion System
XI. Radioactive Waste Management
XII. Radiation Protection
XIII. Conduct of Operations
XIV. Initial Tests and Operations
XV. Safety Analysis
XVI. Technical Specifications
XVII. Quality Assurance

In 1967, the Advisory Committee on Reactor Safety (ACRS) requested that the Nuclear Safety Information Center compile design data on light-water power reactors in a concise tabular format for use by their Comittee. Since that time, tables have been prepared for each power reactor and made available on a limited distribution basis to ACRS, several USAEC Headquarters Offices, and the NSIC staff. The data summaries, which contain about 150 of the more important reactor facts, have proven to be quite useful to these groups and numerous requests have been received for summaries from other organizations that became aware of their existence. These summaries are now being issued in report form in order to make this information more widely available.

Volume II was published in January 1972 covering commercial power reactors with docket numbers larger than and including 50-296 (Browns Ferry No. 3). Volume I publication (December 1973) covered power reactors up to and including docket number 50-295 (Zion Station). This Volume III starts with Hanford No. 2, 50-397, and runs up through Douglas Point, 50-448, 50-449. In the index by sequential docket number, some numbers are missing. The missing docket numbers are for experimental reactors and/or for those not producing commercial power.

Organization of Information

Reactor summaries appear sequentially according to docket number. Some general information such as name, size, location, utility, etc. is listed at the top of the first page, followed by information organized as follows:

A. Thermal-Hydraulic Data — Tabulations of data values on the thermal-hydraulic design characteristics of the reactor core and coolant systems.

B. Nuclear Data — Tabulations of data values on nuclear aspects of the reactor core.

C. Safety-Related Design Criteria — Listing of data on exclusion distance, populations, design wind speed, seismic design, etc.

D. Engineered Safety Features — Data on containment design values, containment system descriptions, emergency core cooling systems.

E. Other Safety-Related Features — Descriptions of auxiliary safety features such as leak detection, long-term emergency cooling, flow restrictors, failed fuel detection, emergency power, etc.

F. General — Other important information such as site features, emergency plans, environmental monitoring, radwaste treatment, waste heat system, etc.

G. Site Data — Information on site topography, population, evaluations, cooling water source, circulation rate, cooling towers, etc.

The seventh page of each report is an aerial perspective sketch of the plant.

Parameters are related to rated power output for a single unit unless otherwise noted. For instance, in a case where the reactor report covers two or three reactors of the same rating at one site, all data values given will be for one unit. Aerial perspective presents a graphic description of the reactor and site features. The terms and features used on it are explained in Figure 1. In most cases, the size of the reactor building and turbine building on the sketch has been increased over true size to better show their relationship to the site.

LEGEND - Parameters refer to each single reactor unit except as noted.

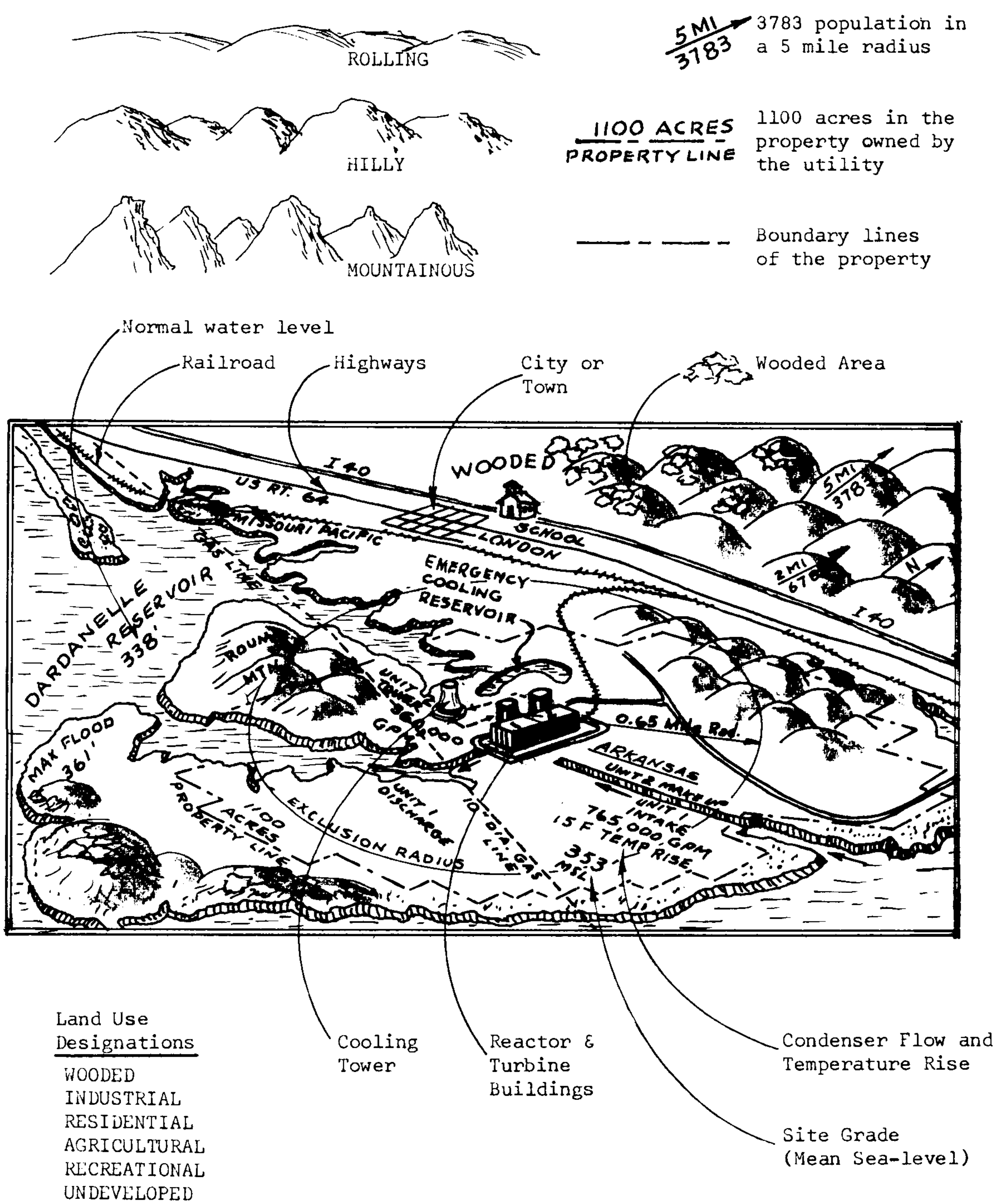


Fig. 1. Explanation of Terms for Site Sketch

Accuracy of Data

All information presented in this publication has been taken from the Preliminary Safety Analysis Reports, the applicant's Environmental Report, or the AEC Environmental Impact Statement. In view of the many changes that may be made in plant design and/or operating conditions in the course of the licensing and subsequent operation of nuclear power plant, the author cannot guarantee the currency of all of the information herein. However, if persons are aware of information which is not correct, NSIC would like to be informed.

GLOSSARY OF TERMS

The following terms and abbreviations are used in the data summaries in this report. This glossary is provided to assist the user in understanding the context in which the terms are applied and to identify the abbreviations.

A-E — Architect-Engineer for the plant. Sometimes the firm serves as consultants to the utility who do their own design and drafting.

Accumulator Tanks — Tanks that contain borated water under pressure (usually about 600 psig) for injection into the primary system of a PWR in the event of a loss of cooling accident. When coolant system pressure drops to tank pressure, check valves open allowing water flow that will flood the core.

Active Heat Transfer Surf Area — The surface area of all fuel rods, measured on the active fuel-portion of the rods.

Auto-Depressurization System — The system that uses pressure relief valves to vent steam to purposely lower reactor pressure so other core cooling systems can operate.

Average Discharge Exposure, MWD/Ton — Average burnup of fuel upon removal from service, expressed in megawatt days per metric ton of fuel.

Avg Film Coeff — An average over the active core of the convective film heat-transfer coefficient, h, defined from

$$Q/A\Delta t_{1m} \equiv h$$

where Q is the heat removed per unit time from fuel surface area A, and Δt_{1m} is the log-mean temperature difference between the coolant and the surface.

Avg Film Diff — The average difference between the local coolant bulk mean temperature and the local fuel clad surface temperature.

Avg Power Density — The power generated in the active core divided by the core volume.

Average Power Range Monitor (APRM) — Selected amplifiers from the Local Power Range Monitoring (LPRM) system are averaged in the APRM.

Blowdown — The quantity of water bled off from the cooling tower collection basin to rid the towers of progressive buildup of dissolved solids. Makeup water to the system replaces blowdown.

BWR — Boiling water reactor.

Burnable Poison — Neutron absorbing materials of relatively high microscopic absorption cross section which are converted to low absorption isotopes by neutron absorption and which are incorporated into reactors to compensate for part or all of the reactivity decrease that would otherwise result from fuel exposure.

Chemical Shim — Supplementary control of the core reactivity by the use of chemical poisons (such as boric acid) in the coolant.

Clean — The reactor and/or fuel elements are said to be clean if fuel elements are nonradioactive and uncontaminated by the products of nuclear reaction.

Closed-Loop-Cooling — Operation of the circulating water system so that water is circulated within a closed loop for condensing steam in the condenser and cooling the water in cooling lakes, cooling towers, or other heat sinks.

Circulating Water System — An arrangement of pipes, valves, controls, and pumps that circulate water through the main turbine-condenser (to condense steam in the condenser) and the ultimate heat sink (cooling lake, cooling towers, etc.) where the heated water is cooled. This can be open-cycle cooling or closed-loop cooling (see definition).

Cold — At ambient temperature.

Containment Atmospheric Control System — A system used to inject nitrogen into containment for inerting. Other aspects of atmospheric control listed as applicable.

Containment Constructor — The contracting firm which erects or fabricates the primary containment structure. In most cases, the actual contractor's name is not available. In these cases, the responsible party such as the utility or A-E will be given.

Containment Cooling System — Spray cooling system for reducing drywell pressure following loss of coolant; or fan coil cooling units that recirculate the air.

Containment Isolation System — A system that provides the method for sealing all openings in the containment system. Each penetration has two isolation valves, one on the inside and one on the outside of the primary containment wall. In case of an accident, the isolation valves close automatically.

Control Rod — A device made of neutron absorbing material capable of being moved into or out of the core to regulate power.

Control Rod Drive Housing — Tube and flange attached to the reactor pressure vessel for the purpose of mounting and containing the control rod drives.

Control-Rod-Drive-Housing Supports — Structural members located under the reactor vessel close to the control-rod-drive housing for the purpose of catching, supporting, and/or preventing excess movement of the control rod, in case a housing ruptures.

Control-Rod Velocity Limiter — An integral part of a control rod mechanism which limits the free-fall velocity of a control rod.

Control Rod Worth Minimizer — Electronic computing device which is used to monitor the control rod pattern in the reactor core. Interlocks are provided which prevent the withdrawal of a control rod with a worth above the established value.

Core Average Void Within Assembly — The percent of voids in the coolant within a fuel assembly.

Core Reflooding System — High flow system to rapidly flood the reactor core following loss of coolant.

Core Spray System — A water system, activated in the event of loss of core cooling, which sprays water on the top of the core to remove reactor core decay heat (used on BWRs only).

Critical Heat Flux — The heat flux at which transition film boiling starts to replace nucleate boiling. It is characterized by an abrupt change in surface heat transfer coefficient.

Curtain Worth — The reactivity worth of the poison curtain.

Design Basis Earthquake — That earthquake which produces the vibratory ground motion for which those features of the plant necessary to shut down the reactor and maintain the plant in a safe condition without undue risk to the health and safety of the public are designed to remain functional.

Design Criteria — A list of requirements of the U.S. Atomic Energy Commission that govern reactor design.

Discharge Structure — The means of discharging water into the lake, river, ocean, or cooling pond. It can be very simple such as a short canal running into the water body, or it can be a complex diffuser system that disperses the water through many openings or jets.

Docket No. — The number assigned by the AEC Directorate of Licensing to a particular reactor when the PSAR is accepted for review.

Doppler Coefficient — The reactivity change due to Doppler broadening of ^{238}U resonance absorption cross section as a result of a change in temperature.

DNBR, Nominal — Departure from Nucleate Boiling Ratio, the minimum value of the ratio of heat flux required for DNB as calculated from the Westinghouse correlation (W-3) divided by the local heat flux in the fuel element.

Drywell — Vessel enclosing the reactor primary system and forming part of the primary containment system of a BWR.

Eff Flow Area for Heat Transfer — The total effective cross sectional area of the fuel channels through which the water flows through the core.

Eff Flowrate for Heat Transfer — That portion of the coolant flow that passes directly through the active core for cooling the fuel elements.

Emergency Power — Electrical power supplied to equipment that must operate in an emergency; usually supplied by diesel-generator sets if offsite power supply is lost. Emergency alternating current is available for engineered safety features and other necessary equipment.

Engineered Safety Features (ESF) — Special systems designed to operate in a nuclear power plant so as to prevent or mitigate the consequences of an accident. Engineered Safety Features include containment vessels, containment sprays, filter systems, emergency core cooling systems, scram system, and the like.

Environmental Monitoring — Collection and analysis of samples of the environment (air, water, soil, aquatic life, terrestrial, etc.) to evaluate effects that might result as a consequence of plant operation.

Evaporative Loss — The loss of water from the cooling tower that evaporates into the cooling air that passes through the cooling tower. This water is continuously replaced by the makeup water system.

Exclusion Distance — The distance from the centerline of the reactor to the nearest exclusion fence boundary.

Flow Restrictor — A static device placed in a steam or water line for the purpose of restricting the blowdown rate in the event of a major line break. The device affords protection for the core, reduced load on the containment system, and additional time for the initiation of the emergency systems.

Fuel Assembly — Assembly of fuel rods, spacers, and related hardware.

Fuel Channel — An open space in the core structure into which the fuel assembly is inserted that provides a coolant flow path through the assembly.

Fuel Element — See Fuel Assembly.

Fuel Rods — Assembly of fuel pellets, fuel cladding, and related hardware welded into a sealed unit.

Fuel Rod Cladding — The material enclosing the UO_2 fuel pellets.

Full Power Xe and Sm — The equilibrium concentrations of the Xenon and Samarium poisons present at full power.

Heat Dissipated to Environment — The quantity of heat ejected to a nearby body of water by discharging quantities of heated water into that water body; or the dissipation of heat to the atmosphere by cooling towers.

High-Head Safety Injection System — See High-Pressure Coolant-Injection System.

High Pressure Coolant-Injection System — High pressure pumps, valves, piping, etc., used to provide emergency core cooling in the event of failure of a small process line.

Hot — At temperatures corresponding to full power operation.

Hydrogen Recombiner — Equipment that combines free oxygen and free hydrogen to produce water. The purpose is to eliminate free hydrogen from the gaseous systems.

Intake Structure — The structure that houses circulating pumps, traveling screens, bar screens, and other devices used in moving water from the water source to the plant. In some cases, the intake structure will include the pipes that run out into the water body and the remote structure for intake.

Isolation Cooling System — High pressure system for rejection of core decay heat when the reactor is isolated from the main condenser.

k_{eff} — The effective multiplication constant of the core.

LOCA — Loss of coolant accident.

Local Power Range Monitor (LPRM) — In-core ion chambers for monitoring local neutron flux in the reactor core.

Low-Head Safety Injection System — See Low-Pressure Coolant Injection System.

Low-Pressure Coolant Injection System — A system of pumps, valves, piping, etc., that pumps quantities of water into the coolant system to reflood the core after blowdown.

Low Population Zone Distance — The radius that circumscribes an area immediately surrounding the exclusion area which contains residents, the total number and density of which are such that there is a reasonable probability that appropriate protective measures could be taken in their behalf in the event of serious accident.

MCHFR — See Minimum Critical Heat Flux Ratio.

MTU — Metric ton of uranium. One metric ton = 1000 kg = 2205 lb.

MWD — Energy in megawatt-days.

Main Steam Lines — Piping which passes steam from the reactor of a BWR or from the steam generator of a PWR to the turbine.

Max Prob Flood Level — The maximum hypothetical elevation at the site to which water could rise in case of the most severe rain, with the most severe winds, with bursting dams, etc.

Metropolis — The nearest city to the plant that is classified as a U.S. city with Standard Metropolitan Statistical Areas as compiled from the Bureau of the Census by the World Almanac. Population figures are the 1970 Total metropolitan area census.

Minimum Critical Heat Flux Ratio (MCHFR) — The smallest ratio of critical heat flux divided by the local heat flux existing in the reactor core at any point in time.

Moderator Coefficient — A combination of moderator void coefficient and moderator temperature coefficient.

Moderator Pressure Coefficient — The change in core reactivity per unit change in moderator pressure.

Moderator Temperature Coefficient — The change in core reactivity level for a unit temperature change in the moderator.

Moderator Void Coefficient — The change in the core reactivity level for a unit change in moderator void content.

NSS Vendor — Supplier of the nuclear steam supply system.

Normal Level — Normal pool elevation in mean sea level (MSL) measurement of the body of cooling water.

Once Through — The cooling cycle where water is removed from the nearby water source, pumped through the condenser for cooling and then discharged back into the river, lake, or ocean.

Open-Cycle Cooling — The system that uses water in the circulating system for once-through cooling. Water is taken from the river, lake, or ocean and used to cool the condenser. It is then discharged back to the same body of water with the added heat.

Operating Basis Earthquake — That earthquake which produces the vibratory ground motion for which those features of the plant necessary for continued operation without undue risk to the health and safety of the public are designed to remain functional.

PWR — Pressurized water reactor.

Peak Enthalpy on Rod Drop — Melting of UO_2 occurs between 220 and 280 cal/gm, and fuel rod rupture will occur about 400 cal/gm. Thus the 280 cal/gm, which represents a safe condition for the fuel, is usually set as the peak enthalpy value acceptable during a power excursion that could occur in a rod drop accident.

Peaking Factor — A term used with heat flux where the peaking factor is the maximum value divided by the average value, whether it be along a fuel rod or radially in the core.

Penetration — A pipe or sleeve which penetrates the containment wall - pipes for flow of fluids, steam, or gases, and special sleeve-plugs for electrical distribution.

Percent Enrichment — Atoms of uranium 235 per 100 atoms of a uranium mixture of ^{235}U and ^{238}U. This quantity may also mean atoms of fissionable nuclide per 100 atoms of metal fuel mixture.

Plant Operating Mode — The manner in which the controls operate the plant, either changing reactor power to match changing electrical load patterns (load-following), or maintaining a constant electrical output from the generator (base-loaded).

Prevailing Wind Direction — The direction from which the wind usually blows.

Primary Containment (System) — Housing for the reactor primary system designed to prevent the release of radioactive materials to the environment in the remote event of accident. In a BWR the system includes the drywell, the pressure suppression pool contained in the torus and the vent pipes. The pool provides a heat sink for rapid reduction of pressure following a loss of coolant accident. In a PWR, the containment system includes the containment vessel, its isolation system, and the spray system which cools the atmosphere and reduces the pressure.

Protective System — The instrumentation system which handles all functions of control relative to operation of engineered safety features or other equipment or functions designed for protection of the plant.

Radwaste — Contraction of the words "radioactive" and "waste," used to describe waste substances which may contain radioactive materials.

Radwaste System — System for handling, treating, or storing solid, gaseous, or liquid wastes which contain radioactive materials.

Reactor — The pressure vessel, the pressure vessel internals, and the control rod drives in which the fission process occurs. In power reactors the fission energy is removed from the reactor by a fluid system which utilizes the energy.

Reactor Building — A nominally leaktight housing for the reactor, reactor auxiliary systems, and the primary containment system, generally referred to as secondary containment.

Reactor Core Isolation Cooling System (RCICS) -- Provides core cooling in case the reactor is isolated from its normal heat sink. It is also used in case of loss-of-flow from the feedwater system and during shutdown by pumping makeup water into the reactor vessel.

Recirculation Flow Control — Provides regulation of the reactor forced cooling flow, which can be used for power regulation.

Residual-Heat-Removal System (RHRS) — A system of pumps, heat exchangers, valves, piping, and controls that function to remove residual heat from the reactor core, the suppression pool, or the containment atmosphere.

River Flow — The average flow past the site in cubic feet per second (cfs).

Rod-Block Monitor — This subsystem hinders control rod withdrawal errors to prevent fuel damage. Two RBM monitoring channels are provided. Output signals from selected groups of Low-Power-Range Monitoring (LPRM) subsystem amplifiers are averaged to control rod movement. Computer system performs the averaging function.

Secondary Containment — Reactor building which is designed to be for low leakage in order to function as containment for reactor refueling operations and as a backup containment during power operation or hot standby.

Seismograph — An instrument used for the measurement of vibration, of particular interest in measuring ground motion and/or building motion due to an earthquake; sometimes called a strong motion accelerometer.

Service Water System — System which supplies process water for cooling purposes throughout the plant for other than the main condenser cooling.

Shutdown — A condition of the reactor in which the core is subcritical and power is not being generated (except that which might originate from afterheat).

Shutdown Boron, ppm — The grams of boric acid H_3BO_3 per million grams of water required to achieve some desired subcritical reactivity level. Also may be given as grams of boron per million grams of water.

Shutdown Margin — Representative of the amount of reactivity which would have to be added to a subcritical reactor to achieve criticality.

Site — Land area location for a power station.

Standby Coolant System — A supply of cooling water that is available in case of emergency. A supply that is not normally used for the core cooling function. This supply is sometimes available by a cross-connection between two or more cooling systems.

Standby Gas Treatment System — Special ventilation system for the reactor building. The system is used if radioactive materials are present in the reactor building. Air from the reactor building is removed, purified, and routed to the vent.

Standby Liquid Control System — A redundant control system for shutting down the reactor in the unlikely event that the normal control system is inoperable. Liquid poison is pumped into the reactor to provide the negative reactivity to assure subcriticality.

Supprn Chamb — Suppression Chamber.

Suppression Chamber — The part of the pressure suppression system which contains the suppression pool to condense steam upon LOCA to minimize pressure buildup in the primary containment system of a BWR.

Suppression Chamber Cooling System — Cooling system for reducing suppression pool temperatures and torus pressure following a loss of coolant accident in a BWR.

Temporary Control Curtain — Burnable poison sheets placed in a new core to compensate for the excess reactivity associated with the initial core. All or any number of the curtains are removable, usually during refueling, when the reduction in reactivity in the core or region thereof makes the control provided by the curtains unnecessary.

Thermal Output — Thermal heat energy output of the reactor.

Total Flow Rate — Quantity of coolant flow through the reactor.

Total Heat Output for Safety Design — The value of heat output for the core used in accident analysis.

Total Peaking Factor — The product of the individual peaking factors. This assumes each peaking factor is effective simultaneously and is therefore a maximum estimate.

Total Rod Worth, Percent — 100 × the change in the multiplication constant from the most reactive configuration of the control rods to the least reactive configuration divided by k_{eff}. In some places it may be expressed in terms of that value of k_{eff} which the rods will hold just critical.

Turbine Orientation — The direction of the turbine centerline with respect to the centerline of the reactor. The interest is in the possibility of ejected turbine blades being missiles that could strike or penetrate containment.

Unborated Water Control — Aspects of boron dilution control, i.e., reduction of boron concentration in the coolant. See chemical shim.

Variable-Cycle Cooling — Both towers and once-through cooling are combined and used in a variable manner depending upon limitations on heat rejection to a river, lake, etc.

Vessel Vendor — Supplier of the reactor vessel.

Data from PSAR

Page 1 (PWR)

BEAVER VALLEY 50-334,* 50-412

Project Name: Beaver Valley Power Station, Units 1 & 2
Location: Beaver Co., Penn.
Owner: Cleve. Elect. Illum. Co., Duquesne, Ohio Ed., Penn. Power et al.
A-E: Stone and Webster
Vessel Vendor: Not specified
NSS Vendor: Westinghouse
Containment Constructor: Not specified

A. THERMAL-HYDRAULIC		B. NUCLEAR	
Thermal Output, MWt	2660	H_2O/U, Cold	4.18
Electrical Output, MWe	856.7	Avg 1st-Cycle Burnup, MWD/MTU	13,700
Total Heat Output, Safety Design, MWt	2774	First Core Avg Burnup, MWD/MTU	25,100
Total Heat Output, Btu/hr	$9{,}051\times10^6$	Maximum Burnup, MWD/MTU	50,000
System Pressure, psia	2250	Region-1 Enrichment, %	2.00
DNBR, Nominal	2.02	Region-2 Enrichment, %	2.70
Total Flowrate, lb/hr	100.9×10^6	Region-3 Enrichment, %	3.35
Eff Flowrate for Heat Trans, lb/hr	93.6×10^6	k_{eff}, Cold, No Power, Clean	1.179
Eff Flow Area for Heat Trans, ft^2	41.8	k_{eff}, Hot, Full Power, Xe and Sm	1.081
Avg Vel Along Fuel Rods, ft/sec	14.4	Total Rod Worth, %	---
Avg Mass Velocity, lb/hr-ft^2	2.31×10^6	Shutdown Boron, No Rods-Clean-Cold, ppm	1360
Nominal Core Inlet Temp, °F	542.5	Shutdown Boron, No Rods-Clean-Hot, ppm	1330
Avg Rise in Core, °F	70.3	Boron Worth, Hot, % $\Delta k/k$/ppm	---
Nom Hot Channel Outlet Temp, °F	646.5	Boron Worth, Cold, % $\Delta k/k$/ppm	---
Avg Film Coeff, Btu/hr ft^2-°F	5500	Full Power Moderator Temp Coeff, $\Delta k/k$/°F	$(+0.3 \text{ to } -4)\times10^{-4}$
Avg Film Temp Diff, °F	38.0	Moderator Pressure Coeff, $\Delta k/k$/psi	$(-0.3 \text{ to } +4)\times10^{-6}$
Active Heat Trans Surf Area, ft^2	42,460	Moderator Void Coeff, $\Delta k/k/cm/cm^3$	−0.1 to +0.3
Avg Heat Flux, Btu/hr ft^2	207,600	Doppler Coefficient, $\Delta k/k$/°F	$(-0.7 \text{ to } -1.8)\times10^{-5}$
Max Heat Flux, Btu/hr ft^2	580,000	Shutdown Margin, Hot 1 rod stuck, %$\Delta k/k$	At least 1%
Avg Thermal Output, kw/ft	6.7	Burnable Poisons, Type and Form	Borosilicate glass in sst rods
Max Thermal Output, kw/ft	18.8	Number of Control Rods 48 × 20	960
Max Clad Surface Temp, °F	657	Number of Part-Length Rods (PLR) 5	100
No. Coolant Loops	3	Compiled by: Fred Heddleson, Dec. '73 Nuclear Safety Information Center	

*This unit ordered prior to 50-412. Earlier data on 50-334 was included in ORNL-NSIC-55, Vol. II.

C. SAFETY-RELATED DESIGN CRITERIA			Reactor: BEAVER VALLEY	
Exclusion Distance, Miles		0.28	Design Winds in mph:	
Low Population Zone Distance, Miles		3.6	At 0 — 50 ft elev	80
Metropolis	Distance	Population	50 — 150 ft	90
Pittsburgh, Pa.	25 mi.	520,117	150 — 400 ft	110
Design Basis Earthquake Acceleration, g		0.10	Tornado 300 mph Rot + 60 trans	
Operating Basis Earthquake Acceleration, g		0.05	ΔP = 3 psi/ 3sec	
Earthquake Vertical Shock, % of Horizontal		---		
Is Intent of 70 Design Criteria Satisfied?	Yes, Section 1.4.2 states that design "meets the intent of the criteria as expressed withing this section"			

D. ENGINEERED SAFETY FEATURES

D1. CONTAINMENT		Design Pressure, psig	45
Max Leak Rate at Design Pressure, %/day	0.1	Calculated Max Internal Pressure, psig	42.7

Type of Construction: A steel-lined, reinforced concrete cylinder with a hemispherical dome and a flat reinforced concrete foundation mat. Containment operates at subatmospheric pressure and is virtually leaktight. The 4 1/2-ft thick walls provide shielding from radiation; the dome is 2 1/2-ft thick. Steel liner is 3/8-in. thick, on side walls, 1/2-in. thick on dome, and 1/4-in. thick on floor. Free volume is 1.8×10^6 cu ft.

Design Basis: Designed to withstand internal pressure resulting from Design Basis Accident (LOCA) without excessive leakage of radioactivity to the environment. Also, designed to withstand natural forces of tornados and earthquake without catastrophic damage. Engineered Safety Features are designed to function after LOCA so containment will be returned to subatmospheric pressure within 45 min after LOCA.

Vacuum Relief Capability: Containment is held at 9 to 11 psia during operation. Alarms on ejector pump prevert lowering of pressure below safe limits.

Post-Construction Testing: Acceptance test is run at 1.15 times the design pressure to check structural integrity. Pressure is then lowered in steps to allow evaluating at each step. Leakage rate tests will be run in accordance with App. J of 10 CFR 50. Periodic tests will be run using the leakage monitoring system.

Penetrations: All penetrations except for cold pipes are double sealed and individually testable.

Weld Channels: Channels will be placed over liner seam welds which are inaccessible after construction. These channels can be pressurized for leak testing.

D2. CONTAINMENT SAFETY FEATURES Reactor: BEAVER VALLEY

Containment Spray System: There are 2 systems — The quench spray with 2 100% capacity pumps (1600 gpm at 250 psig), and the recirculation spray system which has 4 50% capacity pumps (3000 gpm at 265 psig). Quench spray injects borated water and NaOH additive for iodine control. The recirculation system pumps from the sump and cools the water in recirculation coolers. Both systems can reduce containment pressure (after LOCA) to subatmospheric in 45 minutes.

Containment Cooling: Three fan-coil units are used for normal cooling, holding air temperatures below 105 F. Each unit has 50% of total required capacity. Cooling after LOCA is accomplished by the spray systems. The fan-coil units do not run after LOCA.

Containment Isolation System: Provides at least 2 barriers between the inside and outside of containment. These barriers are isolation valves which close automatically on accident conditions.

Containment Air Filtration: There are 4 parallel impregnated charcoal cells sized for 500 cfm each which filters out iodine with 95% efficiency. The purge system has a separate filter system consisting of prefilters, particulate filters, and charcoal filters.

Penetration Room: No penetration rooms shown on building sketches.

D3. SAFETY INJECTION SYSTEMS

Accumulator Tanks: Three tanks each hold about 7000 gal of borated water under nitrogen pressure of 600 psig. When reactor system pressure drops to 600, the accumulators dump their contents, one into each of the reactor cold legs. All action is automatic discharging through 2 check valves in series.

High-head Safety Injection: Three charging pumps rated 150 gpm at 2725 psig inject water into the reactor sweeping 900 gal of 12 wt % boric acid into the system. These pumps take suction from the refueling water storage tank. These pumps have capacity to replace water lost from breaks in lines up to 6-in. diameter.

Low-head Safety Injection: Two low-head pumps (each rated 4000 gpm at minimal pressure) deliver water from the refueling water storage tank to the reactor vessel through the cold legs. When supply in the refueling water storage tank is exhausted, the recirculation mode is initiated and two pumps pump water from the containment sump through heat exchangers for cooling.

E. OTHER SAFETY-RELATED FEATURES	Reactor: BEAVER VALLEY
Reactor Vessel Failure: Design, fabrication procedures, and inspection techniques preclude failure of the vessel.	
Containment Floodability: Found no reference.	
Reactor-Coolant Leak-Detection System: Detected by continuous monitoring of containment air activity and humidity, run-off from cooling coils of fan-coil recirculation units, and liquid level and pumping rate in the containment sump. Any change from the norm indicates leakage.	
Failed-Fuel-Detection System: Instrumentation for this application is being tested. Failed fuel detection is currently performed by periodic analysis of coolant samples by monitoring the coolant letdown activity. Activity in the containment air could detect a leak of 0.1 gpm in 1 min with 1% failed fuel.	
Emergency Power: Two diesel-generator sets supply emergency AC power. Each unit is rated for 2600 KW continuous operation. Each diesel-generator is located in a separate room of one building, rooms separated by a masonry wall. Units have independent accessories. Units can accept loads in 10 seconds after starting. Each unit has a 550-gal day tank and a 20,000-gal storage tank (underground), good for 4 days of full-load continuous operation.	
Control of Axial Xenon Oscillations By Burnable Shims, Part-Length Control Rods, In-Core Instrumentation: Part-length rods control axial power distribution oscillations caused by xenon. The in-core instrumentation is used to periodically calibrate out-of-core instruments which measure the power distribution.	
Boron Dilution Control: During refueling, boron concentration must be reduced from 2000 ppm to 1000 ppm before reactor goes critical. This would take about 1 hr. During startup, the same dilution requires about 2 hr. At full power, excessive dilution will sound alarms which still leaves the operator about 17 minutes to make a correction. Consequently, the operator has adequate time under all conditions to correct a dilution error before a critical change could occur.	
Long-Term Cooling: Long-term cooling can be accomplished using the recirculation spray system which can cool the recirculated water in heat exchangers. The Ohio River is also available for ultimate heat sink if needed. Service water from the river can be diverted for cooling.	
Organic-Iodide Filter: Found no reference.	
Hydrogen Recombiner: Two catalytic recombiners are provided which can be used as a filtered purge system.	

F. GENERAL

Reactor: BEAVER VALLEY

Windspeed, Direction Recorders, and Seismographs:

An on-site meteorological program was initiated in September '69 with instruments at 50 and 150 ft on a tower. Could not find information on seismographs.

Plant Operation Mode: Designed for load following.

Site Description: Located on the SE bank of the Ohio River mostly surrounded by steep slopes and hills rising up about 500 ft above the river. The site area is reasonably level with a level flood plain running along the river NE from the site. The site is crowded by a railroad, state highway and bridge close by and the hill and river.

Turbine Orientation: Turbine centerline is perpendicular to containment. Ejected blades could be thrown off in direction of containment.

Emergency Plans: Employees are instructed in procedures for protection of operating personnel and the general public in case of a major accident such as fire or an accidental release of radioactivity. Arrangements have been made with Aliquippa Hospital for treatment of routine accident patients that may be contaminated. Also, there is an agreement with University Presbyterian Hospital in Pittsburgh for treatment of victims of radiation incidents of all types. Governmental and other agencies are familiar with procedures in case of an abnormal release of radioactivity from the site.

Environmental Monitoring Plans: Program is divided into two phases — preoperational and operational. Preoperational will establish levels of radioactivity and radiation in the site area before operation. Sampling of air, river water, ground water, drinking water, bottom sediments, soil, milk, wild life, fish, and aquatic organism will be carried out. These samples and their analysis will set preoperation base levels. The operational sampling phase is planned to be identical to the preoperation program. The program will be reviewed periodically and changed as required.

Radwaste Treatment: Gaseous wastes are continuously collected, monitored and held in charcoal beds for decay, then compressed, recycled and sent to unit #1 for discharge to the environment. Gases can be held for 30 days for decay if required. Liquid wastes are collected in a 7500-gal tank and then transferred to unit 1 for treatment and release through the circulating water system. Solid wastes will be collected, processed, and packaged in 55-gal drums for shipment offsite where ultimate disposal will be made.

Plant Vent: Gases will be vented from unit #1 facilities. Description of #1 vent could not be found.

G. SITE DATA

Reactor: BEAVER VALLEY

Nearby Body of Water: Ohio River

Normal Level 664.5-ft (MSL)

Max Prob Flood Level 730.0-ft (MSL)

Size of Site 449 Acres

Site Grade Elevation 735-ft (MSL)

Topography of Site: Level on immediate site

of Surrounding Area (5 mi rad): Hilly

Total Permanent Population: In 2 mi radius 6,346 ; 10 mi ______

Date of Data: 1970 In 5 mi radius 18,100 ; 50 mi ______

Nearest City of 50,000 Population: Pittsburgh, Pa.

Dist. from site 25 Miles, Direction SE, Population 520,117

Land Use in 5 Mile Radius: Industrial and residential.

Meteorology: Prevailing wind direction NW or S Avg. speed 5 mph

Stability Data - Mostly Pasquill F

Miscellaneous Items Close to the Site: The Pittsburgh and Lake Erie RR runs through the site about 350 ft from the reactor area. Route 168 crosses the eastern property line about 1500 ft from unit 2 reactor. Natural gas and other pipe lines cross the eastern part of the site. Midland, population 6425, is across the river about 1 mi. NW. A large industrial area is WNW about 1 to 1 1/2 mi. away.

H. CIRCULATING WATER SYSTEM

Type of System: Closed cycle with cooling tower.

Water Taken From: Ohio River for makeup.

Intake Structure: A reinforced concrete structure serving both units 1 and 2, fitted with gate slot, trash rack, and traveling screens. It has 4 bays with 1 pump per bay. Velocity through bar racks is 0.14 fps.

Water Body Temperatures: Winter minimum 34 °F Summer maximum 83 °F

River Flow 7500 (cfs) minimum; 16,000 (cfs) average

Service Water Quantity 27,000 gpm/reactor

Flow Thru Condenser 480,400 (gpm)/reactor Temp. Rise 26 °F

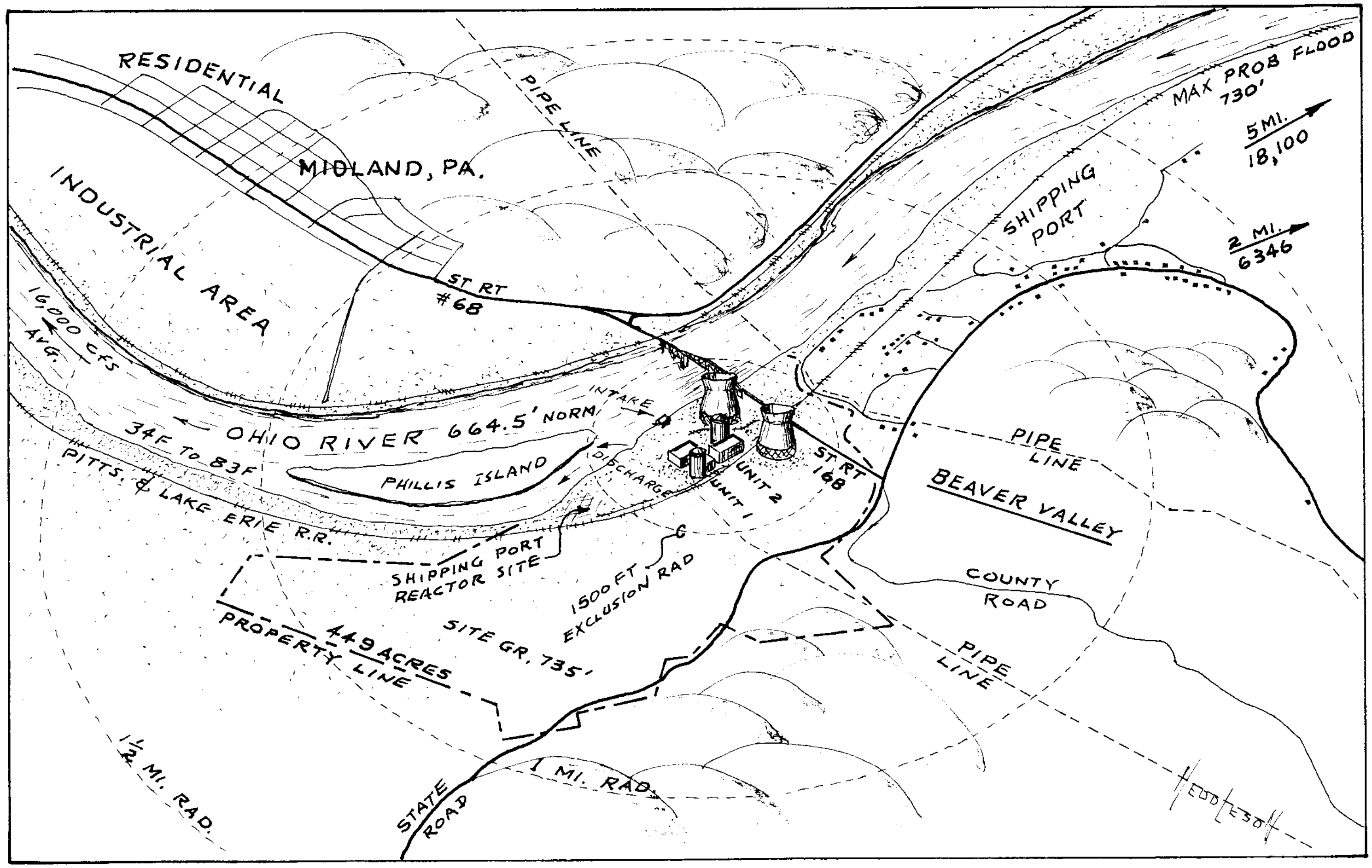
Heat Dissipated to Environment --- (Btu/hr)/reactor

Heat Removal Capacity of Condenser 6300×10^6 (Btu/hr)/reactor

Discharge Structure: Cooling tower blowdown is discharged through discharge structure near SW end of plant.

Cooling Tower(s): Description & Number - One hyperbolic tower for unit 2, one for unit 1

Blowdown ∿15,000 gpm/reactor Evaporative loss 10,500 gpm/reactor


RESIDENTIAL
MIDLAND, PA.
INDUSTRIAL AREA
PIPE LINE
ST RT #68
16,000 CFS AVG.
OHIO RIVER 664.5' NORM
34F TO 83F
PITTS. & LAKE ERIE R.R.
PHILLIS ISLAND
INTAKE
DISCHARGE
UNIT 2
UNIT 1
ST RT 168
SHIPPING PORT REACTOR SITE
1500 FT EXCLUSION RAD
449 ACRES PROPERTY LINE
SITE GR. 735'
1½ MI. RAD.
1 MI. RAD.
STATE ROAD
PIPE LINE
BEAVER VALLEY
COUNTY ROAD
PIPE LINE
SHIPPING PORT
MAX PROB FLOOD 730'
5 MI. 18,100
2 MI. 6346

Data from PSAR

Page 1 (BWR)

HANFORD NUMBER TWO, 50-397

Project Name: Hanford Number Two

Location: USAEC Reservation
Richland, Washington

Owner: Washington Public Power
Supply System

A-E: Burns & Roe

Vessel Vendor: Not specified

NSS Vendor: General Electric

Containment
Constructor: Not specified

A. THERMAL-HYDRAULIC		B. NUCLEAR	
Thermal Output, MWt	3323	H_2O/UO_2 Volume Ratio	---
Electrical Output, MWe	1100	Moderator Temp Coef Cold, Δk/k/°F	---
Total Heat Output, Safety Design, MWt	3458	Moderator Temp Coef Hot, No Voids	---
Steam Flow Rate, lb/hr	14.3×10^6	Moderator Void Coef Hot, No Voids, Δk/k/%	---
Total Core Flow Rate, lb/hr	108.5×10^6	Moderator Void Coef Operating	---
Coolant Pressure, psig	1020	Doppler Coefficient, Cold	---
Heat Transfer Area, ft^2	66,098	Doppler Coefficient, Hot, No Voids	---
Max Power per Fuel Rod Unit Lgth, kw/ft	18.5	Doppler Coefficient, Operating	---
Maximum Heat Flux, Btu/hr-ft^2	428,360	Initial Enrichment, %	---
Average Heat Flux, Btu/hr-ft^2	163,234	Average Discharge Exposure, MWD/Ton	20,807
Maximum Fuel Temperature, °F	4380	Core Average Void Within Assembly, %	79
Average Fuel Rod Surface Temp, °F	560	k_{eff}, All Rods In	---
MCHFR	≥ 1.9	k_{eff}, Max Rod Out	Less than 0.99
Total Peaking Factor	2.6	Control Rod Worth, %	0.01 Δk
Avg Power Density, Kw/ℓ	51.2	Curtain Worth, %	---
Peak Fuel Enthalpy on Rod Drop, Cal/gm	280 cal/gm	Burnable Poisons, Type and Form	Gadolinia dispersed in UO_2
		Number of Control Rods	185
		Number of Part-Length Rods (PLR)	None

Compiled by: F. A. Heddleson, Oct. 1971
ORNL, Nuclear Safety Information Center

Reactor: Hanford Number Two

C. SAFETY-RELATED DESIGN CRITERIA

Exclusion Distance, Mi.	0.57 rad.	
Low Population Zone Dist., Mi.	8 to 10	
Metropolis	Distance	Population
Spokane, Wash.	120 mi.	
Design Basis Earthquake Accel., g	0.250	
Operating Basis Earthquake Accel., g	0.125	
Earthquake Vertical Shock, % of Horizontal	67	

Design Winds in mph:

At 0 - 50 ft	100
50 - 150 ft	120
150 - 400 ft	140
Tornado	300 mph tang + 60 trans.
ΔP =	3 psi/ 3 sec

Is intent of 70 design criteria Satisfied? Yes, see Appendix E.0

Peak Fuel Enthalpy on Rod Drop: 280 cal/gm

Recirculation Pumping System & MCHFR: Recirculation rate effects the type of boiling occurring along fuel rods. As film boiling occurs, max. heat fluxes are obtained.

Protective System: Initiates a fast scram of the reactor to prevent fuel damage or uncontrolled release of radioactive material. Action is automatic.

D. ENGINEERED SAFETY FEATURES

D1. CONTAINMENT (Ctmt)

Drywell Design Press, psig	40.5	Prim Ctmt Leak Rate, %/day	0.5
Supprn Chamb Design Press, psig	40.5	Second Ctmt Design Press, psig	0.25
Calc Max Internal Press, psig	37.2	Second Ctmt Leak Rate, %/day	100

Type of Construction: A steel pressure suppression system is used of the over and under configuration. Drywell is shaped like the frustum of a cone. Cylindrical suppression pool is under the drywell separated by reinforced concrete floor. Drywell free vol is 202,242 ft^3 and suppression chamber has 144,166 ft^3

Design Basis: Designed to resist a LOCA without loss of integrity, mainly the ability to withstand LOCA pressures and temperatures without serious leakage of radioactive products.

Vacuum Relief Capability: Designed for 2 psi external pressure. Vacuum breakers provide controlled flow from suppression chamber to drywell and from drywell to reactor building.

Post-Construction Testing: Description of testing procedures could not be found.

Penetrations: Electrical penetrations are double sealed and individually testable. Other penetrations are single sealed.

Reactor: Hanford Number Two

D2. EMERGENCY CORE COOLING SYSTEMS

Core Spray Cooling System: There are two systems, high pressure and low pressure. High pressure system is described below. Low pressure spray starts on low water in reactor or high drywell pressure if reactor pressure is low enough. One pump delivers 6250 gpm @ 122 psid taking suction from the suppression pool. Each system has separate spargers in reactor.

Auto-Depressurization System: Acts to rapidly reduce reactor vessel pressure after LOCA when HPCIS fails to automatically maintain reactor vessel water level. Depressurization enables the low pressure cooling systems to begin operation. Steam is vented through pressure relief valves.

Residual-Heat-Removal System (RHRS): Consists of pumps, heat exchangers, and piping for the following functions: a) Removal of decay heat during and after plant shutdown; b) Low pressure coolant injection function as described below; and c) Heat removal from containment following LOCA by pumping water from suppression pool through heat exchanger and back to pool to prevent excessive temperature rise in suppression pool. Also, water is sprayed into containment to reduce the pressure. There are 3 pumps each rated 7067 gpm @ 20 psig, 2 heat exchangers with 41.6×10^6 Btu/hr capacity, and the necessary piping, controls, etc., including service-water pumps.

High-Pressure Coolant-Injection System: The system is called High Pressure Core Spray System and operates automatically on low water level in the reactor or if high pressure exists in primary containment. One pump delivers 1650 gpm @ 1110 psid taking suction from the condensate storage tank or suppression pool.

Low-Pressure Coolant-Injection System: An operating mode of Residual Heat Removal System. System starts on low water level in reactor or high pressure in drywell. Three pumps each can deliver 7067 gpm @ 20 psid when other systems are not supplying sufficient water. Suction is taken from suppression pool.

E. OTHER SAFETY-RELATED FEATURES

Standby Coolant System: A cross-tie from the service water pumps to the Residual Heat Removal System provides water if post-accident flooding of containment is required. This provides a large source of water for emergency conditions.

Main-Steam-Line Flow Restrictors: A venturi-type flow restrictor installed in each steam line close to reactor to limit loss of coolant in case of line break, and before the isolation valve can close. Flow is limited to 200 percent of normal rated flow.

Control-Rod Velocity Limiters: Limits velocity at which a rod can fall out of the core. It is a part of the bottom assembly consisting of two nearly mated conical elements acting as large clearance piston and baffle inside control rod guide tube. Velocity of rod for scram is not effected.

Control-Rod-Drive-Housing Supports: Located under reactor vessel near control rod housing. Supports limit travel of a control rod if housing ruptures, thus preventing nuclear excursion. Max travel in hot operating condition would be 1/4-in. plus spring compression of about two inches.

Standby Liquid-Control System: A boron neutron absorber in the coolant provides a redundant, independent, and different way from control rods to shut down reactor . The system makes possible an orderly and safe shutdown in the event that not enough control rods can be inserted.

Reactor: Hanford Number Two

E. OTHER SAFETY-RELATED FEATURES (cont'd)

Containment Atmospheric Control System: No discussion found on containment inerting. A recombiner will be used for hydrogen control.

Reactor Core Isolation Cooling System (RCICS): Provides makeup water to the core during a reactor shutdown or when isolated from the condenser and when feedwater flow is not available. The system may be started manually by the operator or automatically upon receipt of a low reactor water level signal. Water is pumped to the core by a turbine-pump driven by reactor steam. Pump suction is taken from the condensate storage tank, or from the backup suppression pool. Turbine steam exhaust dumps to suppression pool. One pump is provided, rated at 600 gpm @ 1120 psig.

Reactor Vessel Failure: No reference found to vessel failure

Missile & Reactor Forces -

Core Cooling Capability -

Containment Floodability - Can be flooded if necessary by the Residual Heat Removal System.

Reactor-Coolant Leak-Detection Systems: Detection is based on changes in normal operating conditions, such as increase in containment temperature and pressure, abnormal sump-pump operation, and change in radioactivity levels in the containment atmosphere. Leakage limits are set at 15 gpm for unidentifiable leakage, and 50 gpm total leakage. Sump-pump capacity is 50 gpm for each of two pumps.

Failed-Fuel Detection Systems: Consists of four gamma radiation monitors located external to main steam lines just outside primary containment. Monitors are designed to detect a gross release of fission products from the fuel. Upon detection of high radiation, an alarm signal is initiated and trip signals generated by the monitors are used to initiate a scram and to isolate the radioactive material released.

Emergency Power: Two diesel generators are provided, each separately housed and completely independent of the other. Each unit has 8 hrs fuel supply in a day tank and 7 days supply in a storage tank. Units are air started, with air reservoirs for each diesel. Each reservoir has air for five normal starts.

Rod-Block Monitor: Effective in preventing improper rod withdrawal. If a rod-block signal is received during withdrawal, the control rod is automatically stopped at the next notch position, even if continuous rod withdrawal is in process.

Rod Worth Minimizer: Functions to prevent improper rod withdrawal under low power conditions, thus limiting reactivity worth of control rods by enforcing adherence to preplanned rod pattern. This system operates as a function of the process computer.

Reactor: Hanford Number Two

F. GENERAL

Windspeed, Direction Recorders, and Seismographs: A 410-ft high tower located near the center of the Hanford reservation has collected meteorological data for 20 years.

Plant Operating Mode: Load following.

Site Features: Located on the AEC Hanford Reservation about 3 miles west of the Columbia River and about 2 1/2 miles north of the FFTF facility. The land is a flat desert sparsely populated. There are only 5 permanent residents in a 5 mile radius. Off the reservation there is some agricultural use of the land. Water for makeup will come from the Columbia River at mile 350.

Turbine Orientation: Turbine and reactor are on different centerlines that are ∿220 ft apart. Ejected blades would probably not strike containment.

Emergency Plans: Plans being developed to define organization and strategy for all potential emergencies. Plans will provide liason with on-site Federal facilities and off-site support groups including Federal, State, and local government. Document reviews and controls, emergency preparedness assessment and training of plant personnel, including periodic drills, will be set forth objectively by the plan.

Environmental Monitoring Plans: A program will be initiated at least 2 years before operation. A qualified firm will be used for radiological monitoring which will include airborne particulate sampling for α and β, together with β and γ background levels. Rainwater, vegetation, soil, well water, river algae, small animal and fish samples will be taken. The goals of the radiological monitoring program will be to establish pre-operational radiation levels of natural surroundings, to determine any effect on the environment by Project operation.

Radwaste Treatment: Liquid and gaseous wastes that are released will not exceed 1% of the limits allowed by 10CFR20. Liquid wastes will be processed on a batch basis holding over as much liquid as possible. Estimated liquid release is ∿ .5 Ci/yr. Gaseous waste will be held long enough for some radioactive decay and then passed through HEPA and charcoal filters. About 100,000 μCi/sec will be released. Solid wastes will be packed in 55 gal. drums and shipped offsite for burial.

Stack Height - Steel vent 200 ft above grade.

Waste Heat System: Closed loop cooling will be used. The Environmental report says one or two hyperbolic cooling towers will be used with 650,000 gpm flow having a 23F temperature rise in the condenser. Evaporative loss is 15,000 gpm. McNary Dam which forms this pool is 58 miles downstream. Priest Rapids Dam is 47 miles upstream.

G. CIRCULATING WATER SYSTEM & SITE FEATURES

REACTOR NAME Hanford Number Two

THERMAL OUTPUT, MWt 3323

TYPE OF NUCLEAR STEAM SYSTEM BWR

DOCKET NO. 50-397

NEARBY BODY OF WATER Columbia River is 3 mi away

NORMAL LEVEL <395 (MSL)

MAX PROB FLOOD LEVEL 432 (MSL)

SIZE OF SITE NA ACRES

SITE GRADE ELEVATION 441 (MSL)

TOPOGRAPHY OF SITE Flat

OF SURROUNDING AREA (5 MI RAD) Flat

TOTAL PERMANENT POPULATION IN 2 MI RAD 0 (1970) IN 5 MI RAD 5 (1970)

NEAREST CITY OF 50,000 POPULATION Yakima, Washington

DISTANCE FROM SITE 55 MILES POPULATION 47,500 (1970)

LAND USE IN 5 MILE RADIUS AEC Reservation and agricultural off the reservation.

CIRCULATING WATER SYSTEM TYPE OF SYSTEM Closed loop with cooling tower

WATER TAKEN FROM Columbia River FOR Makeup

WATER BODY TEMPERATURES - WINTER AVG 38 F SUMMER AVG 64 F AVG ___ F

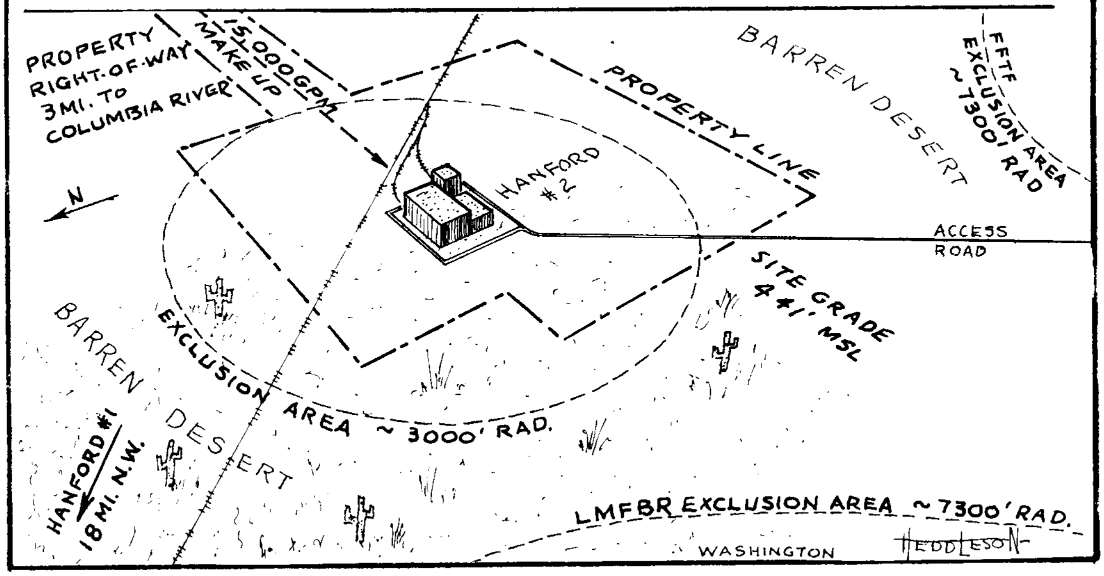
RIVER FLOW 115,000 (cfs) avg. QUANTITY OF MAKEUP WATER 15,000 (gpm)

TOTAL FLOW THROUGH CONDENSERS 650,000 (gpm) TEMPERATURE RISE 23 F

HEAT REMOVAL CAPACITY OF CONDENSERS 7701×10^6 (Btu/hr)

COOLING TOWERS One or two hyperbolic towers (from Environmental Report). The PSAR shows 4 mech. draft towers.

OTHER INFORMATION



Data from PSAR

Page 1 (BWR)

MENDOCINO, 50-398, 50-399

Project Name: Mendocino Power Plant, Units 1 and 2
Location: Mendocino Co., Calif. (NW of San Francisco 130 miles)
Owner: Pacific Gas & Elec. Co.

A-E: Bechtel
Vessel Vendor: Not specified
NSS Vendor: General Electric
Containment Constructor: Not specified

A. THERMAL-HYDRAULIC		B. NUCLEAR	
Thermal Output, MWt	3323	H_2O/UO_2 Volume Ratio	---
Electrical Output, MWe	1168	Moderator Temp Coef Cold, $\Delta k/k/°F$	---
Total Heat Output, Safety Design, MWt	3489	Moderator Temp Coef Hot, No Voids	---
Steam Flow Rate, lb/hr	14.3×10^6	Moderator Void Coef Hot, No Voids, $\Delta k/k/\%$	$-.87 \times 10^{-3}$
Total Core Flow Rate, lb/hr	108.5×10^6	Moderator Void Coef Operating	-1.15×10^{-3}
Coolant Pressure, psig	1020	Doppler Coefficient, Cold	-1.2×10^{-5}
Heat Transfer Area, ft^2	66,098	Doppler Coefficient, Hot, No Voids	-1.18×10^{-5}
Max Power per Fuel Rod Unit Lgth, kw/ft	18.5	Doppler Coefficient, Operating	-1.17×10^{-5}
Maximum Heat Flux, $Btu/hr\text{-}ft^2$	428,360	Initial Enrichment, %	1.85
Average Heat Flux, $Btu/hr\text{-}ft^2$	164,718	Average Discharge Exposure, MWD/Ton	18,512
Maximum Fuel Temperature, °F	4380	Core Average Void Within Assembly, %	79
Average Fuel Rod Surface Temp, °F	560	k_{eff}, All Rods In	---
MCHFR	≥ 1.9	k_{eff}, Max Rod Out	Less than 0.99
Total Peaking Factor	2.6	Control Rod Worth, %	0.01 Δk
Avg Power Density, Kw/ℓ	51.2	Curtain Worth, %	---
Peak Fuel Enthalpy on Rod Drop, Cal/gm	280 cal/gm	Burnable Poisons, Type and Form	Gadolinia-bearing fuel rods
		Number of Control Rods	185
		Number of Part-Length Rods (PLR)	None

Compiled by: F. A. Heddleson, Nov. 1971
ORNL, Nuclear Safety Information Center

Reactor: Mendocino

C. SAFETY-RELATED DESIGN CRITERIA

Exclusion Distance, Mi.	∿0.7	Design Winds in psf:	
Low Population Zone Dist., Mi.	---	At 0 - 50 ft	25
Metropolis / Distance / Population: San Francisco 130 745,000 ('69)		50 - 150 ft	33
Design Basis Earthquake Accel., g	0.5	150 - 400 ft	43
Operating Basis Earthquake Accel., g	0.3	Tornado ΔP = psi/ sec	Tornadoes have not been recorded in the area
Earthquake Vertical Shock, % of Horizontal	66	Is intent of 70 design criteria Satisfied? Yes, see Sect. F.1	

Peak Fuel Enthalpy on Rod Drop: 280 cal/gm

Recirculation Pumping System & MCHFR: Recirculation rate effects the type of boiling occurring along fuel rods. As film boiling occurs, maximum heat fluxes are obtained.

Protective System: Initiates automatic reactor shutdown if nuclear system variables exceed preestablished limits - in time to prevent release of radioactivity from the fuel barrier. System overrides all other controls.

D. ENGINEERED SAFETY FEATURES

D1. CONTAINMENT (Ctmt)

Drywell Design Press, psig	47	Prim Ctmt Leak Rate, %/day	0.5
Supprn Chamb Design Press, psig	47	Second Ctmt Design Press, in. H_2O	0.25
Calc Max Internal Press, psig	40.8	Second Ctmt Leak Rate, %/day	100

Type of Construction: A steel pressure suppression system is used of the over and under configuration. Drywell is shaped like the frustum of a cone. Cylindrical suppression pool is under the drywell separated by reinforced concrete floor. Drywell free vol is 235,000 ft^3 and suppression chamber has 156,000 ft^3.

Design Basis: Designed to withstand the resultant forces of LOCA and to contain the steam and suppress the steam pressure so as to limit the release of fission products. Section 5.2.2 lists 13 factors as Safety Design Bases.

Vacuum Relief Capability: Primary containment designed for 5 psig external pressure. Relief valves between suppression chamber and drywell prevent pressure differential greater than 3 psig. Drywell is vented through ventilation purge.

Post-Construction Testing: Vessel will be tested at 115% of design pressure. Leakage rate tests will be run at calculated max internal pressure. Tests will be run during the life of the plant.

Penetrations: Electrical penetrations are individually testable and probably double sealed. Other piping penetrations are probably single sealed and not individually testable.

Reactor: Mendocino

D2. EMERGENCY CORE COOLING SYSTEMS

Core Spray Cooling System: There are two systems, high pressure and low pressure. High pressure system is described below. Low pressure spray starts on indication of breach in coolant system, if reactor pressure is low enough. One pump delivers 6250 gpm @ 122 psid taking suction first from the suppression pool or next from the condensate storage tank. Each spray system has separate spargers in reactor.

Auto-Depressurization System: Acts to rapidly reduce reactor vessel pressure after LOCA when HPCIS fails to automatically maintain reactor vessel water level. Depressurization enables the low pressure cooling systems to begin operation. Steam is vented through pressure relief valves.

Residual-Heat-Removal System (RHRS): Consists of pumps, heat exchangers, and piping for the following functions: a) Removal of decay heat during and after plant shutdown; b) low pressure coolant injection as described below; c) heat removal from containment following LOCA by pumping water from suppression pool through heat exchanger and back to pool, and spraying water into containment to reduce temperature and pressure; and d) steam condensing function using heat exchangers to condense reactor steam. There are 3 pumps each rated 7450 gpm, 2 heat exchangers with 46.6×10^6 Btu/hr capacity, and the necessary piping, controls, etc., including service-water pumps.

High-Pressure Coolant-Injection System: The system is called High Pressure Core Spray System and operates automatically on low water level in the reactor or if high pressure exists in primary containment. One pump delivers 1650 gpm @ 1110 psid taking suction first from the condensate storage tank or next from suppression pool.

Low-Pressure Coolant-Injection System: An operating mode of Residual Heat Removal System. System starts on indication of breach in coolant system. Three pumps each can deliver 7067 gpm @ 20 psid when other systems are not supplying sufficient water. Suction is taken from suppression pool.

E. OTHER SAFETY-RELATED FEATURES

Standby Coolant System: No reference of cross-ties, or emergency source of water was found.

Main-Steam-Line Flow Restrictors: A venturi-type flow restrictor installed in each steam line close to reactor to limit loss of coolant in case of line break, and before the isolation valve can close. Flow is limited to 200 percent of normal rated flow.

Control-Rod Velocity Limiters: Limits velocity at which a rod can fall out of the core. It is a part of the bottom assembly consisting of two nearly mated conical elements acting as large clearance piston and baffle inside control rod guide tube. Velocity of rod for scram is not effected.

Control-Rod-Drive-Housing Supports: Located under reactor vessel near control rod housing. Supports limit travel of a control rod if housing ruptures, thus preventing nuclear excursion. Max travel in hot operating condition would be 1/4-in. plus spring compression of about two inches.

Standby Liquid-Control System: A boron neutron absorber injected into the coolant provides a redundant, independent, and different way from control rods to shut down reactor. The system makes possible an orderly and safe shutdown in the event that not enough control rods can be inserted.

Reactor: Mendocino

E. OTHER SAFETY-RELATED FEATURES (cont'd)

Containment Atmospheric Control System: Provision for inerting will be included in the design.

Reactor Core Isolation Cooling System (RCICS): Provides makeup water to the core during a reactor shutdown or when isolated from the condenser and when feedwater flow is not available. The system may be started manually by the operator or automatically upon receipt of a low reactor water level signal. Water is pumped to the core by a turbine-pump driven by reactor steam. Pump suction is taken from the condensate storage tank, or from the backup suppression pool. Turbine steam exhaust dumps to suppression pool. One pump is provided, rated at 600 gpm @ 1120 psig.

Reactor Vessel Failure: No reference found to vessel failure.

Missile & Reactor Forces -

Core Cooling Capability -

Containment Floodability - Designed for drywell flooding to top of core.

Reactor-Coolant Leak-Detection Systems: Detection is based on changes in normal operating conditions, such as increase in containment temperature and pressure, and abnormal sump-pump operation. Leakage limits are set at 15 gpm for unidentifiable leakage, and less than 50 gpm total leakage. Sump-pump capacity is 50 gpm for each of two pumps.

Failed-Fuel Detection Systems: Consists of four gamma radiation monitors located external to main steam lines just outside primary containment. Monitors are designed to detect a gross release of fission products from the fuel. Upon detection of high radiation, an alarm signal is initiated and trip signals generated by the monitors are used to initiate a scram and to isolate the radioactive material released.

Emergency Power: There are 3 diesel-generator sets, one unit for each reactor, and one unit shared. There is a 4th unit which supplies power for the high-pressure core-spray pump and accessories. Each unit has a day tank and storage tank with fuel for 7 days of operation. Each generator set is separately housed and completely independent in all ways.

Rod-Block Monitor: Effective in preventing improper rod withdrawal. If a rod-block signal is received during withdrawal, the control rod is automatically stopped at the next notch position, even if continuous rod withdrawal is in process.

Rod Worth Minimizer: Functions to prevent improper rod withdrawal under low power conditions, thus limiting reactivity worth of control rods by enforcing adherence to preplanned rod pattern. This system operates as a function of the process computer.

Reactor: Mendocino

F. GENERAL

Windspeed, Direction Recorders, and Seismographs: Wind data has been recorded since June 1970 at the top of a 20-ft high pole. Meteorological sensors will be erected on a 250-ft high tower. No reference found to seismograph.

Plant Operating Mode: Load following.

Site Features: Located on 409 acres site overlooking the Pacific Ocean about 130 miles northwest of San Francisco. The site grade is about 30 ft and above any possibility of flooding. The area is sparsely populated, most of the land use being agricultural and forests. A LORAN station is adjacent to the site on the north. The small town of Point Arena is about 1 1/2 miles from the reactor.

Turbine Orientation: Turbine and reactor are on different centerlines that are ∿165 ft apart. Ejected blades would probably not strike containment. GE is mfgr.

Emergency Plans: A plan, based on the USAEC's Guide to Emergency Plans will be developed prior to operation. It will be coordinated with the California disaster organizations similar to that followed for Humboldt Bay Power Plant. Site Emergency drills will be staged prior to operation and periodically thereafter to assure that personnel are familiar with the procedures.

Environmental Monitoring Plans: Survey will begin two years prior to plant operation. Objectives will be to establish magnitude and range of natural background radioactivity prior to operation. Effectiveness of radwaste discharge controls during operation will be confirmed by comparing levels of operational radioactivity to natural background levels. Samples will be taken of air particulates, plants, fresh water, milk, animal thyroid, algae, fish, crabs, and sea water.

Radwaste Treatment: Liquid and gaseous wastes that are released will not exceed the limits allowed by AEC rules. Liquid wastes will be processed on a batch basis holding over as much liquid as possible. Estimated liquid release is ∿.5 Ci/yr. Gaseous waste will be held long enough for some radioactive decay and then passed through HEPA and charcoal filters. About 100,000 μCi/sec will be released. Solid wastes will be packed in 55 gal. drums and shipped offsite for burial.

Stack Height - Vent located on roof of reactor building.

Waste Heat System: Once-through cooling system will be used taking water from the Pacific Ocean. Flow through the condenser will be 864,000 gpm with a temperature rise of 18F. A breakwater will be installed to protect the inlet. The design of the discharge has not yet been completed.

G. CIRCULATING WATER SYSTEM & SITE FEATURES

REACTOR NAME Mendocino Power Plant
Units 1 & 2

THERMAL OUTPUT, MWt 3323

TYPE OF NUCLEAR STEAM SYSTEM BWR

DOCKET NO. 50-398
50-399

NEARBY BODY OF WATER Pacific Ocean

NORMAL LEVEL 0 (MSL)

MAX PROB FLOOD LEVEL 28' (MSL)

SIZE OF SITE 409 ACRES

SITE GRADE ELEVATION 30' min (MSL)

TOPOGRAPHY OF SITE Steep cliffs overlooking ocean - rolling on top

OF SURROUNDING AREA (5 MI RAD) Rolling to mountainous

TOTAL PERMANENT POPULATION IN 2 MI RAD 573 (1970) IN 5 MI RAD 1233 (1970)

NEAREST CITY OF 50,000 POPULATION San Francisco

DISTANCE FROM SITE 130 MILES POPULATION 745,000 (1969)

LAND USE IN 5 MILE RADIUS Agricultural

CIRCULATING WATER SYSTEM TYPE OF SYSTEM Once through

WATER TAKEN FROM Pacific Ocean FOR Condenser Cooling

WATER BODY TEMPERATURES - WINTER AVG ___ F SUMMER AVG ___ F AVG ∿50 F

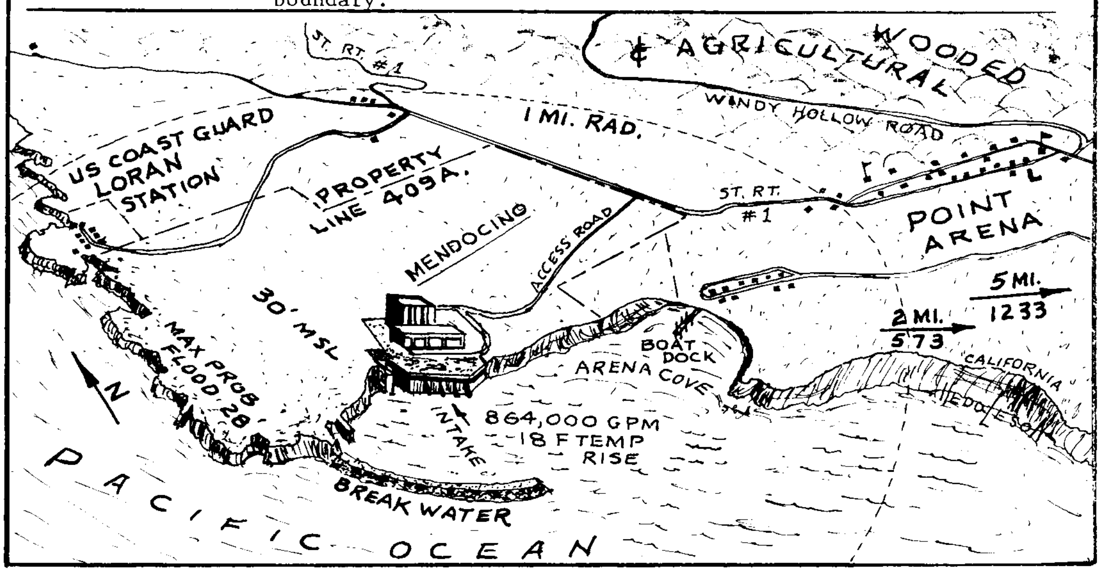
RIVER FLOW NA (cfs) QUANTITY OF MAKEUP WATER ___ (gpm)

TOTAL FLOW THROUGH CONDENSERS 864,000 (gpm) TEMPERATURE RISE 18 F

HEAT REMOVAL CAPACITY OF CONDENSERS 7900×10^6 (Btu/hr)

COOLING TOWERS None

OTHER INFORMATION A U.S. Coast Guard LORAN transmitter is just north of site boundary.



Data from PSAR

Page 1 (PWR)

SHEARON HARRIS, 50-400 THRU -403

Project Name: Shearon Harris Nuclear Power Plant, Units 1–4
A-E: Ebasco
Location: 20 mi SW of Raleigh, N.C.
Vessel Vendor: Not specified
NSS Vendor: Westinghouse
Owner: Carolina Power & Light
Containment Constructor: Not specified

A. THERMAL-HYDRAULIC		B. NUCLEAR	
Thermal Output, MWt	2785	H_2O/U, Cold	4.18
Electrical Output, MWe	900	Avg 1st-Cycle Burnup, MWD/MTU	11,900
Total Heat Output, Safety Design, MWt	2910	First Core Avg Burnup, MWD/MTU	22,000
Total Heat Output, Btu/hr	9469×10^6	Maximum Burnup, MWD/MTU	50,000
System Pressure, psia	2250	Region-1 Enrichment, %	1.90
DNBR, Nominal	2.12	Region-2 Enrichment, %	2.51
Total Flowrate, lb/hr	105.3×10^6	Region-3 Enrichment, %	3.11
Eff Flowrate for Heat Trans, lb/hr	100.7×10^6	k_{eff}, Cold, No Power, Clean	1.207
Eff Flow Area for Heat Trans, ft^2	41.8	k_{eff}, Hot, Full Power, Xe and Sm	1.094
Avg Vel Along Fuel Rods, ft/sec	15.3	Total Rod Worth, % (All rods in)	9.0
Avg Mass Velocity, $lb/hr\text{-}ft^2$	2.41×10^6	Shutdown Boron, No Rods-Clean-Cold, ppm	1360
Nominal Core Inlet Temp, °F	554.5	Shutdown Boron, No Rods-Clean-Hot, ppm	1330
Avg Rise in Core, °F	68.7	Boron Worth, Hot, % Δk/k/ppm	85
Nom Hot Channel Outlet Temp, °F	650.3	Boron Worth, Cold, % Δk/k/ppm	70
Avg Film Coeff, Btu/hr ft^2-°F	5700	Full Power Moderator Temp Coeff, Δk/k/°F	+0.3 to -4.0×10^{-4}
Avg Film Temp Diff, °F	38.1	Moderator Pressure Coeff, Δk/k/psi	−0.3 to $+4.0 \times 10^{-6}$
Active Heat Trans Surf Area, ft^2	42,460	Moderator Void Coeff, (Δk/k) gm/cm^3	−0.1 to +0.3
Avg Heat Flux, Btu/hr ft^2	217,300	Doppler Coefficient, Δk/k/°F	−1.0 to -1.6×10^{-5}
Max Heat Flux, Btu/hr ft^2	580,000	Shutdown Margin, Hot 1 rod stuck, %Δk/k	1
Avg Thermal Output, kw/ft	7.03	Burnable Poisons, Type and Form	Chemical shim & poison rods
Max Thermal Output, kw/ft	18.8	Number of Control Rods 48×20	960
Max Clad Surface Temp, °F	657	Number of Part-Length Rods (PLR) 5×20	100
No. Coolant Loops	3	Compiled by: F. A. Heddleson, Dec. '71 Nuclear Safety Information Center	

Reactor: Shearon Harris

C. SAFETY-RELATED DESIGN CRITERIA

Exclusion Distance, Mi.	1.32 rad.	Design Winds in psf:	
Low Population Zone Dist., Mi.	3	At 0 - 50 ft elev	20
Metropolis / Raleigh, N.C.	Distance / 20 mi. — Population / 117,676 (70)	50 - 150 ft	25
Design Basis Earthquake Accel., g	0.12	150 - 400 ft	30
Operating Basis Earthquake Accel., G	0.06	Tornado 300 mph tang + 60 trans.	
Earthquake Vertical Shock, % of Horizontal	66	ΔP = 3 psi/ 3 sec	

Is intent of 70 Design Criteria satisfied? Yes, Appendix 1A states that, "The plant will be designed, constructed, and operated so as to comply with the applicant's understanding of the intent of the...criteria... ."

D. ENCINEERED SAFETY FEATURES

D1. CONTAINMENT

Design Press, psig	42	Calculated Max Internal Press, psig	38 in 15 sec.
Max Leak Rate at Design Press, %/day	0.3		

Type of Construction: Steel-lined reinforced concrete structure as a vertical right cylinder with a hemispherical dome and flat base. Side walls of cylinder will be 4'-6" thick with 3/8" liner. Dome will be 2'-6" thick with a 1/2" liner. Concrete will be poured 2' deep over the 1/4" thick bottom liner plate. Containment free volume is 2,500,000 cu ft.

Design Basis: Designed to provide protection of the public from consequences of LOCA due to rupture of largest coolant pipe. Containment structure and Engineered Safety Features designed to safely sustain internal and external conditions that may occur during the life of the plant so that design leakage rate limits will not be exceeded, even for coincidental failure of the coolant system during an earthquake or hurricane.

Vacuum Relief Capability: Designed for 2 psi external pressure. Two 3-in. vacuum relief valves are provided each having 2 isolation valves.

Post-Construction Testing: Proof tested at 42 × 115% and held at pressure for 1 hr, after which structure will be checked for deformation and cracking. Leakage rate tests will be run at 42 and 21 psig to check leakage. Similar leakage tests will be run periodically thereafter.

Penetrations: All are double-sealed and individually testable. The hot-pipe penetration is designed to incorporate insulation and a heat exchanger for cooling. A penetration pressurization system is provided.

Weld Channels: Welds will be visually inspected, tested with a vacuum box and soap bubbles, spot checked radiographically and then covered with weld channels and tested at 48.3 psig for 15 minutes.

Reactor: Shearon Harris

D2. CONTAINMENT SAFETY FEATURES

Containment Spray System: Supplies borated water from the refueling water storage tank to containment following a LOCA. The spray from both 50% capacity pumps is adequate to prevent overpressuring the containment. Sodium hydroxide is added to the spray water to help remove iodine. Total heat removal capacity of the system is 240×10^6 Btu/hr. Each pump is rated 1500 gpm @ 200 psig. Suction is taken initially from the refueling water storage tank, but water can be recirculated from the sump.

Containment Cooling: There are four fan-coil cooling units, two running during normal operation and all four after LOCA or other accident. Each cooling unit is rated 60×10^6 Btu/hr. During normal cooling, each of the 2 units running is rated 3.1×10^6 Btu/hr and 160,000 cfm. The service water system furnishes coil cooling water.

Containment Isolation System: Provides a double barrier for all fluid penetrations not serving as accident consequence limiting systems. High containment pressure or the containment isolation signal causes valves on fluid penetrations not associated with Engineered Safety Features to close automatically. Other valves can be closed manually.

Containment Air Filtration: The filter train consists of a moisture separator, a HEPA filter, 2 charcoal filters, and a second HEPA filter all in series. The 2 charcoal filters are for enhanced iodine removal and the second HEPA filter is to catch any radioactive charcoal that is released.

Penetration Room: Sketches show penetration areas just outside containment at 2 different floor levels.

Organic-Iodide Filter: No reference found.

Hydrogen Recombiner: There is a hydrogen purge system with suitable filtration. Also, a hydrogen recombining system will be installed to combine hydrogen and oxygen in the containment atmosphere.

D3. SAFETY INJECTION SYSTEMS

Accumulator Tanks: Three tanks, each containing ∿7000 gallons of borated water, discharge their contents into the cold legs of the reactor vessel when the coolant system pressure drops to 600 psig. Two check valves in series are the only working parts. The contents of the accumulators are held under pressure of a nitrogen cover gas. It is assumed that contents of one tank spill out to the floor.

High-head Safety Injection: Three high-head pumps, normally used as charging pumps, inject borated water from the refueling water storage tank into 2 injection headers. Injection through one header flushes out the boron injection tank pumping boric acid into the reactor. Each pump is rated 150 gpm @ 2750 psig. Pumps are started automatically by the Safety Injection Signal.

Low-head Safety Injection: Two low-head pumps which are part of the Residual Heat Removal System operate to keep the core flooded when there are large breaks in the coolant system. Each pump delivers to a different injection header. Suction is taken initially from the refueling water storage tank, but when this supply runs low, water is cooled and recirculated from the containment sump. These 2 pumps are each rated 3750 gpm @ 600 psig.

Reactor: Shearon Harris

E. OTHER SAFETY-RELATED FEATURES

Reactor Vessel Failure: Sect. 4.3.1.1.1 says some design limits are based on the Fracture Analysis Diagrams and that there are no known service failures under conditions permitted by these limits.

Missile & Reactor Forces -

Core Cooling Capability -

Containment Floodability -

Reactor-Coolant Leak-Detection Systems: Leakage is indicated in the control room by the following measurement methods: (a) containment air particulate monitoring, (b) gas monitor, (c) quantity of makeup water to pressurizer, (d) containment sump water level, (e) containment pressure, temperature, and humidity, and (f) identified leakage through reactor flange.

Failed-Fuel-Detection Systems: No reference found.

Emergency Power: There will be six diesel-generator sets for the four reactor units. Each reactor will have one diesel-generator furnishing power on an independent bus plus the sharing of the other 2 units on a shared bus. Each diesel-generator will be independently housed with its own auxillaries. Two above grade tanks will supply 3 1/2 days of full power operation for the 4 diesels.

Control of Axial Xenon Oscillations:

Burnable Shims - Boron type chemical shim and burnable poison rods. Poison rods are borosilicate glass tubes which will be used only in first cycle.

Part-Length Control Rods - For shaping axial power distribution and to control axial xenon oscillations.

In-Core Instrumentation - Designed to supply info on neutron flux distribution and fuel assembly outlet temperatures.

Unborated Water Control: For boron dilution during refueling and startup there is ample time (∿1 hr) for the operator to recognize the increased count rate signal and terminate manually the source of dilution flow. During full power operation, rod insertion limit alarms alert the operator so he will have at least 15 minutes to correct the dilution error, either during automatic or manual operation. During manual operation, the reactor can reach the overtemperature ΔT trip setpoint.

Long-Term Cooling - Internal or External Systems: Four hours after reactor shutdown when reactor temperature and pressure are about 350 F and 400 psig, the Residual Heat Removal System begins operation and cools reactor to 140 F in 20 hours. The same system can continue for long-term cooling.

Reactor: Shearon Harris

F. GENERAL

Windspeed, Direction Recorders, and Seismographs: A meteoroloigcal program will be started at least 18 months prior to submitting the FSAR. No reference found to seismographs.

Plant Operating Mode: Load following using the 'load and frequency' control system as dispatched from the Raleigh office.

Site Features: Plant is to be located on a site consisting of 18,000 acres on which a reservoir will be built for cooling water. This site is in a sparsely populated rolling to hilly area where most of the area around the plant is wooded. In a 2-mi radius around the plant, the 1970 population was 119. Plant will be about 1 1/2 miles SW of US Highway #1 and the Seaboard Coastline Railroad.

Turbine Orientation: Ejected turbine blades could strike the containment structure.

Emergency Plans: Plans will be formulated and detailed as emergency procedures that will be followed in case of accident. Drills will be held so each individual will be familiar with his responsibility. The goal will be to protect personnel and to terminate or contain the accident and its consequences. Plans will be worked out with a local hospital to obtain medical attention for injured and contaminated personnel.

Environmental Monitoring Plans: A program will be started at least one year before criticality to determine the magnitude and nature of radioactivity near the site. This data will be used to set a baseline for evaluating changes after operation begins. Samples will include water, soil, air particulates, farm and dairy products, fish, other organisms, and bottom sediments. Post-operational monitoring will be established based on findings of the initial program.

Radwaste Treatment: Reactor coolant is processed by concentrating radioactive constituents for shipment off-site and recycling cleaned up water. Liquids from non-reactor-grade water sources (floor drains, laundry, hot showers, and lab drains) will be processed and released to the circulating water system. Fission product gases are removed from the coolant and contained throughout plant life or shipped off-site for disposal. Solid waste is packaged for off-site disposal. The system is designed so radioactive releases from the four units to the surrounding environment will not exceed a small fraction of the 10CFR20 limits and will comply with Appendix 1 of 10CFR50.

Waste Heat System: Condenser cooling water will come from the reservoir using a once-through system. Each of the 4 units will have 630,000 gpm (1400 cfs) circulated through the condenser. The main reservoir will cover 10,000 acres and the after reservoir which flows into the Cape Fear River will cover 400 acres. Total heat transfer to the reservoir will be 6.3×10^9 Btu/hr. Consumptive water use will be 29,000 gpm (65 cfs) average. Max reservoir temperature during the critical summer period will be $\sim$98 F.

G. CIRCULATING WATER SYSTEM & SITE FEATURES		REACTOR NAME Shearon Harris Nuclear Power Plant, Units 1, 2, 3, 4
THERMAL OUTPUT, MWt 2785	TYPE OF NUCLEAR STEAM SYSTEM PWR	DOCKET NO. 50-400, 401, 402, 403

NEARBY BODY OF WATER Impoundment of Buckhorn Creek (10,000 acres)

NORMAL LEVEL 250' (MSL)

MAX PROB FLOOD LEVEL 256' (MSL)

SIZE OF SITE 18,000 ACRES

SITE GRADE ELEVATION 260' (MSL)

TOPOGRAPHY OF SITE Rolling

OF SURROUNDING AREA (5 MI RAD) Rolling

TOTAL PERMANENT POPULATION IN 2 MI RAD 119 (1970) IN 5 MI RAD 1391 (1970)

NEAREST CITY OF 50,000 POPULATION Raleigh, N. C.

DISTANCE FROM SITE 20 MILES POPULATION 117,676 (1970)

LAND USE IN 5 MILE RADIUS Mostly wooded, plus agricultural

CIRCULATING WATER SYSTEM TYPE OF SYSTEM Once Through

WATER TAKEN FROM Reservoir & Cape Fear River FOR Condenser Cooling

WATER BODY TEMPERATURES - WINTER AVG 41 F SUMMER AVG 81 F AVG --- F

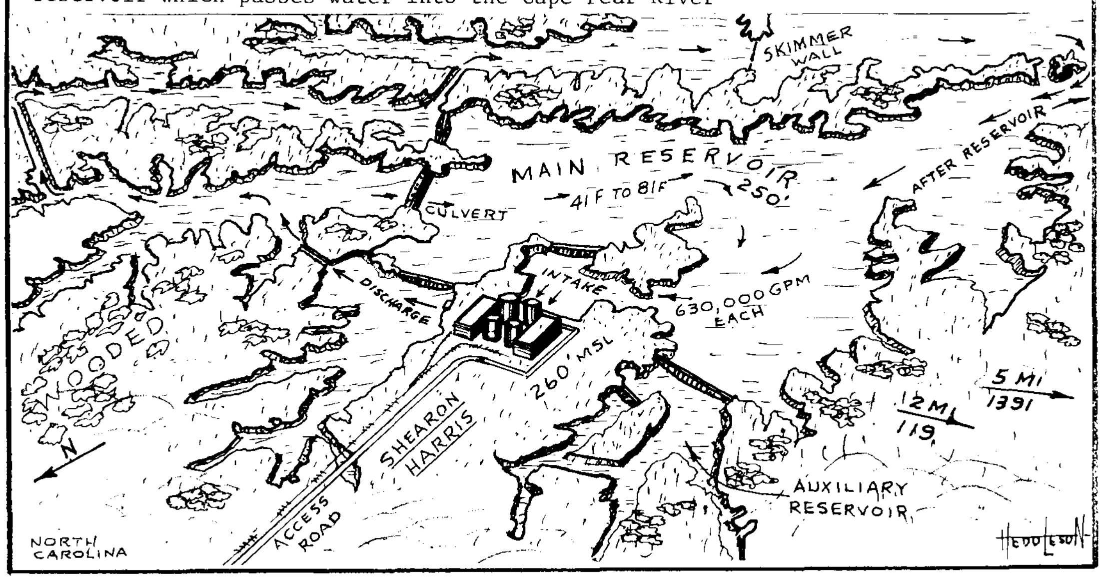
RIVER FLOW 82 (cfs) QUANTITY OF MAKEUP WATER --- (gpm)

TOTAL FLOW THROUGH CONDENSERS 630,000 (gpm) each TEMPERATURE RISE ---F

HEAT REMOVAL CAPACITY OF CONDENSERS 6300×10^6 (Btu/hr) each

COOLING TOWERS None (Circulating Water System not discussed in PSAR)

OTHER INFORMATION Main reservoir passes water to a smaller (400 acres) after-reservoir which passes water into the Cape Fear River



DATA FROM PSAR

Page 1 (PWR)

NORTH ANNA, 50-404 & 50-405

Project Name: North Anna Power Station Units 3 and 4

Location: Louisa Co., Virginia

Owner: Virginia Electric

A-E: Stone & Webster
Vessel Vendor: No specified
NSS Vendor: Babcock & Wilcox
Containment Constructor: Stone & Webster

A. THERMAL-HYDRAULIC		B. NUCLEAR	
Thermal Output, MWt	2631	H_2O/U, Cold	2.85
Electrical Output, MWe	950	Avg 1st-Cycle Burnup, MWD/MTU	13,810
Total Heat Output, Safety Design, MWt	2763	First Core Avg Burnup, MWD/MTU	---
Total Heat Output, Btu/hr	8980×10^6	Maximum Burnup, MWD/MTU	42,000
System Pressure, psia	2250	Region-1 Enrichment, %	avg.
DNBR, Nominal	1.72	Region-2 Enrichment, %	2.53 avg.
Total Flowrate, lb/hr	107×10^6	Region-3 Enrichment, %	avg.
Eff Flowrate for Heat Trans, lb/hr	102×10^6	k_{eff}, Cold, No Power, Clean	1.230
Eff Flow Area for Heat Trans, ft^2	40	k_{eff}, Hot, Full Power, Xe and Sm	1.093
Avg Vel Along Fuel Rods, ft/sec	16.3	Total Rod Worth, %	8.6
Avg Mass Velocity, $lb/hr\text{-}ft^2$	---	Shutdown Boron, with Rods-Clean-Cold, ppm	885
Nominal Core Inlet Temp, °F	566.3	Shutdown Boron, with Rods-Clean-Hot, ppm	549
Avg Rise in Core, °F	61.7	Boron Worth, Hot, % Δk/k/ppm	0.010
Nom Hot Channel Outlet Temp, °F	652.7	Boron Worth, Cold, % Δk/k/ppm	0.013
Avg Film Coeff, Btu/hr ft^2-°F	7800	Full Power Moderator Temp Coeff, Δk/k/°F	$(+0.15 \text{ to } -3.0) \times 10^{-4}$
Avg Film Temp Diff, °F	27	Moderator Pressure Coeff, Δk/k/psi	-0.5×10^{-7} to 3.0×10^{-6}
Active Heat Trans Surf Area, ft^2	40,743	Moderator Void Coeff, Δk/k/% Void	---
Avg Heat Flux, Btu/hr ft^2	214,000	Doppler Coefficient, Δk/k/°F	$(-1.1 \text{ to } -1.7) \times 10^{-5}$
Max Heat Flux, Btu/hr ft^2	582,000	Shutdown Margin, Hot 1 rod stuck, %Δk/k	1
Avg Thermal Output, kw/ft	7.07	Burnable Poisons, Type and Form	Al_2O_3 - B_4C pellets in Zircaloy
Max Thermal Output, kw/ft	19.20	Number of Control Rods	704
Max Clad Surface Temp, °F	657	Number of Part-Length Rods (PLR)	8
No. Coolant Loops	2	Compiled by: Heddleson - October 1972 Nuclear Safety Information Center	

C. SAFETY-RELATED DESIGN CRITERIA			Reactor: North Anna 3 & 4
Exclusion Distance, Miles	0.95 radius		Design Winds in psf:
Low Population Zone Distance, Miles	6		At 0 — 50 ft elev 27
Metropolis	Distance	Population	50 — 150 ft 36
Richmond, Va.	40 mile	249,430(70)	150 — 400 ft 44
Design Basis Earthquake Acceleration, g	0.12		Tornado 300 tang + 60 trans. (mph)
Operating Basis Earthquake Acceleration, g	0.06		ΔP = 3 psi/ 3 sec
Earthquake Vertical Shock, % of Horizontal	66		
Is Intent of 70 Design Criteria Satisfied?	Sect. 1.5 says yes.		

D. ENGINEERED SAFETY FEATURES

D1. CONTAINMENT		Design Pressure, psig	45
Max Leak Rate at Design Pressure, %/day	0.1	Calculated Max Internal Pressure, psig	42.5

Type of Construction:

Steel-lined, reinforced concrete structure with vertical cylindrical walls 4'-6" thick and hemispherical dome roof. Steel liner will be 3/8" thick. Designed for subatmospheric operation.

Design Basis:

Designed to withstand the internal pressure resulting from a LOCA being sufficiently leak tight to contain radioactivity within AEC limits and to provide sufficient shielding.

Vacuum Relief Capability:
No vacuum relief. Will operate at sub atmospheric pressure of 9 to 11 psi.

Post-Construction Testing:
Will be pressure tested at 115% of design pressure, then inspected for leaks. Leakage rate tests will be conducted in accordance with report published in Federal Register, Vol. 36, 8/27/71, pages 17053-056.

Penetrations:
All penetrations appear to be single sealed with no means for individually testing.

Weld Channels:
Seam welds will be covered continuously with test channels. Channels will be separated into test areas.

D2. CONTAINMENT SAFETY FEATURES	Reactor: North Anna 3 & 4
Containment Spray System: There is a quench-spray system and a recirculation spray system. The combination of these can cool and reduce containment to sub atmospheric pressure in 30 minutes after LOCA. There are 2 quench spray pumps and 2 recirculation spray pumps.	
Containment Cooling: Designed to maintain containment at 105 or lower in summer and 80 in winter operation. There will be 3 banks of cooling coils with fans. Coils will be cooled with chilled water. Cooled air will be recirculated. A charcoal filter system is available to clean up the air if required.	
Containment Isolation System: Provides 2 barriers between outside atmosphere and (1) contain. atmosphere and (2) reactor coolant system. All valves operate automatically, and positions are indicated in the control room. Leak tightness of valves can be monitored.	
Containment Air Filtration: Two charcoal filter banks can clean the recirculation cooling air prior to operation of the purge system.	
Penetration Room: Found no reference to penetration room.	

D3. SAFETY INJECTION SYSTEMS
Accumulator Tanks: Two tanks each contain borated water which is dumped into the reactor when the coolant system pressure drops below the tank pressure. Operating pressure and tank capacity not given in PSAR.
High-head Safety Injection: This is an integral part of the makeup and purification system. In emergency operation, 2 of the 3 pumps inject borated water from the refueling water storage tank through the hi-press injection lines. System is initiated by 1600 psig in coolant system or 0-5 psig containment pressure. High-pressure injection pumps are each rated for 450 gpm @1600 psig.
Low-head Safety Injection: A function of portions of the decay heat removal and recirculation spray systems. Two decay heat removal system pumps provide low pressure injection, each rated 3000 gpm@ 150 psig. This system operates independently of and in addition to the HPI system.

E. OTHER SAFETY-RELATED FEATURES

Reactor: North Anna 3 & 4

Reactor Vessel Failure: Stresses are held within design limits by controlling pressures and temp during heatup and cool down to prevent any possibility of brittle fracture.

Containment Floodability: No reference found.

Reactor-Coolant Leak-Detection System: Several methods, as follows: (a) containment air particulate monitoring system (see below), (b) containment gas monitor, (c) unusual quantity of makeup water for presssurizer, (d) containment sump water level, (e) containment pressure, temp, and humidity instrumentation. Containment air-particulate monitor response time is a function of percent of failed fuel and rate of leakage — 1000 cc leakage with 1% failed fuel will be detected in one minute.

Failed-Fuel-Detection System: Detected by gross activity analysis and from specific radio-nuclide analysis of the reactor coolant, particularly checking the ratios of I-131 and I-133, and CS-137 and CS-138 for comparison with standard base values.

Emergency Power: Three diesel-generator sets will serve units 3 &4; one exclusively for unit 3, one for unit 4 and the third unit as backup for either of the other 2. Units will be located in one building separated by fire walls, however all systems and auxiliaries will be independent. Underground fuel-oil storage tank will contain sufficient fuel for 7 days operation of 2 diesels.

Control of Axial Xenon Oscillations By Burnable Shims, Part-Length Control Rods, In-Core Instrumentation: Yes, both burnable shims and part length rods (APSRA) will be used. Out of core detectors will monitor the flux. In-core detector can be used for checking out-of-core detectors.

Boron Dilution Control: A reactor trip will terminate unborated water addition to the makeup tank, and total flow into the coolant system would be terminated by high pressurizer level — all automatically.

Long-Term Cooling: Provided by recirculating water from the containment sump using two recirculation spray pumps and coolers. Each pump is rated 3000 gpm @ 150 psig. Each of the 2 coolers has a capacity of 29×10^6 Btu/hr.

Organic-Iodide Filter: No reference found.

Hydrogen Recombiner: Final design not established.

F. GENERAL

Reactor: North Anna 3 & 4

Windspeed, Direction Recorders, and Seismographs: Temperatures and wind data recorded at 35' and 150' on a tower. Started taking measurements before units 1 & 2 were started. No reference found to seismographs.

Plant Operation Mode: Designed for load following but will operate base loaded.

Site Description: The site is in an area of rolling hills where a 13,000 acre man-made reservoir has been impounded. The area is mostly wooded and sparsely populated. The reservoir is divided into 2 parts so about 1/3 of it can be used as a cooling pond. It is planned that the reservoir will be used for recreational activities.

Turbine Orientation: Ejected turbine blades could strike containment. Westinghouse will supply turbine.

Emergency Plans: Detailed plans have not yet been formulated, however, the plans made for North Anna #1 and #2 will include units 3 and 4. The roles of outside agencies will be determined in discussion with them. The final plan will be similar to the one specified for Surry Station in amendment #17.

Environmental Monitoring Plans: Pre-impoundment studies have been made by Dr. George Simmons to study and to evaluate existing water quality of biological, chemical, radiochemical, and bacteriological analyses. The results of the study supports the observation that the North Anna basin will be improved by the impoundment.

Radwaste Treatment: System designed to collect and separate liquid, gaseous, and solid wastes for activity levels based on 1.0% of fuel rods in core having cladding defects. Liquid Wastes will be stored for decay, then evaporated. Condensate will be filtered and discharged thru the circulating water system. Gaseous Wastes will be suitably diluted before discharge. Solid Wastes will be drummed and shipped offsite for disposal.

Plant Vent: The one process vent for 3 & 4 will terminate 10 ft above the top of one containment structure.

G. SITE DATA

Reactor: North Anna 3 & 4

Nearby Body of Water: North Anna River Reservoir

Normal Level 250' (MSL)

Max Prob Flood Level 259' (MSL)

Size of Site 1075 Acres

Site Grade Elevation 271' (MSL)

Topography of Site: Rolling

of Surrounding Area (5 mi rad): Rolling

Total Permanent Population: In 2 mi radius 225 ; 10 mi 15,929

Date of Data: 2000 In 5 mi radius 1429 ; 50 mi 2,071,500

Nearest City of 50,000 Population: Richmond, Va.

Dist. from site 40 Miles, Direction SSE , Population 249,430

Land Use in 5 Mile Radius: Wooded - 70% - Agricultural - 25%

Meteorology: Prevailing wind direction NNE SSW Avg. speed ~3mph

Stability Data - Pasquill F

Miscellaneous Items Close to the Site: Most of the land surrounding the site is wooded. The town of Mineral 7 1/2 miles WSW is the nearest residential area. The nearest residence is about 1 mile. Good highways are closeby with US 64 about 20 min SW and US 95 about 18 mi E. Fredericksburg, Md. is about 25 miles NE.

H. CIRCULATING WATER SYSTEM

Type of System: One through.

Water Taken From: North Anna Reservoir

Intake Structure: Each unit has a structure with 4 bays, 4 pumps, and equipped with a trash rack and traveling screen. Intake flows will be 1 fps or less.

Water Body Temperatures: Winter minimum 32 °F Summer maximum 85 °F

River Flow 375 (cfs) minimum; --- (cfs) average

Service Water Quantity 20,344 gpm/reactor

Flow Thru Condenser 912,000 (gpm)/reactor Temp. Rise 14 °F

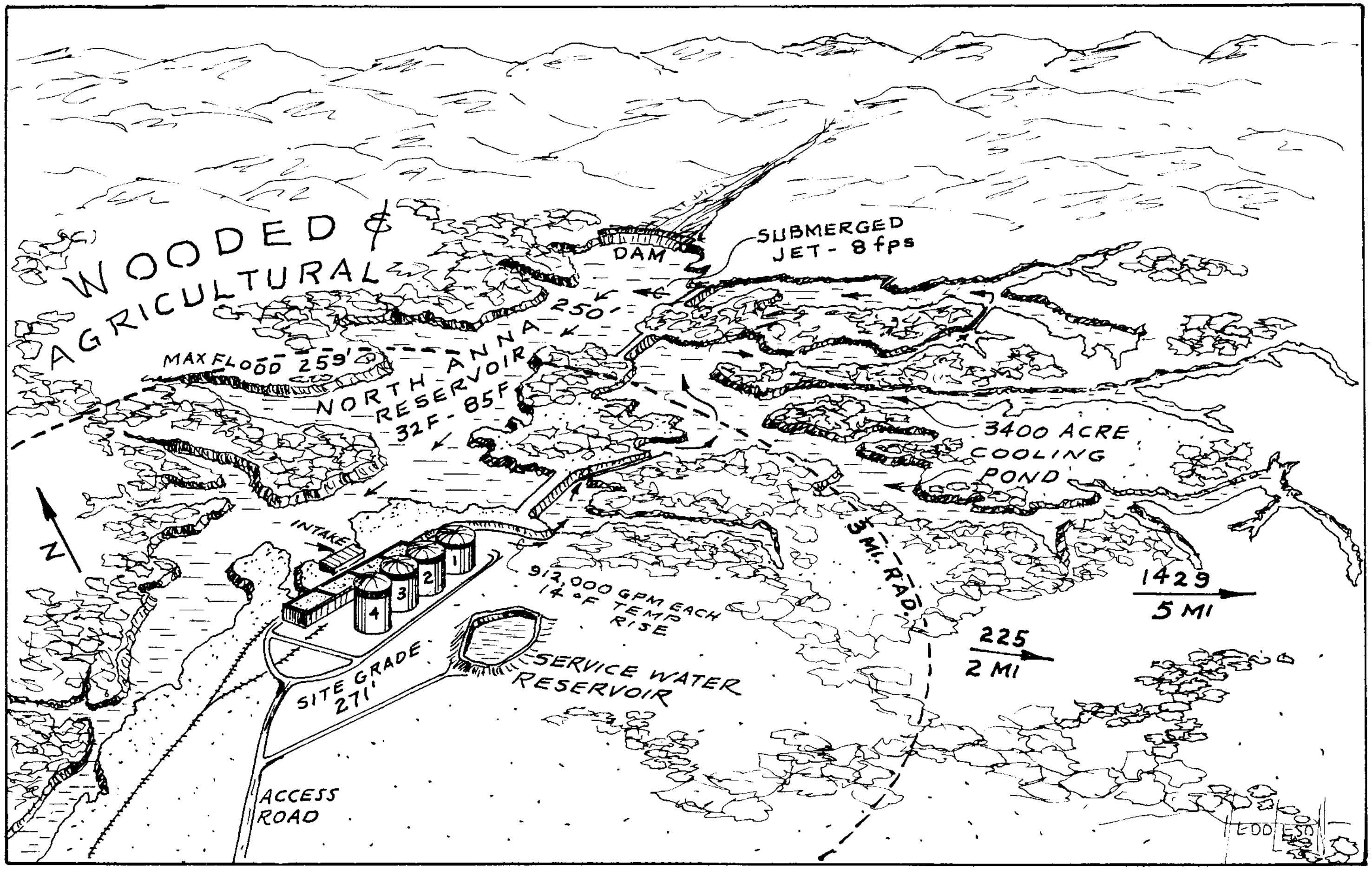
Heat Dissipated to Environment --- (Btu/hr)/reactor

Heat Removal Capacity of Condenser --- (Btu/hr)/reactor

Discharge Structure: Water discharged to a cooling pond called the Waste Heat Treatment Facility consisting of 3400 acres. It discharges into the main reservoir as a submerged jet at 8 fps.

Cooling Tower(s): Description & Number - None

Blowdown ______ gpm/reactor Evaporative loss ______ gpm/reactor



NUCLEAR SAFETY INFORMATION CENTER

LA CROSS BOILING WATER REACTOR 50-409
Formerly 115-5

Project Name: La Cross Boiling Water Reactor

Location: Genoa, Wis.

Owner: Dairyland Power Coop

A-E: Sergent & Lundy
Vessel Vendor: Not specified
NSS Vendor: Allis Chalmers
Containment Constructor: Maxon Const. Co.

A. THERMAL-HYDRAULIC		B. NUCLEAR	
Thermal Output, MWt	165	H_2O/UO_2 Volume Ratio	2.63
Electrical Output, MWe	52.4	Moderator Temp Coef Cold, Δk/k/°F	$+ 3.8 \times 10^{-5}$
Total Heat Output, Safety Design, MWt	---	Moderator Temp Coef Hot, No Voids	$- 4.8 \times 10^{-5}$
Steam Flow Rate, lb/hr	610,000	Moderator Void Coef Hot, No Voids, Δk/k/%	$- 1.6 \times 10^{-3}$
Total Core Flow Rate, lb/hr	10.7×10^6	Moderator Void Coef Operating	$- 2.3 \times 10^{-3}$
Coolant Pressure, psig	1300	Doppler Coefficient, Cold	---
Heat Transfer Area, ft^2	5163	Doppler Coefficient, Hot, No Voids	---
Max Power per Fuel Rod Unit Lgth, kw/ft	---	Doppler Coefficient, Operating	---
Maximum Heat Flux, Btu/hr-ft^2	434,700	Initial Enrichment, %	3.63
Average Heat Flux, Btu/hr-ft^2	109,100	Average Discharge Exposure, MWD/Ton	12,700
Maximum Fuel Temperature, °F	3850	Core Average Void Within Assembly, %	---
Max Fuel Rod Surface Temp, °F	585	k_{eff}, All Rods In	0.919
MCHFR	2.75	k_{eff}, Max Rod Out	0.990
Total Peaking Factor	---	Control Rod Worth, %	25
Avg Power Density, Kw/ℓ	41.4	Curtain Worth, %	---
Peak Fuel Enthalpy on Rod Drop, Cal/gm	---	Burnable Poisons, Type and Form	---
		Number of Control Rods 29 x 80	2320
		Number of Part-Length Rods (PLR)	None

Much of the data requested on this are not presented in the "Operating Safeguards Report," and so numerous omissions occur.

Compiled by: Fred Heddleson, May 1973
ORNL, Nuclear Safety Information Center

C. SAFETY-RELATED DESIGN CRITERIA

Reactor: LA CROSS

Exclusion Distance, Miles: 0.21 radius	Design Winds:
Low Population Zone Distance, Miles: 3 radius	At 0 — 50 ft elev 20 psf
	50 — 150 ft ---
	150 — 400 ft ---
Design Basis Earthquake Acceleration, g: ---	Tornado ---
Operating Basis Earthquake Acceleration, g: ---	ΔP = -- psi/ -- sec
Earthquake Vertical Shock, % of Horizontal: ---	Is Intent of 70 Design Criteria Satisfied? ---

Metropolis	Distance	Population
La Cross, Wis.	20	51,153

Recirculation Pumping System & MCHFR:

Protective System:

D. ENGINEERED SAFETY FEATURES

D1. CONTAINMENT

Drywell Design Pressure, psig: 52	Primary Containment Leak Rate, %/day: 0.1
Suppression Chamber Design Pressure, psig: ---	Second Containment Design Pressure, psig: ---
Calculated Max Internal Pressure, psig: 48.5	Second Containment Leak Rate, %/day: ---

Type of Construction:

A right circular cylinder with a hemispherical dome and semi-eliptical bottom. Shell thickness of side walls is 1.16 in. covered on the inside with 9" of concrete for shielding, and 0.60 in. thick for the dome. The structure is set on piles driven deeply and covered with concrete. Free air volume is 264,160 cu. ft.

Design Basis:

Designed for MCA where a 20" circulation pipe ruptures and containment pressure rises to 48.5 psig so that containment integrity will be held and leakage of containment atmosphere will not exceed 0.1% of vol. per day. It is assumed that 35% of fuel rods would suffer partial melting.

Vacuum Relief Capability

Two vacuum breakers begin to open when internal vacuum exceeds 0.3 psig.

Post-Construction Testing: Containment structure was tested for leakage and found to be leaktight. Tests were run at 60 psig. A pressure test was conducted in increments up to 59.8 psig.

Penetrations: No reference found on whether penetrations are double sealed and testable.

D2. EMERGENCY CORE COOLING SYSTEMS Reactor: LA CROSS
Core Spray Cooling System: Water is taken from a 42,000 gal overhead storage tank by 2 pumps rated 50 gpm each at 1450 psig, or supply can be by gravity feed. Boron from the boron injection tank is pumped into the reactor with the spray water. Spray sparger nozzles are located above the fuel elements and spray down on them. 15,000 gal of water are reserved in the tank for core spray.
Auto-Depressurization System: No reference found.
Residual-Heat-Removal System (RHRS): Components usually in the RHRS are the shutdown consenser which dissipates decay heat after the reactor shuts down until the reactor water temperature drops to 470°F. Another system, the Decay Heat Cooling System, cools the reactor from 470°F to 120°F and maintains the reactor water temperature at 120°F during refueling or alterations.
High-Pressure Coolant-Injection System: On page 2-8 it states that "If the reactor core becomes uncovered, emergency cooling water will be provided automatically at either high or low pressure." However, no further information on the system or equipment was found.
Low-Pressure Coolant-Injection System: See above.

E. OTHER SAFETY-RELATED FEATURES
Main-Steam-Line Flow Restrictors: No reference found.
Control-Rod Velocity Limiters: No reference found.
Control-Rod-Drive-Housing Supports: No reference found.
Standby Liquid-Control System: A manual boron injection system can be used to shut down the reactor.

E. OTHER SAFETY-RELATED FEATURES (cont'd) Reactor: LA CROSS

Standby Coolant System:
Found no reference; however, it is certain that water can be pumped from the Mississippi River for emergency cooling.

Containment Atmospheric Control System: Two 30-T air coolers maintain temp of about 80°F. The units have heating coils for heating as required. Each unit circulates 12,000 cfm. Air is exhausted from the building and passed through filters before venting to the stack. Also a building spray system is available using water from the 42,000 gal storage tank in the dome.

Reactor Core Isolation Cooling System (RCICS):
A shutdown condenser system is available to condense reactor steam when the reactor is isolated from the main condenser by closure of the reactor building steam isolating valve on turbine building isolation valve. Shell side of condenser can be cooled by demineralized water or by the high pressure service water system.

Reactor Vessel Failure:

No reference found.

Containment Floodability:
No reference found.

Reactor-Coolant Leak-Detection System:

No reference found.

Failed-Fuel Detection Systems: Failed fuel is first detected from the vent and waste-gas disposal system radiation monitors. The failed fuel element is located by the system that samples steam and water that passes through each individual fuel element.

Emergency Power:
Supplied by a 125-kW diesel generator set. In addition to power from the diesel-generator set, a source of power is provided by the 120-V d-c battery system through an inverter which supplies 120-V a-c. The 480-V bus is supplied by a 250 kW engine-generator set.

Rod-Block Monitor:
A rod withdrawal circuit provides a system similar to rod block.

Rod-Worth Minimizer:

No reference found.

F. GENERAL	Reactor: LA CROSS
Windspeed, Direction Recorders, and Seismographs: A recording anemometer was installed on roof of nearby steam plant. No reference to seismographs was found.	
Plant Operation Mode: Base loaded, but designed for load following.	
Site Description: Located on the east bank of the Mississippi River in a valley about 2-3/4 miles wide with bluffs rising up from the valley about 500 ft high. The immediate plant site was formed along the river by fill material dredged from the river channel. Bluff east of the site starts rising up about 1000 ft east of the reactor.	
Turbine Orientation: Turbine was supplied by Allis Chalmers. It is on the same centerline with the containment structure.	
Emergency Plans: Detailed emergency procedures are contained in the reactor operating manual designating employee responsibility and actions to be taken in cases of emergency. Evacuation of the station and areas around the station are described. Local, county, state, and federal agencies will be called for help as needed.	
Environmental Monitoring Plans: The program established is coordinated by the State of Wisconsin Department of Health. Samples are taken for analysis of radiation levels in the air, river water and silt, well and tap water, rain and snow, fish and small animals, milk, vegetation, and soil. Program was designed to measure preoperational levels and then to compare post-operation levels for determination of radiation effects.	
Radwaste Treatment: If activity levels are too high, off-gases from 72 hr of full-power operation may be held in storage tanks; otherwise gases will be vented up the stack. Liquid wastes are handled by the batch method, with liquids in containment collected in two 6000-gal tanks and liquids in the turbine building collected in two smaller tanks. Demineralizers may be used to process wastes for release to the condenser circulating water discharge line. Release is permitted, however, only if analysis indicates that activity levels do not exceed 10 CFR 20 limits. Liquid wastes too active for release may be transferred to the waste treatment building where for concentration by evaporation or ion exchange for eventual off-site shipment in concrete-lined drums. Solid wastes are packaged in drums for off-site shipment.	
Plant Vent: Stack is 350 ft high of reinforced concrete construction with an aluminum nozzle at the top.	

Page 6, BWR

G. SITE DATA

Reactor: LA CROSS

Nearby Body of Water: Mississippi River

Normal Level 620' (MSL)
Max Prob Flood Level 635' (MSL)

Size of Site --- Acres   Site Grade Elevation 639' (MSL)

Topography of Site: level

of Surrounding Area (5 mi rad): level westerly, hilly to east

Total Permanent Population: In 2 mi radius ____; 10 mi 7,420

Date of Data: 1960   In 5 mi radius 1,076 ; ~~50~~ 25 mi 114,900

Nearest City of 50,000 Population: La Cross

Dist. from site 20 Miles, Direction N , Population 51,153

Land Use in 5 Mile Radius: Mostly agricultural except for area west of plant for about 3 miles wherever plain is marshy. Some areas are wooded.

Meteorology: Prevailing wind direction SSE Avg. speed 6 mph NNW in winter.

Stability Data - Annual average inversion 30-35% of time.

Miscellaneous Items Close to the Site: Genoa (pop. 320) is about 1 mi north, and La Cross 20 miles north. The Chicago Burlington and Quincy RR is 475' west of the reactor running along parallel with Wisconsin highway #35. The nearest house is 1192 ft from the reactor. U.S. Lock #8 is 3/4 miles north. A coal fired steam plant (14,000 kwe) is adjacent to the nuclear plant.

H. CIRCULATING WATER SYSTEM

Type of System: once through

Water Taken From: Mississippi River

Intake Structure: There is an intake structure (not described) that has 2 pumps for condenser cooling water.

Water Body Temperatures: Winter minimum -- °F   Summer maximum -- °F

River Flow 8000 (cfs) minimum; 27,970 (cfs) average

Service Water Quantity --- gpm/reactor

Flow Thru Condenser 30,000 (gpm)/reactor   Temp. Rise -- °F

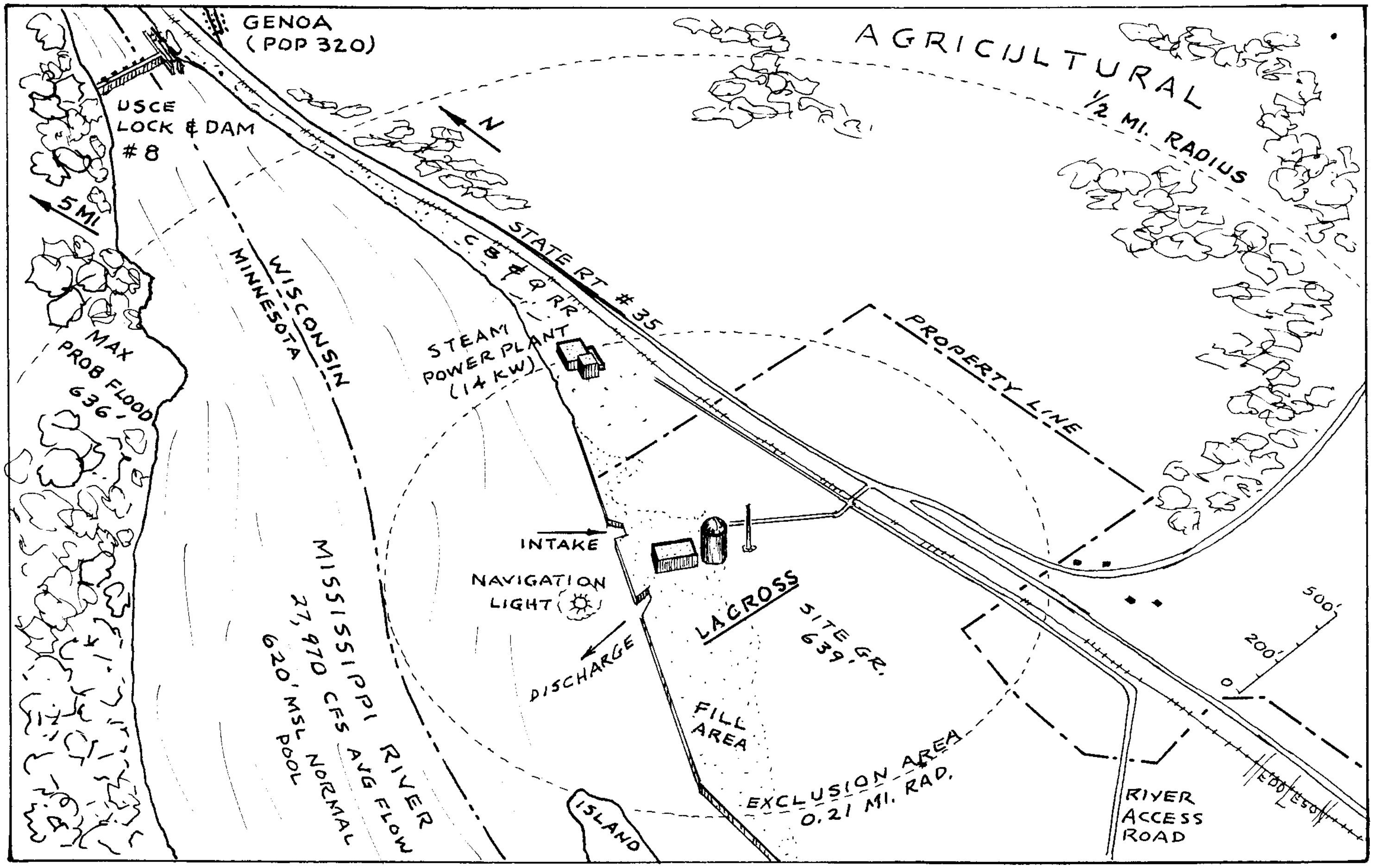
Heat Dissipated to Environment -- (Btu/hr)/reactor

Heat Removal Capacity of Condenser -- (Btu/hr)/reactor

Discharge Structure: No description given.

Cooling Tower(s): Description & Number - None

Blowdown ____ gpm/reactor   Evaporative loss ____ gpm/reactor


GENOA
(POP 320)
USCE
LOCK & DAM
8
N
AGRICULTURAL
1/2 MI. RADIUS
5 MI
STATE RT # 35
C B & Q RR
WISCONSIN
MINNESOTA
MAX
PROB FLOOD
636'
STEAM
POWER PLANT
(14 KW)
PROPERTY LINE
INTAKE
NAVIGATION
LIGHT
LACROSS
SITE GR.
639'
DISCHARGE
MISSISSIPPI RIVER
27,970 CFS AVG FLOW
620' MSL NORMAL
POOL
FILL
AREA
EXCLUSION AREA
0.21 MI. RAD.
ISLAND
RIVER
ACCESS
ROAD
0
200'
500'

Data from PSAR

Page 1 (BWR)

NINE MILE POINT # 2, 50-410

Project Name: Nine Mile Point Nuclear Station Unit 2

Location: Oswego Co., N.Y.

Owner: Niagra Mohawk Power Corp.

A-E: Stone & Webster

Vessel Vendor: Not identified

NSS Vendor: General Electric

Containment Constructor: Not specified

A. THERMAL-HYDRAULIC		B. NUCLEAR	
Thermal Output, MWt	3323	H_2O/UO_2 Volume Ratio	---
Electrical Output, MWe	1100	Moderator Temp Coef Cold, $\Delta k/k/°F$	---
Total Heat Output, Safety Design, MWt	3489	Moderator Temp Coef Hot, No Voids	---
Steam Flow Rate, lb/hr	14.3×10^6	Moderator Void Coef Hot, No Voids, $\Delta k/k/\%$	---
Total Core Flow Rate, lb/hr	108.5×10^6	Moderator Void Coef Operating	---
Coolant Pressure, psig	1020	Doppler Coefficient, Cold	-1.2×10^{-5}
Heat Transfer Area, ft^2	66218	Doppler Coefficient, Hot, No Voids	-0.7×10^{-5}
Max Power per Fuel Rod Unit Lgth, kw/ft	18.5	Doppler Coefficient, Operating	---
Maximum Heat Flux, $Btu/hr\text{-}ft^2$	428,000	Initial Enrichment, %	---
Average Heat Flux, $Btu/hr\text{-}ft^2$	164,380	Average Discharge Exposure, MWD/Ton	19,000
Maximum Fuel Temperature, °F	4380	Core Average Void Within Assembly, %	41.3
Average Fuel Rod Surface Temp, °F	565	k_{eff}, All Rods In	---
MCHFR	>1.9	k_{eff}, Max Rod Out	less than 0.99
Total Peaking Factor	2.60	Control Rod Worth, % - one rod	0.01 Δk
Avg Power Density, Kw/ℓ	51.2	Curtain Worth, %	---
Peak Fuel Enthalpy on Rod Drop, Cal/gm	280	Burnable Poisons, Type and Form	Gadolinia in selected fuel rods
DATA FROM PSAR		Number of Control Rods	185
		Number of Part-Length Rods (PLR)	None

Compiled by: Heddleson, September 1972
ORNL, Nuclear Safety Information Center

C. SAFETY-RELATED DESIGN CRITERIA	Reactor: Nine Mile Point 2
Exclusion Distance, Miles: 1 mile radius	Design Winds in mph:
Low Population Zone Distance, Miles: 4 mile radius	At 0 — 50 ft elev: 90
Metropolis / Distance / Population: Syracuse, N.Y. / 34 mile / 197,208	50 — 150 ft: 105
	150 — 400 ft: 125
Design Basis Earthquake Acceleration, g: 0.10	Tornado 300 mph + 60 trans.
Operating Basis Earthquake Acceleration, g: 0.05	ΔP = 3psi/ 3sec
Earthquake Vertical Shock, % of Horizontal: 66	Is Intent of 70 Design Criteria Satisfied? Yes

Recirculation Pumping System & MCHFR: Controls the variable position of the flow control discharge value. By changing the flow rate the core power level and MCHFR is changed. System adjusts automatically to reactor output and load demand.

Protective System: Initiates an automatic reactor shutdown if nuclear system variables exceed preestablished limits; in time to prevent release of radioactivity. This system overrides all other controls.

D. ENGINEERED SAFETY FEATURES

D1. CONTAINMENT

Drywell Design Pressure, psig	45	Primary Containment Leak Rate, %/day	1.1
Suppression Chamber Design Pressure, psig	45	Second Containment Design Pressure, psig	0.25
Calculated Max Internal Pressure, psig	37	Second Containment Leak Rate, %/day	100

Type of Construction: And over-and-under reinforced concrete, steel-lined pressure suppression type structure. The reactor vessel is housed in the upper drywell, and the lower pressure suppression chamber stores a large volume of water. Connecting vent pipes can vent steam to the suppression chamber where it will be condensed. Drywell free volume is 230,000 cu ft and suppression chamber air volume is 160,000 cu ft.

Design Basis: Designed to limit release of radioactive materials to the environment in case of a postulated LOCA so that offsite doses will be below limits of 10CFR100. Also, designed to withstand the effects of a design basis earthquake.

Vacuum Relief Capability: Designed for 5 psi external. No vacuum relief devices are provided.

Post-Construction Testing: Will be pressure tested at 52 psig. Leakage rate tests will be conducted per specs published in the Federal Register, Volume 36, Number 167, August 27, 1971, pages 17053 to 17056.

Penetrations: Single barrier penetrations that are not testable.

D2. EMERGENCY CORE COOLING SYSTEMS Reactor: Nine Mile Point 2

Core Spray Cooling System: There is a high pressure and a low pressure core spray system. The high pressure system starts when reactor water level drops to a specified level. One pump supplies 1650 gpm 1110. The low pressure system has one pump rated 6250 gpm @ 122 psid. Both systems take suction from suppression pool, however, the high pressure system takes suction also from the condensate storage tank.

Auto-Depressurization System: If high pressure coolant systems cannot supply enough water to the reactor vessel, this system automatically lowers the pressure by venting thru pressure relief valves down to a level where low pressure coolant systems start operating.

Residual-Heat-Removal System (RHRS): A combination of 4 subsystems consisting of 3 closed piping loops, 2 heat exchangers, 3 main system pumps, and service water pumps with controls and instrumentation. Modes of operation are (1) shut down cooling to dump steam from the reactor and/or circulate reactor water thru heat exchangers for cooling, (2) containment cooling to limit temp of water in suppression pool, (3) steam condensing mode using RHRS heat exchangers to condense steam using service water for cooling, and (4) low pressure coolant injection discussed below.

High-Pressure Coolant-Injection System: The high-pressure core spray system is the only high pressure injection system. (See above 'Core Spray Cooling System.')

Low-Pressure Coolant-Injection System: A part of the Residual Heat Removal System whose purpose is to keep water in the reactor after a LOCA. This system operates automatically when differential pressure between the reactor and containment is 20 psid or less. The 3 pumps take suction from the suppression pool and pump 7,450 gpm each at 20 psid.

E. OTHER SAFETY-RELATED FEATURES

Main-Steam-Line Flow Restrictors: Venturi-type restrictors installed in main steam lines to limit flow to 5% of design flow in case of line rupture.

Control-Rod Velocity Limiters: Limits velocity at which a rod can fall out of the core, consisting of two nearly mated conical elements acting as large clearance piston and baffle inside control rod guide tube.

Control-Rod-Drive-Housing Supports: Located under reactor vessel near control rod housing. Supports limit travel of a control rod if housing ruptures. Max travel in hot operating condition would be about two inches.

Standby Liquid-Control System: A neutron absorber solution provides a backup means to shutdown the reactor even if control rods cannot be operated.

E. OTHER SAFETY-RELATED FEATURES (cont'd) **Reactor:** Nine Mile Point 2

Standby Coolant System: Service water piping is cross-connected to the discharge from the RHRS heat exchanger.

Containment Atmospheric Control System: Designed to hold drywell temp below 137°F during normal operation using fan-coil coolers. Containment can be inerted with nitrogen. Drywell can be vented thru the standby gas treatment system. Hydrogen and oxygen buildup can be monitored. Nitrogen purge will keep O_2 and H_2 from reaching high levels.

Reactor Core Isolation Cooling System (RCICS): Provides makeup water to reactor vessel when vessel is isolated. The systems uses a steam-driven turbine-pump unit and operates automatically in time and with sufficient coolant flow to maintain adequate water level in the reactor vessel. Pump capacity is 616 gpm.

Reactor Vessel Failure: If fabricated and operated within design limits, there is low probability of failure from any known failure mechanism.

Containment Floodability: Containment can be flooded by the Residual Heat Removal System.

Reactor-Coolant Leak-Detection System: Will be detected by monitoring pressure, temperature, fillup rates of equipment, temperature differential on cooling water for equipment coolers, increased flows of condensate from coolers, water levels in equipment and higher than usual radioactivity measurements. Unidentified leakage limit rate has been set at 5 gpm flowing into the drywell drain tanks.

Failed-Fuel Detection Systems: Consists of four gamma radiation monitors located externally to main steam lines just outside primary containment. Monitors are designed to detect a gross release of fission products from the fuel. On detection of high radiation, the trip signals generated by monitors initiate a reactor scram and isolation of containment.

Emergency Power: There are 3 diesel-generating sets each independently housed with independent auxiliaries. Diesel-generators are rated so any 2 units can carry all emergency loads with the 3rd unit serving as alternate or standby. Fuel capacity will be maintained for operation of all 3 units for 7 days. Starting time is 10 seconds.

Rod-Block Monitor: Prevents fuel damage resulting from rod-withdrawal error. Provides a warning signal to the operator. The RBM subsystem has 2 RBM channels, each of which uses input signals from a number of LPRM channels. A trip signal from either RBM channel can initiate a rod block.

Rod-Worth Minimizer: A computer function that help the operator in startup, shut down, and low power control-rod procedures. Prevents operator from establishing patterns not consistent with preplanned rod sequences.

F. GENERAL

Reactor: Nine Mile Point 2

Windspeed, Direction Recorders, and Seismographs: Data collection started in 1963 for Unit 1. A 204' tower used to measure wind speed, direction, and temp at 30' and 200'. No reference found to seismographs.

Plant Operation Mode: Designed for automatic load following.

Site Description: Located on the southeast shore of Lake Ontario about 15 feet above normal lake level. The site is relatively flat with a few swamps and bogs. Oswego sandstone under the site is essentially impermeable. U.S. Highway 104 runs E-W about 3 miles south of the site.

Turbine Orientation: GE will supply turbine. Reactor and turbine are on same centerline.

Emergency Plans: Detailed written procedures for Unit 1 will be expanded to include Unit 2. These procedures will treat Units 1 and 2 and the FitzPatrick Plant jointly. Appropriate personnel are trained in these procedures, and periodic drills and reviews are conducted. A procedure is established to cover emergencies at the site. It includes liaison with local fire and police departments, state police, public health authorities, local hospitals, and the AEC.

Environmental Monitoring Plans: A program was established for the operating Nine Mile Point Unit 1, and the FitzPatrick Plant, presently under construction. This program will also cover Nine Mile Point Unit 2. Reference levels of radiation that have been established for the areas surrounding the site will form the basis of comparison for future measurements. The program covers fish, underwater plants, and milk.

Radwaste Treatment: Liquid waste will be collected, treated, stored, and processed. All liquids that can be reused will be returned to the system. Liquids not reuseable will be discharged through the circulating water system (~10,000 gal per day). Solid wastes will be collected and packaged for off-site disposal. Gases, most of which come from the main condenser air removal system will be held for 20 days for xenon decay. Gases will be processed including condensing of vapors, use of catalytic recombiner for control of hydrogen, chiller-condenser moisture separator, and filtering (charcoal and HEPA).

Plant Vent: A reinforced concrete stack, or a steel tower supporting the vent will be provided. Design is not complete.

G. SITE DATA — Reactor: Nine Mile Point 2

Nearby Body of Water: Lake Ontario

Normal Level 246' (MSL)

Max Prob Flood Level 253' (MSL)

Size of Site 900 Acres — Site Grade Elevation 261' (MSL)

Topography of Site: Flat to Rolling

of Surrounding Area (5 mi rad): Rolling

Total Permanent Population: In 2 mi radius 279 ; 10 mi 35,183

Date of Data: 1970 — In 5 mi radius 4487 ; 50 mi 930,798

Nearest City of 50,000 Population: Syracuse, N.Y.

Dist. from site 34 Miles, Direction SSE, Population 197,208

Land Use in 5 Mile Radius: Farming and Residential, mostly pasture land.

Meteorology: Prevailing wind direction N — Avg. speed 10 mph

Stability Data - Large scale tropospheric mixing throughout the year.

Miscellaneous Items Close to the Site: Located adjacent to Nine Mile Point #1 and about 2400 feet west of FitzPatrick plant. The Ontario Bible Conference operates a summer camp just west of utility's property. Oswego is the nearest population center. It is about 7 miles SW. The nearest residence is about 1 mile away. The nearest school is 6 1/2 miles.

H. CIRCULATING WATER SYSTEM

Type of System: Once through.

Water Taken From: Lake Ontario

Intake Structure: Located 1650 ft off shore on the lake bottom in 24 ft. of water. Deicing equipment is provided. Water is drawn into the screenwall where there will be trash racks and traveling screens. Intake velocity is 1.0 fps.

Water Body Temperatures: Winter minimum 32 °F — Summer maximum 71 °F

River Flow NA (cfs) minimum; NA (cfs) average

Service Water Quantity 45,000 gpm/reactor

Flow Thru Condenser 500,000 (gpm)/reactor — Temp. Rise 32 °F

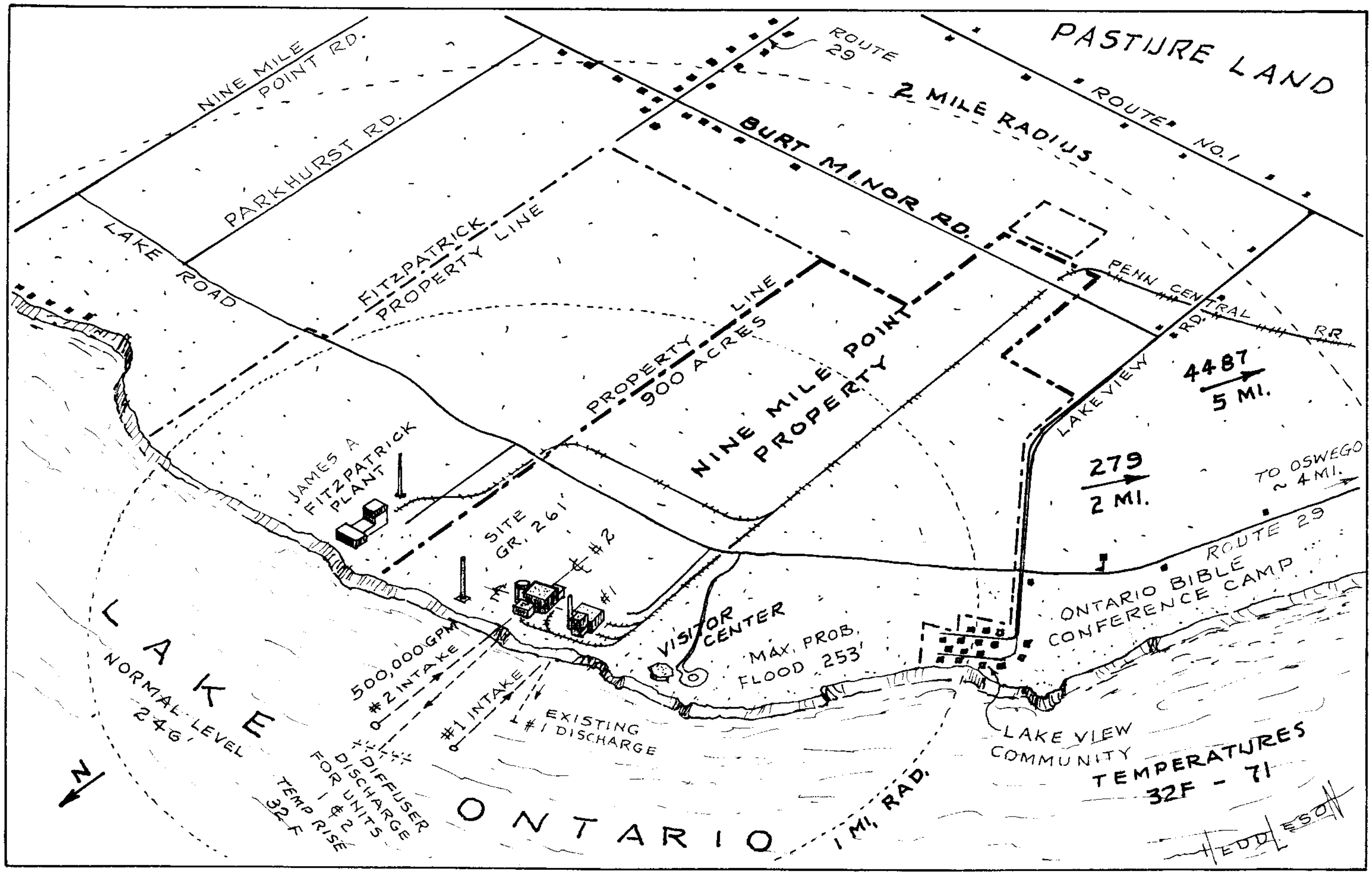
Heat Dissipated to Environment --- (Btu/hr)/reactor

Heat Removal Capacity of Condenser $8{,}152 \times 10^6$ (Btu/hr)/reactor

Discharge Structure: A diffuser type discharge will be used for combined Unit 1 and 2 discharge. A diffuser pipe 555 ft long will have 24 ports each 2.5 ft in diameter.

Cooling Tower(s): Description & Number - None

Blowdown ______ gpm/reactor — Evaporative loss ______ gpm/reactor



ORNL NUCLEAR SAFETY INFORMATION CENTER

FROM PSAR & RESAR

Page 1 (PWR)

CATAWBA, 50-413, 50-414

Project Name: Catawba Nuclear Station, Units 1 and 2

Location: York Co., S.C.

Owner: Duke Power

A-E: Duke
Vessel Vendor: Not specified
NSS Vendor: Westinghouse
Containment Constructor: Duke

A. THERMAL-HYDRAULIC		B. NUCLEAR	
Thermal Output, MWt	3411	H_2O/U, Cold	~4.0
Electrical Output, MWe	1180	Avg 1st-Cycle Burnup, MWD/MTU	14,000
Total Heat Output, Safety Design, MWt	3582	First Core Avg Burnup, MWD/MTU	33,000
Total Heat Output, Btu/hr	$11{,}641 \times 10^6$	Maximum Burnup, MWD/MTU	50,000
System Pressure, psia	2235	Region-1 Enrichment, %	2.25
DNBR, Nominal	2.03	Region-2 Enrichment, %	2.80
Total Flowrate, lb/hr	142.1×10^6	Region-3 Enrichment, %	3.30
Eff Flowrate for Heat Trans, lb/hr	135.8×10^6	k_{eff}, Cold, No Power, Clean	< 1.60
Eff Flow Area for Heat Trans, ft^2	51.4	k_{eff}, Hot, Full Power, Xe and Sm	< 1.25
Avg Vel Along Fuel Rods, ft/sec	16.9	Total Rod Worth, %(p 4.3-35 RESAR)	4.15
Avg Mass Velocity, lb/hr-ft^2	2.65×10^6	Shutdown Boron, No Rods-Clean-Cold, ppm	< 1500
Nominal Core Inlet Temp, °F	557.3	Shutdown Boron, No Rods-Clean-Hot, ppm	< 1500
Avg Rise in Core, °F	62.3	Boron Worth, Hot, % Δk/k/ppm	---
Nom Hot Channel Outlet Temp, °F	---	Boron Worth, Cold, % Δk/k/ppm	---
Avg Film Coeff, Btu/hr ft^2-°F	---	Full Power Moderator Temp Coeff, pcm/°F	
Avg Film Temp Diff, °F	---	Moderator Pressure Coeff, Δk/k/psi	$(+3 \times 10^{-6})$ EOL
Active Heat Trans Surf Area, ft^2	52,200	Moderator Void Coeff, Δk/k/% Void (p 4.3 - 33 RESAR)	
Avg Heat Flux, Btu/hr ft^2	217,200	Doppler Coefficient, Δk/k/°F	---
Max Heat Flux, Btu/hr ft^2	521,300	Shutdown Margin, Hot 1 rod stuck, %Δk/k	1
Avg Thermal Output, kw/ft	7.05	Burnable Poisons, Type and Form	Borosilicate glass Crystals in tubular form
Max Thermal Output, kw/ft	16.9	Number of Control Rods	1060
Max Clad Surface Temp, °F	660	Number of Part-Length Rods (PLR)	160
No. Coolant Loops	4	Compiled by: Fred Heddleson Nov-72 Nuclear Safety Information Center	

C. SAFETY-RELATED DESIGN CRITERIA			Reactor: Catawba
Exclusion Distance, Miles		0.47 radius	Design Winds in mph:
Low Population Zone Distance, Miles		3.80 radius	At 0 — 50 ft elev 95
Metropolis	Distance	Population	50 — 150 ft 110
Charlotte, N.C.	19	241,178 (70)	
Design Basis Earthquake Acceleration, g		0.15	150 — 400 ft 125
Operating Basis Earthquake Acceleration, g		0.08	Tornado 300 mph rot.+ 60 mph trans.
Earthquake Vertical Shock, % of Horizontal		66	ΔP = 3 psi/ 3 sec
Is Intent of 70 Design Criteria Satisfied?	Yes — Sect. 3.1 states "how these criteria meet AEC General Design Criteria."		

D. ENGINEERED SAFETY FEATURES

D1. CONTAINMENT		Design Pressure, psig	15
Max Leak Rate at Design Pressure, %/day	0.2 1st day then 0.5	Calculated Max Internal Pressure, psig	9

Type of Construction: Free standing steel structure surrounded by a reinforced concrete structure leaving 5 ft clearance in the annulus. The concrete walls of the cylinder are 3 ft thick and the dome roof is 2 ft thick. The steel containment vessel is thick. The 5 ft annulus will be filled with ice for ice condenser type containment. Net free volume is 1,223,200 cu ft.

Design Basis: Designed to withstand peak pressure and temperature resulting from a LOCA. Also designed for wind loads and seismic loads, as listed above, without loss of integrity and with leakage with in specified limits.

Vacuum Relief Capability: Containment vessel is designed to resist all calculated external pressures and vacuum breakers will not be required.

Post-Construction Testing: Standard leakage rate tests will be conducted before operation and periodically thereafter. Part of these tests will be run at peak calculated accident pressure.

Penetrations: Electrical penetrations are double sealed and individually testable. Other penetrations appear to be single sealed.

Weld Channels: Found no reference.

D2. CONTAINMENT SAFETY FEATURES Reactor: Catawba

Containment Spray System: Two redundant systems are provided, either capable of full cooling load after LOCA. System is designed to provide cooling sufficient to hold pressures below 15 psig. Each system has one pump rated 3400 gpm at 300 psig. Each system has two sets of spray headers. A containment spray heat exchanger has 86 x 10^6 Btu/hr capacity.

Containment Cooling: Temperatures are maintained between 60°F and 120°F. All vent systems are recirculation type except the purge system. Upper compartment has 4 free-standing fan-coil units (3 req'd for normal operation). Lower compartment has same number of units. Capacities of units could not be found.

Containment Isolation System: Valves will be on all fluid penetrations both inside and outside containment to provide a double barrier against leakage. Containment isolation signal will automatically close valves, except for valves on lines serving Engineered Safety Features.

Containment Air Filtration: The annulus has 2 filter trains where fission products are filtered out by charcoal filters. Either filter system can handle the full LOCA load.

Penetration Room: Electrical penetration room shown on sketches.

D3. SAFETY INJECTION SYSTEMS

Accumulator Tanks: Four tanks are provided, each holding about 6400 gallons of borated water under nitrogen gas pressure of 660 psig. Check valves will open when reactor coolant system pressure drops to about 600-650 psig and each accumulator will discharge into a loop, flooding the reactor cavity.

High-head Safety Injection: There are 2 safety injection pumps and 2 centrifugal charging pumps that pump into the loops after small breaks (6 in diam or less). Safety injection pumps are rated 425 gpm at 1500 psig, and the centrifugal charging pumps are rated 150 gpm at 2800. Both pumps take suction from the refueling water storage tank (borated water) and pump it into the cold legs. The charging pumps sweep the concentrated boric acid from the boron injection tank.

Low-head Safety Injection: Two residual heat removal system pumps flood the core through cold legs when the pressure in the system drops to where the pumps will operate. Suction is taken from the Refueling Water Storage Tank until that supply is exhausted. Water is then recirculated from the sump. Capacity of these pumps could not be found.

E. OTHER SAFETY-RELATED FEATURES Reactor: Catawba
Reactor Vessel Failure: No reference to failure was found.
Containment Floodability: No reference found.
Reactor-Coolant Leak-Detection System: Primary method of detection is measurement of containment sump water level and pump operation as read out in the control room. A leak of 1 gpm is detectable within 40 min. A backup method is measurement of flow through the volume control tank and its water level. Other leak detection methods are particulate air activitiy monitor. Allowable leakage rate limits are 10 and 2 gpm for identifiable and unidentifiable respectively.
Failed-Fuel-Detection System: A gross failed-fuel detector is provided as a developmental instrument system which continuously passes a coolant sample through a neutron detector. Response time of the detector is about 60 seconds.
Emergency Power: Four diesel-generator sets each reated at 5000 kw for continuous operation are arranged 2 units for each reactor. One unit can supply power required to shutdown one reactor unit. Diesel-generators are independently housed and have independent systems for starting, etc. Each diesel has a day tank with 1 hr. of fuel supply and an underground storage tank with fuel capacity for 7 days of continuous diesel operation.
Control of Axial Xenon Oscillations By Burnable Shims, Part-Length Control Rods, In-Core Instrumentation: In core instrumentation gives information on radial, axial, and azimuthal core characteristics giving fission power distribution. Burnable poison provide partial control of excess reactivitiy available during first fuel cycle.
Boron Dilution Control: In either automatic control, or in manual control, boron dilution cannot proceed so rapidly that operators do not have sufficient time for correction. There is a leeway of at least 15 minutes for correction. If no action is taken, power and temperature rise will cause the reactor to reach overtemperature at trip setpoint.
Long-Term Cooling: Containment spray can be run for long periods to provide containment cooling. Also the residual heat removal pumps can recirculate borated water from the sump, through the RHRS heat exchangers for cooling.
Organic-Iodide Filter: No reference found.
Hydrogen Recombiner: Has electrical hydrogen recombiner to limit hydrogen to less than 4% after LOCA.

F. GENERAL	Reactor: Catawba

Windspeed, Direction Recorders, and Seismographs: Meteorological data collection started June 1971 and include wind speed and direction and temperatures all recorded. Tower is 130 ft high. Data will eventually be recorded in the control room. Two strong motion triaxial accelerographs will be installed.

Plant Operation Mode: Load frequency control from a Duke Central Systems Operation Center will be used.

Site Description: Located on Lake Wylie of the Catawba River System of dams and hydro stations. The site is on a peninsula extending out into the lake so cooling water can be taken in on one side of the peninsula and discharged from the other side. The area has good foundation geology with favorable seismic history. Meteorology factors provide reasonable diffusion. Transportation aspects are good.

Turbine Orientation: Reactor and turbine on different centerlines. Ejected blades could not strike containment. GE will supply turbine-generators.

Emergency Plans: Established for protection of life and property in all emergency and accident situations. Particularly applying to radiation and contamination where the health and safety of station personnel and the general public may be involved, including other general industrial emergency and accident conditions. The Plan will be a coordinated effort involving station personnel, facilities and equipment; emergency resources and capabilities of Duke Power Company; outside emergency services; and various local, state and federal agencies having jurisdiction or concern for the public health and safety.

Environmental Monitoring Plans: One full year of data will be collected prior to plant operation. Survey will provide background data on numbers and kinds of organisms in the lake plus data on chemical and physical characteristics. When plant operation starts, Lake Wylie will be monitored to detect any detrimental effects. Adequate plans will be made to assure that operational data can be compared with pre-operational data to detect significant changes, including any interaction between Allen Steam Station and Catawba Nuclear Station. Supplemental sampling will be undertaken to determine the impact of plant construction in the immediate site area.

Radwaste Treatment: Liquid wastes will be collected, processed, and released into the circulating water discharge system at concentrations lower than specified in 10CFR20 and as low as practical. Gaseous wastes will be collected and stored for life time of the plant holdup. No releases of fission gases will be made. Gases are compressed and run through catalytic hydrogen recombiners. Solid wastes will be collected and stored for later shipment to an off site AEC licensed disposal site.

Plant Vent: Could not find definite information.

G. SITE DATA

Reactor: Catawba

Nearby Body of Water: Lake Wylie

Normal Level 569.4' (MSL)

Max Prob Flood Level 591.8' (MSL)

Size of Site --- Acres
23,600 acres along the lake

Site Grade Elevation 593.5' (MSL)

Topography of Site: Rolling

of Surrounding Area (5 mi rad): Rolling

Total Permanent Population: In 2 mi radius 495 ; 10 mi 65,220

Date of Data: 1970 In 5 mi radius 5620 ; 50 mi ____

Nearest City of 50,000 Population: Charlotte, N.C.

Dist. from site 19 Miles, Direction NE , Population 241,178

Land Use in 5 Mile Radius: Wooded with recreational and permanent homes along the lake.

Meteorology: Prevailing wind direction SW Avg. speed ~7 mph

Stability Data - Monthly average 1/3 each for Pasquill C, D, F

Miscellaneous Items Close to the Site: Generally, the site is remote, but closeness of many things including Duke electrical load centers is unusual. Distances are -- to nearest house - 2/3 mi nearest school - 4 mi, nearest dairy - 5.3 mi, nearest industry - 3 1/2 mi, nearest hospital - 7 mi. Rock Hill is the nearest population center having about 34,000 population 5 miles away.

H. CIRCULATING WATER SYSTEM

Type of System: Once through

Water Taken From: Lake Wylie

Intake Structure: A skimmer wall is located at the entrance to the intake cove. Water flowing into the cove is drawn through the intake channel to the intake structure where circulating water pumps are located.

Water Body Temperatures: Winter minimum 43 °F Summer maximum 83 °F

River Flow 490 (cfs) minimum; 4400 (cfs) average

Service Water Quantity --- gpm/reactor

Flow Thru Condenser 1,000,000* (gpm)/reactor Temp. Rise 16 °F

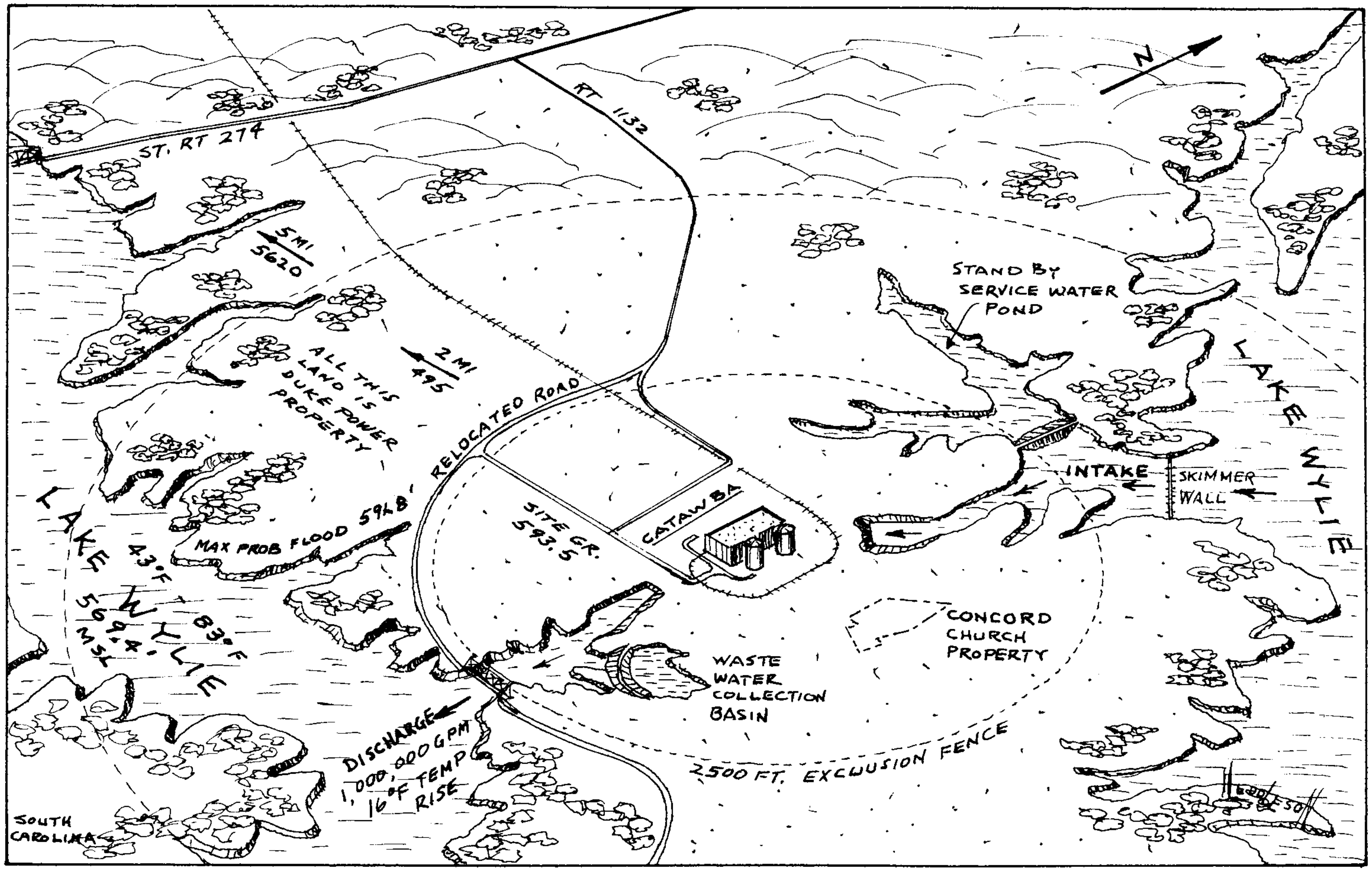
Heat Dissipated to Environment --- (Btu/hr)/reactor

Heat Removal Capacity of Condenser *summer operation (Btu/hr)/reactor

Discharge Structure: Water is discharged on the surface into Big Allison Creek inlet so the heated effluent will flow out over the surface of the lake for heat dissipation to the atmosphere.

Cooling Tower(s): Description & Number - None

Blowdown ____ gpm/reactor Evaporative loss ____ gpm/reactor



NUCLEAR SAFETY INFORMATION CENTER

Data from PSAR

Page 1 (BWR)

GRAND GULF, 50-416, 50-417

Project Name: Grand Gulf Nuclear Station 1 and 2

Location: Claiborne Co., Miss.

Owner: Mississippi Power and Light

A-E: Bechtel

Vessel Vendor:

NSS Vendor: General Electric

Containment Constructor: Bechtel

A. THERMAL-HYDRAULIC		B. NUCLEAR	
Thermal Output, MWt	3833	H_2O/UO_2 Volume Ratio	---
Electrical Output, MWe	1313	Moderator Temp Coef Cold, Δk/k/°F	(+4 to -14) × 10^{-5}
Total Heat Output, Safety Design, MWt	4025	Moderator Temp Coef Hot, No Voids	(+4 to -14) × 10^{-5}
Steam Flow Rate, lb/hr	16.5 × 10^6	Moderator Void Coef Hot, No Voids, Δk/k/%	-5.5 × 10^{-5}
Total Core Flow Rate, lb/hr	113.5 × 10^6	Moderator Void Coef Operating	-9 × 10^{-4}
Coolant Pressure, psig	1040	Doppler Coefficient, Cold	---
Heat Transfer Area, ft^2	78,624	Doppler Coefficient, Hot, No Voids	---
Max Power per Fuel Rod Unit Lgth, kw/ft	13.4	Doppler Coefficient, Operating	-2.5 × 10^{-5}
Maximum Heat Flux, Btu/hr-ft^2	354,100	Initial Enrichment, %	---
Average Heat Flux, Btu/hr-ft^2	159,732	Average Discharge Exposure, MWD/Ton	27,500
Maximum Fuel Temperature, °F	3325	Core Max Void Within Assembly, %	42
Average Fuel Rod Surface Temp, °F	---	k_{eff}, All Rods In	---
MCHFR	≥ 1.9	k_{eff}, Max Rod Out	0.945
Total Peaking Factor	2.219	Control Rod Worth,	0.01Δk
Avg Power Density, Kw/ℓ	56	Curtain Worth, %	None
Peak Fuel Enthalpy on Rod Drop, Cal/gm	280	Burnable Poisons, Type and Form	Gadolinia in UO_2
		Number of Control Rods	193
		Number of Part-Length Rods (PLR)	None

Compiled by: Fred Heddleson - February 1973
ORNL, Nuclear Safety Information Center

C. SAFETY-RELATED DESIGN CRITERIA — Reactor: Grand Gulf

Exclusion Distance, Miles	0.48	
Low Population Zone Distance, Miles	2	
Metropolis	Distance	Population
Jackson, Miss.	55 mi.	153,968
Design Basis Earthquake Acceleration, g	0.15	
Operating Basis Earthquake Acceleration, g	0.08	
Earthquake Vertical Shock, % of Horizontal	67	

Design Winds in mph:

At 0 — 50 ft elev	90
50 — 150 ft	105
150 — 400 ft	125
Tornado 300 mph tang + 60 trans	
ΔP = 3 psi/ 1 sec	
Is Intent of 70 Design Criteria Satisfied?	Yes

Recirculation Pumping System & MCHFR: Recirculation flow control system sets position of flow control discharge value thus adjusting coolant flow rate and core power level. Adjustment is automatic to adjust power output to load demand.

Protective System: Initiates a rapid, automatic shutdown in time to prevent fuel cladding damage following abnormal transients. Protection system overrides all operator action.

D. ENGINEERED SAFETY FEATURES

D1. CONTAINMENT

Drywell Design Pressure, psig	23	Primary Containment Leak Rate, %/day	---
Suppression Chamber Design Pressure, psig	15	Second Containment Design Pressure, psig	15
Calculated Max Internal Pressure, psig	Drywell 25	Second Containment Leak Rate, %/day	0.1

Type of Construction: Mark III type using drywell and suppression pool with a conventional PWR type cycindrical containment structure around it. Cylindrical walls are 3'-6" thick with 2'-6" thick dome. The suppression pool surrounds the drywell, inside the main cylindrical structure. Free air vol of outer structure is 14×10^6 cu ft. Drywell has 280,000 cu ft free vol. Water vol of suppression pool is 164,000 cu ft.

Design Basis: Designed to provide the needed functions for normal operation and to withstand accident conditions with sufficient strength to contain the accident providing sufficient space for water vapors and steam after LOCA, and with sufficient water in pool to absorb accident energy, and to provide shielding.

Vacuum Relief Capability Vacuum breakers provided between drywell and containment volume to prevent back flow through the vent system that might flood the drywell.

Post-Construction Testing: Containment will be tested at 1.15 design pressure for strength with local tests for leakage rates.

Penetrations: Type I penetrations are double sealed, all others are single sealed. Electrical penetrations are class I and are individually testable.

D2. EMERGENCY CORE COOLING SYSTEMS   Reactor: Grand Gulf

Core Spray Cooling System: There is a high pressure core spray and a low pressure core spray system. High pressure core spray is described below under HPCI system. The low pressure core spray operates after the pressure drops. One pump delivers 7000 gpm at 122 psid to the spray sparger. High pressure system takes suction from condensate storage tank and the suppression pool. The low pressure system takes suction from the suppression pool.

Auto-Depressurization System: Rapidly reduces reactor vessel pressure in a LOCA when HPCS system cannot maintain vessel water level. Pressure is vented through relief values so low pressure pumps will start and pump water into the vessel.

Residual-Heat-Removal System (RHRS): The residual heat removal (RHR) system includes a number of pumps and heat exchangers that can be used to cool the nuclear system under a variety of situations. During normal shutdown and reactor servicing, the RHR system removes residual and decay heat. Also the RHR system removes decay heat whenever the main heat sink (main condenser) is not available. Another operational mode of the RHR system is low pressure coolant injection, which is described below.

High-Pressure Coolant-Injection System: One pump with electric motor pumps water into the pressure vessel in case of small breaks or leaks so water level and high pressure can be maintenance. Pump capacity is 1500 gpm @ 1130 psid. Pump motor runs off emergency power bus in case of main electrical failure. This is a high pressure core spray system.

Low-Pressure Coolant-Injection System: An operating mode of the Residual Heat Removal System to reflood the core after LOCA. System uses 3 pumps each rated at 7450 gpm @ 20 psid. System operates after pressure drops to it's operating level in time to prevent fuel cladding damage. Suppression pool is the source of water for these pumps.

E. OTHER SAFETY-RELATED FEATURES

Main-Steam-Line Flow Restrictors: Limits loss of coolant from the reactor vessel before main steam line isolation values close.

Control-Rod Velocity Limiters: Limits velocity at which a rod can fall out. Designed so that velocity is limited in one direction only. Scram velocity not effected.

Control-Rod-Drive-Housing Supports: Beams installed under the housings prevent the housing and rod from dropping more than about 2" in case of housing failure. Thus, rod travel would be limited to a safe value

Standby Liquid-Control System: A redundant system for shutting down the reactor using boron in the reactor coolant.

E. OTHER SAFETY-RELATED FEATURES (cont'd) Reactor: Grand Gulf
Standby Coolant System: Water from the Mississippi is available through the service water intake and pipes to the river so that water is available for cooling the reactor after shutdown.
Containment Atmospheric Control System: Consists of fresh-air supply fans, exhaust fans, two full-capacity charcoal filter trains, and the associated ducting, dampers, and controls required to provide a reliable source of fresh air for the comfort and safety of personnel.
Reactor Core Isolation Cooling System (RCICS): Provides makeup water for reactor vessel when it becomes isolated. A steam-driven turbine pump rated 800 gpm at 1120 psid operates automatically to maintain adequate water level in the reactor vessel.
Reactor Vessel Failure: No reference found
Containment Floodability: Drywell can be filled with water to a level above the reactor core.
Reactor-Coolant Leak-Detection System: Leaks are detected by temperature, pressure, flow, and fission product sensors. Small leaks will be detected by temperature and pressure changes, fillup of sumps, and fission product concentrations. Large leaks are detected by changes in reactor water level and flow rates in process lines.
Failed-Fuel Detection Systems: Four gamma radiation monitors located external to the main steam lines are just outside containment. The monitors detect a gross release of fission products from failed fuel. On detection, the reactor is automatically shut down.
Emergency Power: Each reactor has 3 diesel-generator sets available to supply emergency power when the off-site source of power fails. Each diesel-generator is rated at 5000 Kw continuous. Generator sets will start automatically when normal electrical power is lost. Starting time is 10 seconds. Each diesel has a day tank with 2 hr supply and each unit is connected to a storage tank with 7 days supply for full load operation.
Rod-Block Monitor: Supplies a trip signal to the reactor manual control system to prevent control rod removal. There are 2 RBM channels with each channel receiving imput from several LPRM channels. A trip signal from either RBM channel can initiate a rod block.
Rod-Worth Minimizer: Enforces startup, shutdown, and low power level control rod procedures. Prevents operator from establishing control rod patterns not consistent with prestored sequences.

F. GENERAL

Reactor: Grand Gulf

Windspeed, Direction Recorders, and Seismographs: Two temporary towers were installed in March 1972, each one 33 ft high with HRI 1071 Mechanical Weather Stations. A permanent tower 162 ft high will be installed later. No reference found to seismographs.

Plant Operation Mode: Designed for load following.

Site Description: Site is SW Miss. on the east side of the Miss. River. The site area is on higher ground (130') overlooking the river and its broad flood plains. Two lakes exist on the western portion of the site. The plant is about 8000 feet from the river bank. There is no possibility of the plant site being flooded.

Turbine Orientation: Ejected turbine blades could strike the containment structure. Centerlines are 173'-6" apart. Mfg by G.E.

Emergency Plans: Will be developed prior to startup for organization of personnel to deal with emergencies at the plant. The plan will be coordinated with state and local disaster-control organizations including local community officials. Federal, state, and local personnel will be given radiological training. Evacuation routes will be considered and site emergency drills will be held.

Environmental Monitoring Plans: The important pathways to man will be monitored by radiological measurements, including surveys, passive dosimeters, and samples collected for laboratory analyses. These will include airborne, aquatic, and terrestrial pathways. The radiological monitoring program will start at least one year prior to reactor startup. The program is designed to document background levels of direct radiation and concentrations of radionuclides that exist in aquatic and terrestrial ecosystems before and after plant operation and document the concentrations of radionuclides that could be attributable to plant operation.

Radwaste Treatment: Liquid wastes will be collected, processed, recycled. Some treated wastes will discharge to the condensate storage tank, some to a drain collection tank, and some liquid will be discharged to the environment after treatment. Total whole body dose from liquids discharged is estimated at 1.5×10^{-4} mr/yr. Gaseous wastes are dried, cooled to 45°F and passed through NEPA filters and charcoal beds which are maintained at 0°F. Hydrogen and oxygen are catalytically recombined. Gases are held up for 30 minute decay. Dose from gaseous releases is 1.6 man-rem/yr. whole body. Solid wastes will be compacted into 55 gal containers and shipped off-site for disposal.

Plant Vent: Gases vented from roof vents.

G. SITE DATA

Reactor: Grand Gulf

Nearby Body of Water: Mississippi River

Normal Level ~55' (MSL)

Max Prob Flood Level 96.2 (MSL)

Size of Site 2200 Acres Site Grade Elevation 132.5' (MSL)

Topography of Site: Flat to Rolling

of Surrounding Area (5 mi rad): Flat to the west, rolling to the east

Total Permanent Population: In 2 mi radius 190 ; 10 mi 7245

Date of Data: 1970 In 5 mi radius 2086 ; 50 mi 269,314

Nearest City of 50,000 Population: Jackson, Miss.

Dist. from site 55 Miles, Direction ENE, Population 153,968

Land Use in 5 Mile Radius: Wooded and Recreational

Meteorology: Prevailing wind direction N-NW Avg. speed 8 mph

Stability Data - Pasquill-Turney class E occurs 39.6% of time

Miscellaneous Items Close to the Site: Site is 25 miles S of Vicksburg and 37 miles NNE of Natchez. Port Gibson, a small town, is 6 miles SE. The Grand Gulf Military Park borders a portion of the north side of the site. The Warner YMCA Camp is about 3 1/2 miles NE and caters to about 110 boys during the summer. There are numerous hunting lodges near the site. Grand Gulf village is about 2 mi from the plant.

H. CIRCULATING WATER SYSTEM

Type of System: Closed system using cooling towers

Water Taken From: Mississippi River for makeup

Intake Structure: Gravity flow from river through 2 intake crib structures, through 2 five-foot dia. pipes to the intake structure. Service water pumps are in the intake structure.

Water Body Temperatures: Winter minimum 33 °F Summer maximum 82°F

River Flow 73,000 (cfs) minimum; ~600,000 (cfs) average

Service Water Quantity 42,000 gpm/reactor max

Flow Thru Condenser 548,000 (gpm)/reactor Temp. Rise 31 °F

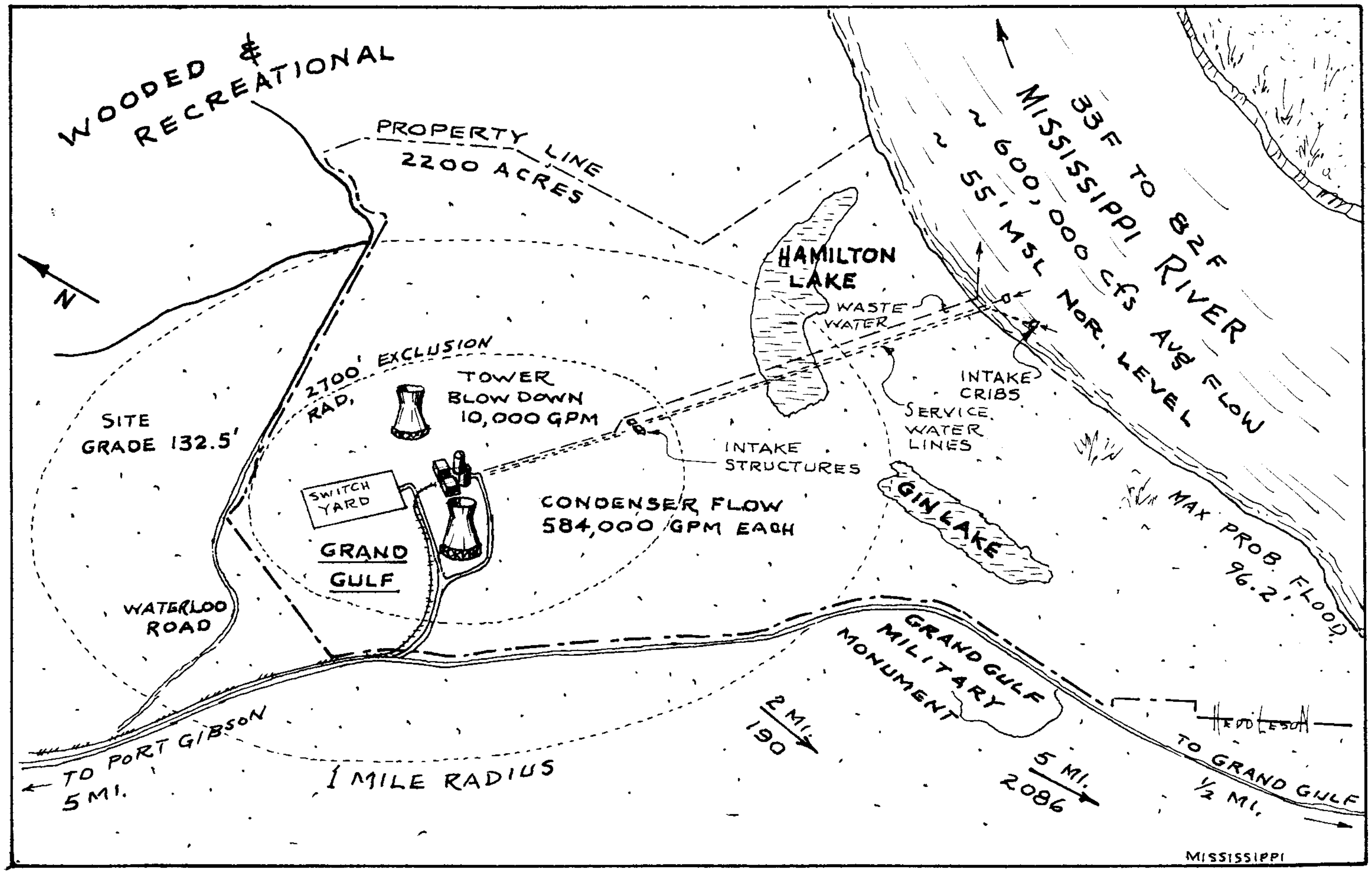
Heat Dissipated to Environment --- (Btu/hr)/reactor

Heat Removal Capacity of Condenser --- (Btu/hr)/reactor

Discharge Structure: Service water and cooling tower blow down will be discharged to the waste water basin, and conveyed from there to the river.

Cooling Tower(s): Description & Number - 1 natural draft unit per reactor - 410' dia × 492' high

Blowdown 10,000 gpm/reactor Evaporative loss 18,000 gpm/reactor



NUCLEAR SAFETY INFORMATION CENTER

FROM PSAR & RESAR(W) — Page 1 (PWR)

MILLSTONE, 50-423

Project Name: Millstone Nuclear Power Station, #3

Location: Waterford, Conn.

Owner: The Millstone Point Co.

A-E: Stone & Webster

Vessel Vendor: Combustion Eng.

NSS Vendor: Westinghouse

Containment Constructor: Not specified

A. THERMAL-HYDRAULIC		B. NUCLEAR	
Thermal Output, MWt	3411	H_2O/U, Cold	∿4.0
Electrical Output, MWe	1180	Avg 1st-Cycle Burnup, MWD/MTU	14,000
Total Heat Output, Safety Design, MWt	3582	First Core Avg Burnup, MWD/MTU	33,000
Total Heat Output, Btu/hr	$11,641 \times 10^6$	Maximum Burnup, MWD/MTU	50,000
System Pressure, psia	2250	Region-1 Enrichment, %	2.25
DNBR, Nominal	2.02	Region-2 Enrichment, %	2.80
Total Flowrate, lb/hr	140.4×10^6	Region-3 Enrichment, %	3.30
Eff Flowrate for Heat Trans, lb/hr	134.1×10^6	k_{eff}, Cold, No Power, Clean	<1.60
Eff Flow Area for Heat Trans, ft^2	51.4	k_{eff}, Hot, Full Power, Xe and Sm	<1.25
Avg Vel Along Fuel Rods, ft/sec	16.6	Total Rod Worth, % (p.4.3-35 RESAR)	∿7.33 EOL
Avg Mass Velocity, lb/hr-ft^2	2.62×10^6	Shutdown Boron, No Rods-Clean-Cold, ppm	<1500
Nominal Core Inlet Temp, °F	557.9	Shutdown Boron, No Rods-Clean-Hot, ppm	<1500
Avg Rise in Core, °F	63.1	Boron Worth, Hot, % Δk/k/ppm	∿1/100
Nom Hot Channel Outlet Temp, °F	∿647	Boron Worth, Cold, % Δk/k/ppm	∿1/85
Avg Film Coeff, Btu/hr ft^2-°F	∿6000	Full Power Moderator Temp Coeff, pcm/°F	0 to -40
Avg Film Temp Diff, °F	∿36	Moderator Pressure Coeff, Δk/k/psi	$(+3 \times 10^{-6})$ EOL
Active Heat Trans Surf Area, ft^2	52,200	Moderator Void Coeff, Δk/k/% Void (p.4.3-11 RESAR)	Negative
Avg Heat Flux, Btu/hr ft^2	217,200	Doppler Power Coef. at full power, pcm/% power	-6 to -12
Max Heat Flux, Btu/hr ft^2	521,300	Shutdown Margin, Hot 1 rod stuck, %Δk/k	1
Avg Thermal Output, kw/ft	7.05	Burnable Poisons, Type and Form	Borosilicate glass Crystals (tubular)
Max Thermal Output, kw/ft	16.7	Number of Control Rods	1060
Max Clad Surface Temp, °F	660	Number of Part-Length Rods (PLR)	160
No. Coolant Loops	4	Compiled by: Fred Heddleson April 1973 Nuclear Safety Information Center	

C. SAFETY-RELATED DESIGN CRITERIA			Reactor: Millstone #3
Exclusion Distance, Miles	0.34 radius		Design Winds in mph:
Low Population Zone Distance, Miles	2.4 radius		At 0 — 50 ft elev 115
Metropolis	Distance	Population	50 — 150 ft 140
Hartford, Conn.	38	158,017	
Design Basis Earthquake Acceleration, g	0.17		150 — 400 ft 170
Operating Basis Earthquake Acceleration, g	0.09		Tornado 300 mph rot. + 60 trans.
Earthquake Vertical Shock, % of Horizontal	66		ΔP = 3 psi/ 3 sec
Is Intent of 70 Design Criteria Satisfied?	Yes, 'design will conform.' See Section 3.1.2		

D. ENGINEERED SAFETY FEATURES

D1. CONTAINMENT		Design Pressure, psig	45
Max Leak Rate at Design Pressure, %/day	0.25	Calculated Max Internal Pressure, psig	40.3

Type of Construction:

Reinforced concrete cylinder with 4'-6" thick walls and 2'-6" thick dome. A steel liner 3/8" thick will cover the walls, and 1/4" thick the dome. Containment will operate at 9.5 to 11.5 psia (less than atmospheric). Structure will be 140' ID by 200' high, having 2.3 x 10^6 cu ft free volume.

Design Basis:

Designed for sub-atmospheric operation and all the loads experienced as a result of LOCA; design incorporates depressurization systems (sprays and air coolers) to return containment pressure to subatmospheric within 50 minutes after LOCA. Designed to limit leakage to 0.25% of volume per day.

Vacuum Relief Capability:

Found no reference.

Post-Construction Testing:

Will be structural tested at 4 intervals up to 1.15 design pressure. Will be held at each pressure for 1 hr. Leakage rate tests will be run at 40.3 psig and at other pressures in accordance with appendix J of 10CFR50.

Penetrations:

Sketches do not indicate double sealed penetrations. Electrical penetrations have a tap for halogen testing.

Weld Channels:

Will be placed over all liner seam welds that will be inaccessible after construction, with provisions for pressurizing to check for leakage.

D2. CONTAINMENT SAFETY FEATURES	Reactor: Millstone #3

Containment Spray System: Two systems will operate - the quench spray system starts 60 seconds after CDA signal, pumping 2200 gpm of borated water, and the recirculation spray system after 300 seconds. Each system has two 100% capacity subsystems. Each of 4 recirculation spray pumps has 3,750 gpm capacity and usually 2 would run at the same time, pumping through a heat exchanger to cool the water.

Containment Cooling: Cooling after LOCA is provided by two systems described above. For normal operation, 3 fan-coil units, each with 2×10^6 btu/hr capacity will operate to hold containment temperature under 135F. A purge system, also, is available to exhaust air and let new air enter for one air change per hour.

Containment Isolation System: Valves on each side of penetrations running through the containment structure will close automatically to prevent leakage of radioactivity through these lines. Valves close automatically on SIS signal.

Containment Air Filtration: Consists of 2 100% capacity systems each with a 2000 cfm fan and a filter bank with prefilter, carbon absorber, and HEPA filter. Containment air is recirculated through the filters to remove radioactivity.

Penetration Room:
Sketches show penetration areas.

D3. SAFETY INJECTION SYSTEMS

Accumulator Tanks: There are 4 accumulator tanks each holding 6400 gal of borated water under nitrogen pressure of 660 psig. Each accumulator is connected to one cold leg of the reactor vessel and as such automatically dumps their contents into the reactor to flood the core when system pressure drops below 660 psig.

High-head Safety Injection: There are 3 charging pumps and 2 safety injection pumps that operate to supply borated water to the reactor vessel when the injection signal is received. Charging pumps are rated 425 gpm at 1500 psig and safety injection pumps 150 gpm at 2800 psig. Pumps take suction from the refueling water storage tank. The charging pumps inject through the boron injection tank to force 12% concentrated boric acid solution from the tank into the reactor core.

Low-head Safety Injection: Two pumps of the Residual Heat Removal System serve as low-head pumps for core flooding. Pumps are rated 3000 gpm at 600 psig. After LOCA, the water pumped will be a maximum of 55F, suction taken from the refueling water storage tank.

E. OTHER SAFETY-RELATED FEATURES	Reactor: Millstone #3

Reactor Vessel Failure:

Found no reference.

Containment Floodability:

Found no reference.

Reactor-Coolant Leak-Detection System: Leakage can be determined by gas and particulate radiation monitors (0.1 gpm in 1.5 min), containment air recirculation fan coolers (3 gpm in 40 min), drain sump, reactor coolant makeup rate, humidity measurements, and temperature measurements.

Failed-Fuel-Detection System:

No reference found to such a system.

Emergency Power: Two diesel-generator sets will supply emergency power as needed. Each set will be independent of the other, separately housed, and with separate auxiliaries. Units are rated, 4,300 kW continuous. Fuel will be available to run a unit at full load for 7 days. Units are started with compressed air and should be ready to start receiving load after 10 seconds.

Control of Axial Xenon Oscillations By Burnable Shims, Part-Length Control Rods, In-Core Instrumentation: Part length rods help to suppress xenon induced oscillations and in-core instrumentation will be used for flux monitoring and/or the checking of out-of-core instruments

Boron Dilution Control: During refueling and startup operator has about 1 hr to correct boron dilution. During operation, alarms will alert the operator to dilution condition providing him about 15 minutes in which he has ample time to correct the situation.

Long-Term Cooling: Long-term cooling (PSAR p. 1.2-6) accomplished by containment recirculation pumps - 3750 gpm each, and by Residual Heat Removal System (RESAR p. 5.5-30) where 2 pumps each have 3000 gpm capacity. Sump water is cooled in heat exchangers.

Organic-Iodide Filter: No reference found.

Hydrogen Recombiner: A catalytic recombiner will be operated after LOCA to hold hydrogen below 4% of volume.

F. GENERAL	Reactor: Millstone #3

Windspeed, Direction Recorders, and Seismographs: A tower 140' high has been used since 1965 to make meteorological measurements. A tower 450' high is planned. Strong motion accelerometers will be installed in 3 locations to measure and record seismic disturbances.

Plant Operation Mode: Designed for automatic load programming from a central dispatch system from 50% to 100% of full power.

Site Description: Located along the southern coast of Connecticut on a peninsula where the Niantic River flows into Niantic Bay. Long Island Sound is just south of the site. The site is characterized by flat land, an ocean shore climate, and a quarry on the site into which heated water from the condensers are piped. The quarry is about 350' x 1200'.

Turbine Orientation: Sufficient information is not given in PSAR. General Electric will furnish turbine.

Emergency Plans: Organized to cope with emergencies, to classify severity, to define and assign responsibilities, and to clearly outline courses of action required to safeguard the public and station personnel. Detailed procedures will be developed for the site. Procedures will consider radiation hazards, weather conditions, and availability of personnel. Written agreements have been reached with local, state, and federal agencies, and private medical support facilities for support in event of an emergency. These agreements ensure proper coordination of activities for an emergency.

Environmental Monitoring Plans:

The Environmental Report is not available at this time so information on this subject was not in the PSAR. Also, there was no information on condenser flow and water temperatures for presentation at bottom of page 6.

Radwaste Treatment: Liquid wastes will be evaporated to obtain disposable or reusable primary grade water and concentrated residues. Evaporator residues and solid wastes will be drummed and shipped offsite for ultimate disposal. Gaseous wastes (hydrogen streams and air streams with radioactivity) will be treated before release to the environment. By continuous degasification and purification of coolant letdown, the consequences of coolant leakage will be minimized. Hydrogen waste gas streams produced will be passed through charcoal decay beds. Decayed gas will be recycled back to the RCS. Aerated waste gas streams will be passed through carbon adsorbers for iodine removal and, when needed, through charcoal decay beds to provide holdup time for decay of noble gases.

Plant Vent: 375' high stack for unit #1.

G. SITE DATA

Reactor: Millstone #3

Nearby Body of Water: Niantic Bay off Long Island Sound

Normal Level 0 (MSL)

Max Prob Flood Level 22' (MSL)

Size of Site 500 Acres   Site Grade Elevation 24' (MSL)

Topography of Site: flat

of Surrounding Area (5 mi rad): flat to rolling

Total Permanent Population: In 2 mi radius 4776 ; 10 mi 98,784

Date of Data: 1970   In 5 mi radius 46,550 ; 50 mi 2,481,518

Nearest City of 50,000 Population: New Haven, Connecticut

Dist. from site 35 Miles, Direction W , Population 137,707

Land Use in 5 Mile Radius:

Undeveloped, residential, and recreational

Meteorology: Prevailing wind direction E-NE Avg. speed 5mph

Stability Data - Good ventilation and frequent air mass changes.

Miscellaneous Items Close to the Site: The village of Niantic is 1.5 mi. NW and New London (31,630 pop) is 3.2 mi ENE. There is a residential area 1/2 mi NE of the site. The Penn Central RR runs E-W across the northern boundary. Harkness Memorial Park is 3 mi E. The Connecticut Yankee Power reactor is 20 mi NW.

H. CIRCULATING WATER SYSTEM

Type of System: Once through.

Water Taken From: Niantic Bay

Intake Structure: Reinforced concrete structure with six bays, each having trash racks, traveling screen, and circulating pump.

Water Body Temperatures: Winter minimum ____ °F   Summer maximum ____ °F

River Flow NA (cfs) minimum; NA (cfs) average

Service Water Quantity 68,000 gpm/reactor

Flow Thru Condenser 900,000 (gpm)/reactor   Temp. Rise 18 °F

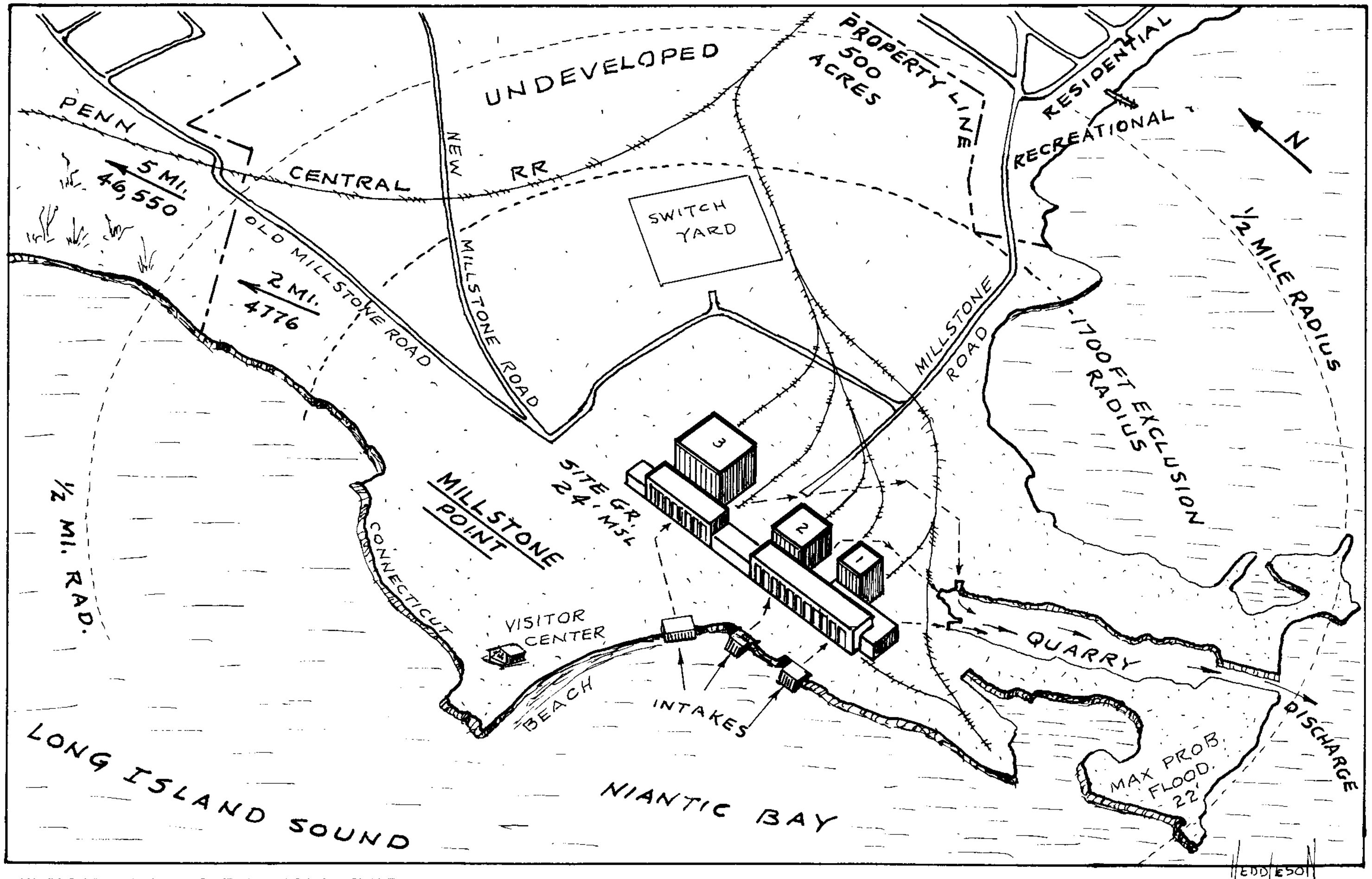
Heat Dissipated to Environment ____ (Btu/hr)/reactor

Heat Removal Capacity of Condenser ____ (Btu/hr)/reactor

Discharge Structure: Cooling water is discharged to a quarry which discharges through a canal to the bay.

Cooling Tower(s): Description & Number - None

Blowdown ____ gpm/reactor   Evaporative loss ____ gpm/reactor


UNDEVELOPED
PROPERTY LINE
500 ACRES
RESIDENTIAL
RECREATIONAL
N
PENN CENTRAL RR
NEW MILLSTONE ROAD
5 MI. 46,550
2 MI. 4776
OLD MILLSTONE ROAD
SWITCH YARD
MILLSTONE ROAD
1/2 MILE RADIUS
1700 FT EXCLUSION RADIUS
3
2
1
SITE GR. 24' MSL
MILLSTONE POINT
CONNECTICUT
VISITOR CENTER
BEACH
INTAKES
QUARRY
DISCHARGE
MAX PROB. FLOOD 22'
1/2 MI. RAD.
LONG ISLAND SOUND
NIANTIC BAY
HEDDLESON

VOGTLE, 50-424 THRU -427

Project Name: Vogtle Nuclear Plant, Units 1, 2, 3, and 4

Location: Burke Co., Georgia

Owner: Georgia Power Company

A-E: Bechtel
Vessel Vendor: not specified
NSS Vendor: Westinghouse
Containment Constructor: Georgia Power

A. THERMAL-HYDRAULIC		B. NUCLEAR	
Thermal Output, MWt	3411	H_2O/U, Cold	∿4.0
Electrical Output, MWe	1172	Avg 1st-Cycle Burnup, MWD/MTU	14,000
Total Heat Output, Safety Design, MWt	3565	First Core Avg Burnup, MWD/MTU	33,000
Total Heat Output, Btu/hr	$11,641 \times 10^6$	Maximum Burnup, MWD/MTU	50,000
System Pressure, psia	2235	Region-1 Enrichment, %	2.25
DNBR, Nominal	2.03	Region-2 Enrichment, %	2.80
Total Flowrate, lb/hr	142.1×10^6	Region-3 Enrichment, %	3.30
Eff Flowrate for Heat Trans, lb/hr	135.8×10^6	k_{eff}, Cold, No Power, Clean	<1.60
Eff Flow Area for Heat Trans, ft^2	51.4	k_{eff}, Hot, Full Power, Xe and Sm	<1.25
Avg Vel Along Fuel Rods, ft/sec	16.9	Total Rod Worth, %	4.15
Avg Mass Velocity, $lb/hr\text{-}ft^2$	2.65×10^6	Shutdown Boron, No Rods-Clean-Cold, ppm	<1500
Nominal Core Inlet Temp, °F	557.3	Shutdown Boron, No Rods-Clean-Hot, ppm	<1500
Avg Rise in Core, °F	62.3	Boron Worth, Hot, % Δk/k/ppm	--
Nom Hot Channel Outlet Temp, °F	--	Boron Worth, Cold, % Δk/k/ppm	--
Avg Film Coeff, Btu/hr ft^2-°F	--	Full Power Moderator Temp Coeff, Δk/k/°F	--
Avg Film Temp Diff, °F	--	Moderator Pressure Coeff, Δk/k/psi	$(+3 \times 10^{-6}$ EOL)
Active Heat Trans Surf Area, ft^2	52,200	Moderator Void Coeff, Δk/k/% Void (p. 4.3 -	33 RESAR)
Avg Heat Flux, Btu/hr ft^2	217,200	Doppler Coefficient, Δk/k/°F	--
Max Heat Flux, Btu/hr ft^2	521,300	Shutdown Margin, Hot 1 rod stuck, %Δk/k	1
Avg Thermal Output, kw/ft	7.05	Burnable Poisons, Type and Form	Borosilicate glass Crystals in tubular form
Max Thermal Output, kw/ft	16.9	Number of Control Rods	1060
Max Clad Surface Temp, °F	660	Number of Part-Length Rods (PLR)	160
No. Coolant Loops	4	Compiled by: Fred Heddleson March 1973 Nuclear Safety Information Center	

C. SAFETY-RELATED DESIGN CRITERIA			Reactor: VOGTLE
Exclusion Distance, Miles	0.68 radius		Design Winds in mph:
Low Population Zone Distance, Miles	2 radius		At 0 — 50 ft elev 105
Metropolis	Distance	Population	
Columbia, S.C.	75 mi.	100,000	50 — 150 ft 130
Design Basis Earthquake Acceleration, g	0.20		150 — 400 ft 160
Operating Basis Earthquake Acceleration, g	0.12		Tornado 300 mph
Earthquake Vertical Shock, % of Horizontal	67		ΔP = -- psi/-- sec
Is Intent of 70 Design Criteria Satisfied?	Yes, Section 3.1-1 PSAR		

D. ENGINEERED SAFETY FEATURES

D1. CONTAINMENT	Design Pressure, psig 47
Max Leak Rate at Design Pressure, %/day 0.1	Calculated Max Internal Pressure, psig 55 Fig. 6.2-6

Type of Construction:

A prestressed concrete structure forming a veritical right cylinder 3'-6" thick dome. Structure is lined with 1/4" thick steel plate. The concrete structure is surrounded by an enclosure building of conventional steel construction for limited airtightness. Containment free volume is 2.75×10^6 cu. ft.

Design Basis:

Designed to withstand the internal pressure and coincident temperature resulting from LOCA with release of radioactivity limited to AEC regulations.

Vacuum Relief Capability:

No reference found.

Post-Construction Testing:

Tested for strength at 1.15 design pressure. Leakage rate tests will be run at 100% and 50% of design pressure and held for 24 hrs. Periodic leak rate tests will be run at 50% of design pressure.

Penetrations:

Electrical penetrations are double sealed and individually testable. Piping penetrations are single barriers.

Weld Channels:

Vacuum box for soap bubble testing will be used for checking welds.

D2. CONTAINMENT SAFETY FEATURES Reactor: VOGTLE

Containment Spray System:

There are 2 spray trains each with 100% capacity for cooling after LOCA. Spray nozzles are located high above the operating deck. One pump in each spray train has 2600 gpm capacity taking suction from the refueling water storage tank. In recirculation phase, water is drawn from the containment sump and cooled in heat exchangers.

Containment Cooling:

During normal operation, fan-cooler units (4) remove sufficient heat to hold containment temperature at 120°F or lower. Containment spray and fan-coolers can remove energy to maintain pressure and temperature below design limits after LOCA. Each unit has 0.45×10^6 Btu/hr capacity for normal operation, or 9.4×10^6 Btu/hr for emergencies.

Containment Isolation System:

Minimizes leakage of radioactive materials through pipes penetrating the reactor building walls, in case of LOCA. Double barrier protection is provided on lines that are part of the reactor coolant pressure boundary or connected directly to the containment atmosphere.

Containment Air Filtration:

Leakage from containment collects in the enclosure building and is passed through a filtering system which includes charcoal filters. System operates continuously.

Penetration Room:

There are piping and electrical penetration rooms with filtering systems.

D3. SAFETY INJECTION SYSTEMS

Accumulator Tanks:

Four tanks are provided, each holding about 6400 gallons of borated water under nitrogen gas pressure of 660 psig. Check values will open when reactor coolant system pressure drops to about 600-650 psig and each accumulator will discharge into a loop, flooding the reactor cavity.

High-head Safety Injection:

There are 2 safety injection pumps and 2 centrifugal charging pumps that pump into the loops after small breaks (6 in. diam or less). Safety injection pumps are rated 425 gpm at 1500 psig, and the centrifugal charging pumps are rated 150 gpm at 2800. Both pumps take suction from the refueling water storage tank (borated water) and pump it into the cold legs. The charging pumps sweep the concentrated boric acid from the boron injection tank.

Low-head Safety Injection:

Two residual heat removal system pumps flood the core through cold legs when the pressure in the system drops to where the pumps will operate. Suction is taken from the Refueling Water Storage Tank until that supply is exhausted. Water is then recirculated from the sump. Capacity of these pumps could not be found.

E. OTHER SAFETY-RELATED FEATURES   Reactor: VOGTLE

Reactor Vessel Failure:

No reference found.

Containment Floodability:

No reference found.

Reactor-Coolant Leak-Detection System: Variations in particulate activity, gaseous activity and specific humidity of containment atmosphere above a preset level give indication of leakage in the control room. Particulate and gaseous activity are monitored by containment air particulate and radiogas monitors. Specific humidity is monitored by condensate measuring system and dew point temperature system. Maximum permissible leakage from unidentifiable sources will be 1 gpm.

Failed-Fuel-Detection System:

An instrument system has been developed and marketed by Westinghouse. Inservice correlation between instrument readings and actual fuel conditions are being studied. Up to 3 years of operational experience may be required before this program can be terminated.

Emergency Power:

Four diesel-generator sets each rated at 6000 kw for continuous operation are arranged 2 units for each reactor. One unit can supply power required to shutdown one reactor unit. Diesel-generators are independently housed and have independent systems for starting, etc. Each diesel has a day tank with 3 hr. of fuel supply and an underground storage tank with fuel capacity for 7 days of continuous diesel operation.

Control of Axial Xenon Oscillations By Burnable Shims, Part-Length Control Rods, In-Core Instrumentation: In-core instrumentation gives information on radial, axial, and azimuthal core characteristics giving fission power distribution. Burnable poison provide partial control of excess reactivity available during first fuel cycle.

Boron Dilution Control:

In either automatic control, or in manual control, boron diluation cannot proceed so rapidly that operators do not have sufficient time for correction. There is a leeway of at least 15 minutes for correction. If no action is taken, power and temperature rise will cause the reactor to reach overtemperature at trip setpoint.

Long-Term Cooling:

Residual heat removal system can circulate water through reactor and cool it in RHRS heat exchangers. Also, water is available from the cooling tower sumps or from back-up wells. River water is available as backup supply for other cooling systems.

Organic-Iodide Filter: No reference found.

Hydrogen Recombiner:

Electrical hydrogen recombiners provided to reduce hydrogen in post-LOCA containment atmosphere.

F. GENERAL Reactor: VOGTLE

Windspeed, Direction Recorders, and Seismographs:
Data available from Augusta airport and from USAEC Savannah River plant. In April 1972 instruments were installed at the site on a 150' high tower. No reference found to seismographs.

Plant Operation Mode:
Designed for load following if required.

Site Description:
Site is on a bluff overlooking the flood plain of the Savannah River at about river mile 151. There is an existing Combustion Turbine Plant. The foundation geology is good as is seismic history. Transportation is adequate with access to both rail lines and river traffic. The river flow will support a closed cycle cooling system.

Turbine Orientation: Turbines will be supplied by GE. Ejected blades could strike containment. Centerlines are 300' apart.

Emergency Plans:
Prescribes actions by plant personnel to minimize exposure of persons to radiation both onsite and offsite. Radiological emergencies fall into 3 classes -- local, site, and general emergencies. Plan prescribes order of priority, responsibilities, and personnel and material resources available for assistance. Offsite support agencies will be local sheriffs, county commissioners, doctors and hospitals, Georgia and South Carolina State Highway Patrols, and Savannah River AEC.

Environmental Monitoring Plans:
An environmental radiation monitoring program will be initiated a few months before startup of Unit 1. Measurements of activity in air, water, and selected biota will be made. Background measurements at locations least affected by the plant will be made concurrently with measurements at locations that are more likely to be affected by releases from the plant.

Radwaste Treatment:
Liquid wastes will be collected, processed, and recycled so very little waste is released to the environment. Waste discharged to the river will be 5 curies/yr/unit. The only release of radioactive gases will be from equipment leakage during normal operation. Gaseous wastes will be collected, as much as possible, and stored for the life of the plant. After collection, gases will be compressed and run through catalytic hydrogen recombiners. Solid wastes will be either from filtering and demineralizer operation, or from low-radiation level paper, clothing, rags, towels, etc. Solids will be packed into 55 gal. drums and shipped offsite for disposal.

Plant Vent:
Vent is attached to outside of containment structure and projects 10' above top of dome.

G. SITE DATA — Reactor: VOGTLE

Nearby Body of Water: Savannah River
Normal Level 80' (MSL)
Max Prob Flood Level 168.2 (MSL)

Size of Site 3177 Acres — Site Grade Elevation 220' (MSL)

Topography of Site: Rolling
of Surrounding Area (5 mi rad): Rolling, river flood plain

Total Permanent Population: In 2 mi radius 15 ; 10 mi 4365
Date of Data: 1977 In 5 mi radius 354 ; 50 mi 572,780

Nearest City of 50,000 Population: Augusta, Georgia
Dist. from site 26 Miles, Direction NNW, Population 59,864

Land Use in 5 Mile Radius:
50% USAEC lands, of the remaining land, 30% is farmed the rest being wooded.

Meteorology: Prevailing wind direction NW Avg. speed 6.5 mph
Stability Data - ---

Miscellaneous Items Close to the Site:
Savannah River, USAEC Savannah River Plant is across the river. Combustion turbine plant on site, nearest road Georgia Highway 23, 5 miles, nearest railroad Central of Georgia, 12 miles, nearest occupied house 3 miles, closest school, Gerard Elementary 8 miles.

H. CIRCULATING WATER SYSTEM

Type of System: Closed cycle, natural draft cooling towers.

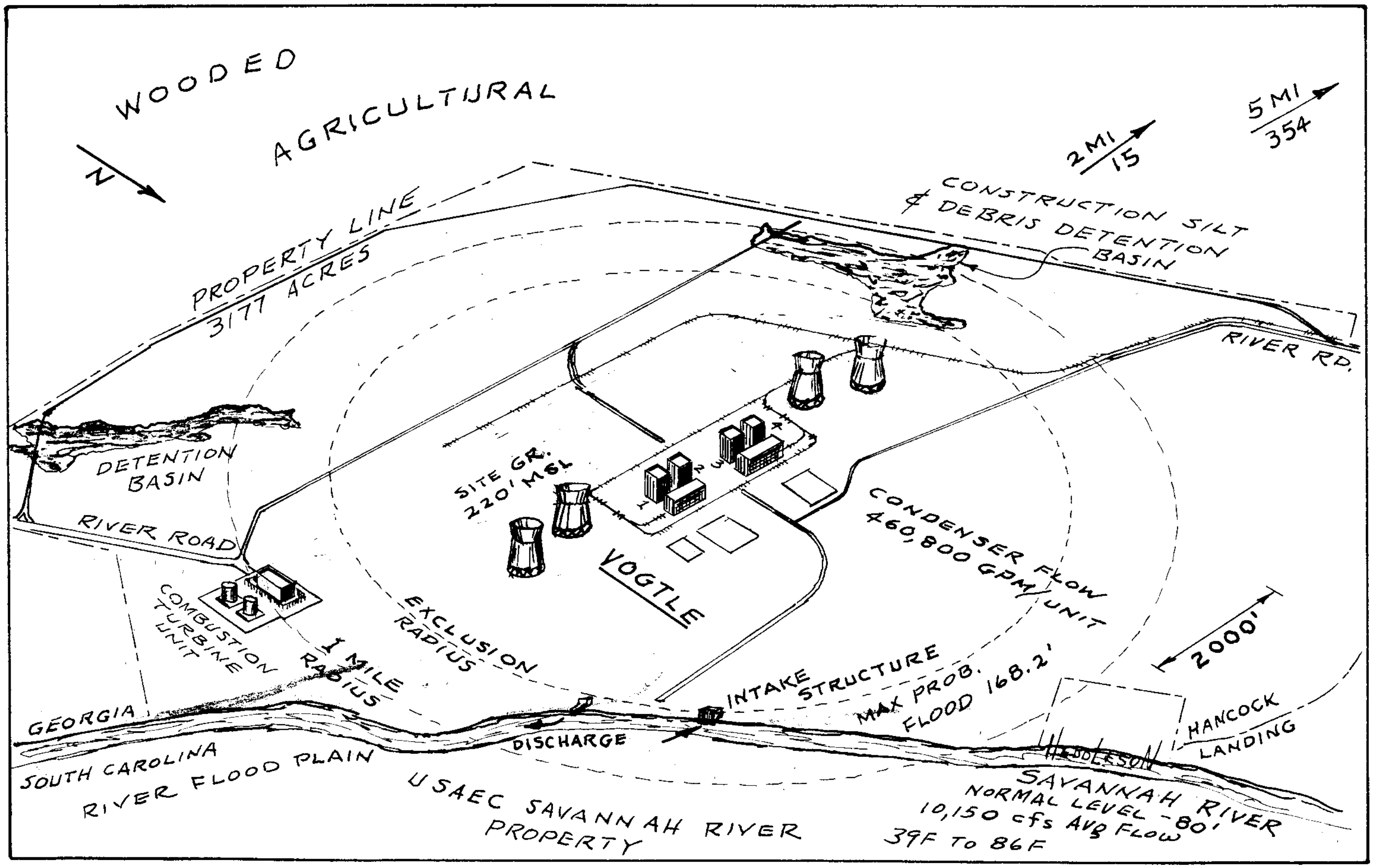
Water Taken From: Savannah River

Intake Structure: Will be built on the bank of the Savannah River to furnish makeup water for the cooling system. There is a trash rack with a mechanical rake and also vertical traveling screens. Velocity through traveling screens - 0.9 fps maximum.

Water Body Temperatures: Winter minimum 39 °F Summer maximum 86 °F
River Flow 5800 (cfs) minimum; 10150 (cfs) average
Service Water Quantity 56,500 gpm/reactor
Flow Thru Condenser 460,800 (gpm)/reactor Temp. Rise -- °F
Heat Dissipated to Environment 7942×10^6 (Btu/hr)/reactor
Heat Removal Capacity of Condenser 7942×10^6 (Btu/hr)/reactor

Discharge Structure: There is a 200-ft long outfall canal with an energy dissipator so that the velocity of the water entering the river will be approximately the velocity of the river. Flow rate - 160,000 gpm/4 units. Discharge is 1600 ft downstream from intake.

Cooling Tower(s): Description & Number - natural draft - 4 total
Blowdown ~4000 gpm/reactor Evaporative loss 16,400 gpm/reactor


WOODED
AGRICULTURAL
N
PROPERTY LINE
3177 ACRES
2 MI
15
5 MI
354
CONSTRUCTION SILT
& DEBRIS DETENTION
BASIN
RIVER RD.
DETENTION
BASIN
RIVER ROAD
SITE GR.
220' MSL
VOGTLE
CONDENSER FLOW
460,800 GPM/UNIT
2000'
COMBUSTION
TURBINE
UNIT
1 MILE
RADIUS
EXCLUSION
RADIUS
INTAKE
STRUCTURE
MAX PROB.
FLOOD 168.2'
HANCOCK
LANDING
GEORGIA
DISCHARGE
SOUTH CAROLINA
RIVER FLOOD PLAIN
USAEC SAVANNAH RIVER
PROPERTY
SAVANNAH RIVER
NORMAL LEVEL - 80'
10,150 cfs AVG FLOW
39F To 86F

Data from PSAR Page 1 (PWR)

SURRY, 50-434, 50-435

Project Name: Surry Power Station Units 3 & 4

Location: Surry Co., Virginia

Owner: Virginia Electric & Power Company

A-E: Stone & Webster
Vessel Vendor:
NSS Vendor: B & W
Containment Constructor: Stone & Webster

A. THERMAL-HYDRAULIC		B. NUCLEAR	
Thermal Output, MWt	2631	H_2O/U, Cold	2.85
Electrical Output, MWe Net	882	Avg 1st-Cycle Burnup, MWD/MTU	14,204
Total Heat Output, Safety Design, MWt	2763	First Core Avg Burnup, MWD/MTU	---
Total Heat Output, Btu/hr	8977×10^6	Maximum Burnup, MWD/MTU	55,000
System Pressure, psia	2250	Region-1 Enrichment, %	---
DNBR, Nominal	1.72	Region-2 Enrichment, %	Avg 2.80
Total Flowrate, lb/hr	108×10^6	Region-3 Enrichment, %	---
Eff Flowrate for Heat Trans, lb/hr	103×10^6	k_{eff}, Cold, No Power, Clean	1.256
Eff Flow Area for Heat Trans, ft^2	40	k_{eff}, Hot, Full Power, Xe and Sm	1.114
Avg Vel Along Fuel Rods, ft/sec	16.3	Total Rod Worth, % Δk/k	8.6
Avg Mass Velocity, $lb/hr\text{-}ft^2$		Shutdown Boron, with Rods-Clean-Cold, ppm	1185
Nominal Core Inlet Temp, °F	566.3	Shutdown Boron, with Rods-Clean-Hot, ppm	737
Avg Rise in Core, °F	61.7	Boron Worth, Hot, % Δk/k/ppm	0.01
Nom Hot Channel Outlet Temp, °F	652.7	Boron Worth, Cold, % Δk/k/ppm	0.013
Avg Film Coeff, Btu/hr ft^2-°F	7800	Full Power Moderator Temp Coeff, Δk/k/°F	$(+0.26 \text{ to } -3.0) \times 10^{-4}$
Avg Film Temp Diff, °F	27	Moderator Pressure Coeff, Δk/k/psi	$(-0.5 \text{ to } +3) \times 10^{-6}$
Active Heat Trans Surf Area, ft^2	40,743	Moderator Void Coeff, Δk/k/% Void	-1.7×10^{-2}
Avg Heat Flux, Btu/hr ft^2	214,000	Doppler Coefficient, Δk/k/°F	$(-1.1 \text{ to } -1.7) \times 10^{-5}$
Max Heat Flux, Btu/hr ft^2	582,000	Shutdown Margin, Hot 1 rod stuck, %Δk/k	1
Avg Thermal Output, kw/ft	7.07	Burnable Poisons, Type and Form	Al_2O_3-B_4C pellets in Zircaloy
Max Thermal Output, kw/ft	19.2	Number of Control Rods 44 × 16	704
Max Clad Surface Temp, °F	657	Number of Part-Length Rods (PLR)	127
No. Coolant Loops	2	Compiled by: F. A. Heddleson Nuclear Safety Information Center	

C. SAFETY-RELATED DESIGN CRITERIA		Reactor: Surry 3 & 4	
Exclusion Distance, Miles	0.31	Design Winds in mph:	
Low Population Zone Distance, Miles	3	At 0 — 50 ft elev	105
Metropolis / Distance / Population: Newport News, Hampton, Va. — 5 mi. to city limits	292,159	50 — 150 ft	130
Design Basis Earthquake Acceleration, g	0.15	150 — 400 ft	133
Operating Basis Earthquake Acceleration, g	---	Tornado	300 mph + 60 trans.
Earthquake Vertical Shock, % of Horizontal	66	ΔP =	3 psi/ 3 sec
Is Intent of 70 Design Criteria Satisfied?	Will conform as outlined in Section 3.1.		

D. ENGINEERED SAFETY FEATURES

D1. CONTAINMENT		Design Pressure, psig	45
Max Leak Rate at Design Pressure, %/day	0.1	Calculated Max Internal Pressure, psig	39.8

Type of Construction: Will be a steel-lined, heavily reinforced concrete structure with a vertical cylindrical wall and a hemispherical dome, all supported on a flat concrete base mat. The steel liner will make the containment virtually leaktight; below ground level, a waterproof membrane will protect the structure from the effects of groundwater and will protect the steel liner from external hydrostatic pressure. Free volume is 1.8×10^6 cu. ft.

Design Basis: Designed to withstand DBA, Safe Shutdown and 1/2 Safe Shutdown Earthquake, severe weather phenomena, and to meet biological shielding requirements. Operating pressure will be 9.5 to 11.5 psia (subatmospheric).

Vacuum Relief Capability: Since operating pressure will be about 3 to 5 psi below atmospheric, no vacuum relief valves are required.

Post-Construction Testing: Leakage rate tests will be run periodically. A leakage monitoring system will monitor for leakage rates less than 0.10% of volume in 24 hours. Will be pressure tested at 115% of design pressure.

Penetrations: Only electrical penetrations have provision for leak testing.

Weld Channels: All liner plate seams will be covered with small steel channels and zoned for separate testing areas.

D2. CONTAINMENT SAFETY FEATURES	Reactor: Surry 3 & 4
Containment Spray System: Two spray systems are available — Quench Spray with NaOH additive and Recirculation Spray. Quench Spray consists of two 100% capacity systems, each with 2 pumps, taking suction from the 550,000-gal refueling water storage tank. The recirculation spray pumps from the containment sump. The systems can reduce containment pressure after LOCA to subatmospheric in 45 minutes.	
Containment Cooling: Containment air recirculation system is used only for normal cooling — not sized for LOCA requirements. System consists of 3 banks of cooling coils each with a fan that discharges cooled air into a common ventilation duct.	
Containment Isolation System: Provides 2 barriers between outside atmosphere and (1) containment atmosphere and (2) reactor coolant system. All valves operate automatically, and positions are indicated in the control room. Leak tightness of valves can be monitored.	
Containment Air Filtration: Consists of 2 separate banks of filters with fan. A filter bank will have a prefilter, charcoal filter, and HEPA filter. Designed to recirculate containment air and remove radioactivity, if required.	
Penetration Room: Found no reference on sketches in PSAR.	

D3. SAFETY INJECTION SYSTEMS
Accumulator Tanks: Two core flooding tanks each containing 7800 gal of borated water discharge their contents into the reactor when the system pressure drops to 600 psig. Tanks are under nitrogen pressure and operate automatically through check valves. Tanks are connected to the reactor core flooding nozzle.
High-head Safety Injection: Consists of 3 makeup pumps for normal operation; which operate during emergency, starting on low reactor coolant pressure (1600 psig) or high containment pressure. Pumps are rated 250 gpm at 2500 psig. They take suction from the refueling water storage tank. All switching, valve settings are automatic but can be controlled manually from the control room.
Low-head Safety Injection: Two decay heat removal pumps each rated 3000 gpm at 400 psig deliver borated water from the refueling water storage tank into the core flooding nozzle. When low water level in the RWST is reached, 2 of the recirculation spray pumps start and begin to circulate water from the containment sump through the recirculation spray coolers.

E. OTHER SAFETY-RELATED FEATURES

Reactor: Surry 3 & 4

Reactor Vessel Failure: Found no reference.

Containment Floodability: Found no reference.

Reactor-Coolant Leak-Detection System: Several systems as follows: (a) Containment radioactivity monitoring; (b) Makeup water for pressurizer; (c) Containment sump level; (d) Recirculation fan cooler heat load, and (e) Containment pressure, temperature, and humidity. Normally expected leakage from all sources is expected to be 0.11 gpm. A leakage of 5 gpm would be detected in about 15 minutes by changes in pressure, temperature, and humidity.

Failed-Fuel-Detection System: Presence of minor quantities of fission products can be detected with the gross gamma monitor on the letdown line.

Emergency Power: Three diesel-generator sets will be available, one for unit 3, one for unit 4, and the 3rd a backup for either unit. One generator will be able to supply the total emergency load for one reactor. Each generating set will be located in a separate cubicle within a category I building. Each diesel will have a fuel oil day tank with supply for 3 hours. Two underground fuel tanks will be available, sized for 7 days continuous operation of 2 diesels.

Control of Axial Xenon Oscillations By Burnable Shims, Part-Length Control Rods, In-Core Instrumentation: Yes, both burnable shims and part length rods (APSRA) will be used. Out-of-core detectors will monitor the flux. In-core detector can be used for checking out-of-core detectors.

Boron Dilution Control: System has several interlocks and alarms to prevent improper operation. Alarms are provided to annunciate that interlock setpoints have been reached. Flow of dilution water is automatically terminated by the ICS when flow has integrated to a preset value.

Long-Term Cooling: Recirculation spray pumps are used for long-term cooling, pumping through recirculation coolers. Pumps are rated 3500 at 120 psig. Heat exchangers are rated 3×10^6 Btu/hr.

Organic-Iodide Filter: No reference found.

Hydrogen Recombiner: Two units draw air from containment and discharge back into containment. Can also use subatmospheric purge for H_2 control.

F. GENERAL

Reactor: Surry 3 & 4

Windspeed, Direction Recorders, and Seismographs:

Windspeeds measured with 150-ft tower starting in Jan. 1970. Strong motion triaxial accelerometers will be installed. Two units will be installed in containment, the third in the auxiliary building.

Plant Operation Mode:

Designed for load following.

Site Description:

Plant is located on a peninsula-like piece of land surrounded on 3 sides by the James River which is about 3 miles wide all around the site and has a 25-ft deep channel. This point in the river is just about the limit of salt intrusion from the ocean. Area surrounding the site is low and flat, much of which is heavily wooded and marshy. Population density is low.

Turbine Orientation: Ejected turbine blades could strike containment. Centerlines are about 300 ft apart. GE will supply the turbine.

Emergency Plans:

Objective is protection of health and safety of the public in the event of an accident at the facility. The Emergency Plan for Units 3 and 4 will be the Units 1 and 2 Emergency Plan, extended by revision at the operating license stage to include all four units.

Environmental Monitoring Plans:

A program has been carried out for Units 1 & 2 to verify the adequacy of radiation control and to provide field data for estimating dose to the environment. A preoperational surveillance was underway for some time with cooperation from Virginia Institute of Marine Science to establish base-line conditions for evaluation of operating data. Milk, shellfish, and silt were selected as indicator samples. Studies will be continued and expanded as required for Units 3 & 4.

Radwaste Treatment:

Waste liquids generated during plant operation and refueling will be collected, classified, and processed either for recycle within the plant or for discharge offsite. Filtration, evaporation, demineralization, and clarification processes will be used. For gaseous waste, there will be high efficiency particulate filtration, catlytic recombination of hydrogen and oxygen storage for radioactive decay, and dilution with air. Solid waste system will provide holdup, packaging and storage for offsite shipment and disposal.

Plant Vent: Process vent is 3 in. in diameter and extends 10 ft. above the containment building. A ventilation air vent will extend above the turbine building roof.

Page 6, PWR

G. SITE DATA

Reactor: Surry 3 & 4

Nearby Body of Water: James River

Normal Level 0' (MSL)
Max Prob Flood Level 28.2' (MSL)

Size of Site 840 Acres   Site Grade Elevation 26.5' (MSL)

Topography of Site: Flat

of Surrounding Area (5 mi rad): Flat

Total Permanent Population: In 2 mi radius 7 ; 10 mi 108,154

Date of Data: 1970   In 5 mi radius 659 ; 50 mi ______

Nearest City of 50,000 Population: Newport News, Virginia

Dist. from site 10 avg Miles, Direction SE , Population 138,177

Land Use in 5 Mile Radius: Agricultural west and south. Water and military reservations north and east. Recreation (hunting, fishing, parks) is popular in area.

Meteorology: Prevailing wind direction None Avg. speed 7.5 mph

Stability Data - Slightly unstable to neutral 2/3 of time.

Miscellaneous Items Close to the Site: Jamestown Island, a Federal park, is 4-mi NW; Chippokes Plantation, a State park, is 3-mi WSW. Jamestown National Historical Park is 5-mi WNW and Colonial Williamsburg is 7 1/2-mi NNW. Adjacent to the site on the north is Hog Island, a waterfowl refuge. These numerous attractions bring thousands of visitors to the area.

H. CIRCULATING WATER SYSTEM

Type of System: Closed system spray canal - 384 power spray modules. Evaporation total 400 gpm.

Water Taken From: Makeup from James River.

Intake Structure: Makeup intake from discharge canal for Units 1 and 2 circulating water — total makeup for evaporation, seepage, and blowdown will be 1180 gpm.

Water Body Temperatures: Winter minimum 35 °F Summer maximum 84 °F

River Flow Tidal flow (cfs) minimum; 8960 (cfs) average

Service Water Quantity 10,500 gpm/reactor

Flow Thru Condenser 1,033,000 (gpm)/reactor Temp. Rise 24.4 °F

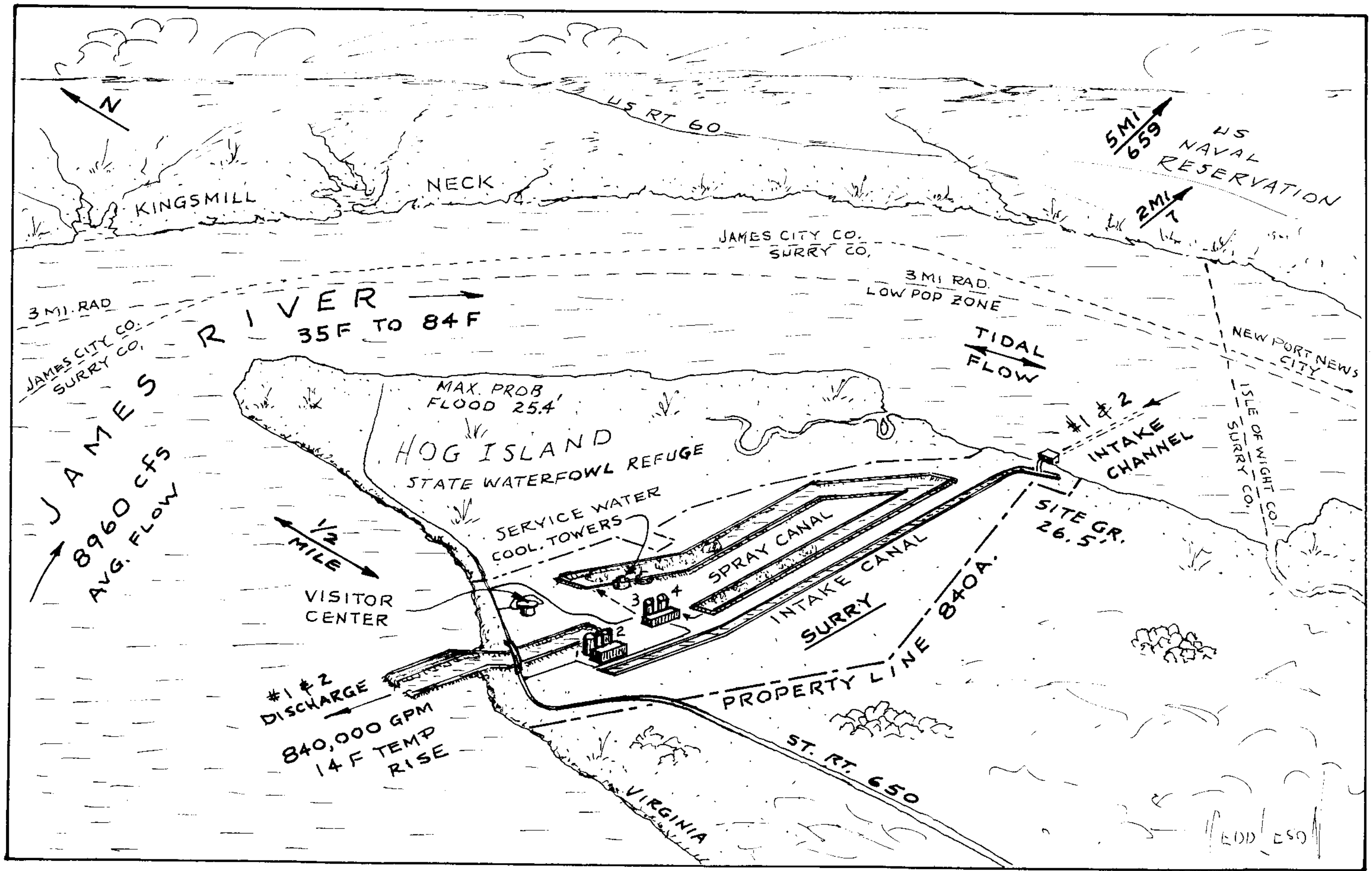
Heat Dissipated to Environment --- (Btu/hr)/reactor

Heat Removal Capacity of Condenser --- (Btu/hr)/reactor

Discharge Structure: Blowdown from spray canal discharged to circulating water canal for Units 1 and 2.

Cooling Tower(s): Description & Number - 2 units to cool service water used for cooling after LOCA.

Blowdown --- gpm/reactor Evaporative loss --- gpm/reactor



NUCLEAR SAFETY INFORMATION CENTER

Data from PSAR Page 1 (PWR)

BELLEFONTE, 50-438, 50-439

Project Name: Bellefonte Nuclear Plant
Units 1 & 2
Location: Jackson Co. (NE Ala.)
7 mi, ENE of Scottsboro, Ala.
Owner: TVA

A-E: TVA
Vessel Vendor: Babcock & Wilcox
NSS Vendor: Babcock & Wilcox
Containment
Constructor: TVA

A. THERMAL-HYDRAULIC		B. NUCLEAR	
Thermal Output, MWt	3413	H_2O/U, Cold	2.92
Electrical Output, MWe	1329	Avg 1st-Cycle Burnup, MWD/MTU	16,790
Total Heat Output, Safety Design, MWt	3763	First Core Avg Burnup, MWD/MTU	---
Total Heat Output, Btu/hr	$11,649\times10^6$	Maximum Burnup, MWD/MTU (Design)	55,000
System Pressure, psia	2250	Region-1 Enrichment, %	2.42
DNBR, Nominal	1.73	Region-2 Enrichment, %	2.80
Total Flowrate, lb/hr	139×10^6	Region-3 Enrichment, %	3.30
Eff Flowrate for Heat Trans, lb/hr	132×10^6	k_{eff}, Cold, No Power, Clean	1.246
Eff Flow Area for Heat Trans, ft^2	56.6	k_{eff}, Hot, Full Power, Xe and Sm	1.116
Avg Vel Along Fuel Rods, ft/sec	15.1	Total Rod Worth, ($\Delta k/k$), %	8.5
Avg Mass Velocity, lb/hr-ft^2	---	Shutdown Boron, All Rods-Clean-Cold, ppm	1108
Nominal Core Inlet Temp, °F	572.5	Shutdown Boron, All Rods-Clean-Hot, ppm	748
Avg Rise in Core, °F	58.6	Boron Worth, Hot, % $\Delta k/k$/ppm	0.95×10^{-2}
Nom Hot Channel Outlet Temp, °F	652.7	Boron Worth, Cold, % $\Delta k/k$/ppm	1.26×10^{-2}
Avg Film Coeff, Btu/hr ft^2-°F	7700	Full Power Moderator Temp Coeff, $\Delta k/k$/°F	$(+0.1$ to $-3.0)\times10^{-4}$
Avg Film Temp Diff, °F	26	Moderator Pressure Coeff, $\Delta k/k$/psi	-0.5×10^{-7} to $+3\times10^{-6}$
Active Heat Trans Surf Area, ft^2	57,602	Moderator Void Coeff, $\Delta k/k$/% Void	$+3.0\times10^{-4}$ to -3.0×10^{-3}
Avg Heat Flux, Btu/hr ft^2	197,000	Doppler Coefficient, $\Delta k/k$/°F	$(-1.1$ to $-1.7)\times10^{-5}$
Max Heat Flux, Btu/hr ft^2	534,000	Shutdown Margin, Hot 1 rod stuck, %$\Delta k/k$	1
Avg Thermal Output, kw/ft	6.49	Burnable Poisons, Type and Form	$Al_2O_3B_4C$ in Zircaloy-4
Max Thermal Output, kw/ft	17.61	Number of Control Rods 68×16	1088
Max Clad Surface Temp, °F	657	Number of Part-Length Rods (PLR)	128
No. Coolant Loops	2	Compiled by: Fred Heddleson, Sept.'73 Nuclear Safety Information Center	

C. SAFETY-RELATED DESIGN CRITERIA			Reactor: BELLEFONTE
Exclusion Distance, Miles		0.57	Design Winds in mph:
Low Population Zone Distance, Miles		2	At 0 — 50 ft elev 105
Metropolis	Distance	Population	50 — 150 ft 130
Huntsville, Ala.	38 mi	228,239	150 — 400 ft 150
Design Basis Earthquake Acceleration, g		0.18	Tornado 300 mph rot + 60 trans.
Operating Basis Earthquake Acceleration, g		0.09	ΔP = 3 psi/ --sec
Earthquake Vertical Shock, % of Horizontal		66	
Is Intent of 70 Design Criteria Satisfied?	Will conform to the 55 applicable as specified in Appendix A CFR Part 50.		

D. ENGINEERED SAFETY FEATURES

D1. CONTAINMENT		Design Pressure, psig	50
Max Leak Rate at Design Pressure, %/day	0.2	Calculated Max Internal Pressure, psig	64.7

Type of Construction: A post-tensioned concrete structure of right cylindrical configuration with a shallow dome roof, having 1/4-in. steel liner. Primary structure surrounded by a free-standing secondary containment of a thin reinforced concrete shell designed to maintain slight vacuum for inleakage in the 10-ft annulus. Net free primary volume is 3.8×10^6 cu ft. The secondary containment has a volume of 1.5×10^6 cu ft.

Design Basis: Reactor building design ensures no risk from horizontal ground acceleration of 0.18g plus vertical acceleration of 0.12g. Secondary containment designed to resist various combinations of winds, tornado forces, external missiles, snow loads, and external water pressure for normal and accident conditions.

Vacuum Relief Capability: Remote, manual valves relieve primary containment. On isolation, these valves close automatically.

Post-Construction Testing: Periodic leakage rate tests will be run during the life of the plant. A structural acceptance test will be run at 1.15 × 50 psig and measurements made of deformations.

Penetrations: Type IV (cold piping penetration) is double sealed and individually testable. All others are single sealed. Type III has a test connection. This is the emergency sump valve room penetration.

Weld Channels: Some seam welds will be covered with channels. All welds will be soap-bubble tested with a vacuum box.

D2. CONTAINMENT SAFETY FEATURES Reactor: BELLEFONTE

Containment Spray System: Called Reactor Building Spray System, which consists of 2 pumps (2000 gpm at 240 psig), 2 spray headers and associated piping, valves, etc. Both spray paths operating furnishes 100% capacity after LOCA. Suction is taken from BWST. Emergency operation is initiated by high pressure signal.

Containment Cooling: Three fan-coil circulation units provide normal cooling during operation and emergency cooling after LOCA. Each cooling unit has 50% cooling capacity. On high containment pressure, fan speeds slow down, full flow of cooling water begins thru coils and the 3rd standby unit starts. Total heat removal rate per unit is 132.7×10^6 Btu/hr.

Containment Isolation System: In case of a LOCA, will provide, in some lines, at least 2 barriers to prevent release of radioactivity from containment. An isolation barrier is either a closed system, a check valve on an incoming line, a valve that is automatically closed, or a remote manual or a locked closed valve.

Containment Air Filtration: All air leaving primary containment passes thru HEPA filters and charcoal absorbers. Flow is into secondary containment which is held at negative pressure. Any air leaving secondary containment passes thru HEPA filters and charcoal absorbers.

Penetration Room: None shown on sketches.

D3. SAFETY INJECTION SYSTEMS

Accumulator Tanks: Two tanks each containing 10,875 gal of borated water automatically discharge their contents into the reactor vessel when system pressure drops to 600 psig. Tanks discharge directly into the reactor pressure vessel.

High-head Safety Injection: Two makeup pumps (700 gpm at 1040 psig) supply borated water from the borated water storage tank in case of small breaks. Normally, one pump is in operation providing makeup to the reactor. Pumps start automatically on the engineered safety feature actuation signal.

Low-head Safety Injection: Two pumps (5000 gpm at 165 psig) supply water to the reactor vessel after LOCA. Suction is taken from the borated water storage tank. When supply in this tank is exhausted, suction is switched to the containment sump. These pumps are called decay heat removal pumps.

E. OTHER SAFETY-RELATED FEATURES — Reactor: BELLEFONTE

Reactor Vessel Failure: The thoroughness of design, evaluation, and testing precludes failure.

Containment Floodability: No reference found.

Reactor-Coolant Leak-Detection System: Leakage can be determined by: (1) Radiation monitoring, (2) humidity monitoring, (3) cooling coil condensate monitoring, and (4) gross leakage monitoring (excessive makeup for pressurizer and containment sump monitoring). Allowable leakage is 1 gpm for 12 hours or 10 gpm. Best sensitivity is in the air particulate monitoring which could detect a leak of 1 gpm in 10 minutes if there was no failed fuel.

Failed-Fuel-Detection System: A test facility will be provided where a suspect leaky fuel assembly can be placed in a flushing loop and checked for leakage of radioactivity.

Emergency Power: Two diesel-generators will be provided to furnish emergency power for each reactor unit. Diesels will be housed in independent structures, each engine having independent air starting systems. Each diesel has its own fuel supply sufficient for 7 days of continuous running at full power.

Control of Axial Xenon Oscillations By Burnable Shims, Part-Length Control Rods, In-Core Instrumentation:

Self-powered neutron detectors monitor, through the computer, flux distribution in the core.

Boron Dilution Control: With the highest rate of dilution, automatic controls will insert rods to maintain power level and reactor coolant temp. Rod insertion beyond the allowable band will close the feed block valve to terminate addition of water. On manual control with no control rod insertion, reactivity additions cause a high temp or high pressure trip. Control rod insertion will cause feed block valve to close, terminating addition of borated water.

Long-Term Cooling: The low-head safety injection system in the recirculation stage will provide long-term cooling. Water is pumped through the decay heat removal coolers, 2 of which have 41×10^6 Btu/hr capacity each. Emergency, long-term cooling could be provided by water from the lake.

Organic-Iodide Filter: No reference found.

Hydrogen Recombiner: Units are installed for post LOCA hydrogen control.

F. GENERAL	Reactor: BELLEFONTE

Windspeed, Direction Recorders, and Seismographs: Temporary 130-ft tower 2 mi NNE of site erected in May 1972. A permanent 300-ft tower will be installed before fuel loading. Found no reference to seismographs.

Plant Operation Mode: Base loaded, but designed for load following.

Site Description: Site consists of about 1500 acres on a peninsula in the Guntersville Reservoir on the Tennessee River at river mile 392. Site is on the west shore of the lake on the SE side of Browns Valley. The site is moderately wooded with steep hills on the eastern side. Across the lake, foothills of Sand Mountain rise up to 1400 ft (MSL). Site lies in a NE-SW valley.

Turbine Orientation: Ejected blades could not strike containment.

Emergency Plans: Plan sets forth policies, purposes, delegations, standards, and instructions necessary to handle emergencies so as to protect the health and safety of the public and TVA employees. Responsibilities of off-site agencies are defined. The State Dept. of Health in Ala. and surrounding states have been consulted. AEC and EPA have been consulted. Plans include evacuation and feeding of effected populations.

Environmental Monitoring Plans: Details of programs are related to final plant design, so monitoring programs are tentative. As details are completed, monitoring programs will be reevaluated and modified. When completed, proposed monitoring will be coordinated with appropriate Federal, state, and local agencies as required by Executive Order 11514. The preoperational program will establish a baseline of data on distribution of natural and manmade radioactivity in the environment near the plant site. With this background, it will then be possible to determine the earliest possible buildup of radionuclides.

Radwaste Treatment: High-activity liquid waste is collected and processed by demineralization or evaporation. Low-activity waste may be discharged without processing. Evaporator distillate may be reused as reactor plant makeup water or disposed of in accordance with applicable Federal and state standards. Evaporator residues and solid wastes are stored, packaged, and shipped from the site for ultimate disposal at an authorized location. Tritiated wastes are kept separated and recycled. Gaseous wastes are collected and stored until their radioactivity level is low enough for discharge in accordance with applicable Federal and state standards. Two waste gas decay tanks are provided with a capacity for a 60-day decay holdup period.

Plant Vent: Steel vent runs up the side of the containment structure terminating near the top of the structure.

G. SITE DATA , Reactor: BELLEFONTE

Nearby Body of Water: Guntersville Reservoir of the Tennessee River

Normal Level 595' (MSL)

Max Prob Flood Level 632' (MSL)

Size of Site ~1500 Acres Site Grade Elevation 646' (MSL)

Topography of Site: Flat valley

of Surrounding Area (5 mi rad): Hilly out of the valley

Total Permanent Population: In 2 mi radius 115 ; 10 mi 18,410

Date of Data: 1970 In 5 mi radius 2775 ; 50 mi ______

Nearest City of 50,000 Population: Huntsville, Alabama

Dist. from site 38 Miles, Direction W , Population 146,565

Land Use in 5 Mile Radius: Agricultural and wooded.

Meteorology: Prevailing wind direction NE/SW Avg. speed 2 mph

Stability Data - Calm 15%, 1 to 3 mph wind 58%. Pasquill E 33%.

Miscellaneous Items Close to the Site: Widows Creek coal-fired plant is 15 miles NE; Guntersville Dam - 43 mi; Scottsboro (pop 9324) - 7 mi WSW; Pisgah (pop 519) - 5 mi ESE; Hollywood (pop 865) - 3 1/2 mi WNW; US Hwy 72 - 2 mi NW; I59 - 20 mi SE; and Southern RR - 3 mi NW.

H. CIRCULATING WATER SYSTEM

Type of System: Closed system using cooling towers.

Water Taken From: Guntersville Reservoir for makeup.

Intake Structure: Located at end of intake channel which will have max water velocity of 0.2 fps. Structure will have 4 openings 8' × 15'. Max flow velocity thru openings will be 0.42 fps. Velocity thru traveling screen will be 0.24 fps.

Water Body Temperatures: Winter minimum 41 °F Summer maximum 81 °F

River Flow 2900 (cfs) minimum; 38,300 (cfs) average

Service Water Quantity 12,865 gpm/reactor max (normal operation)

Flow Thru Condenser 466,000 (gpm)/reactor Temp. Rise 36 °F

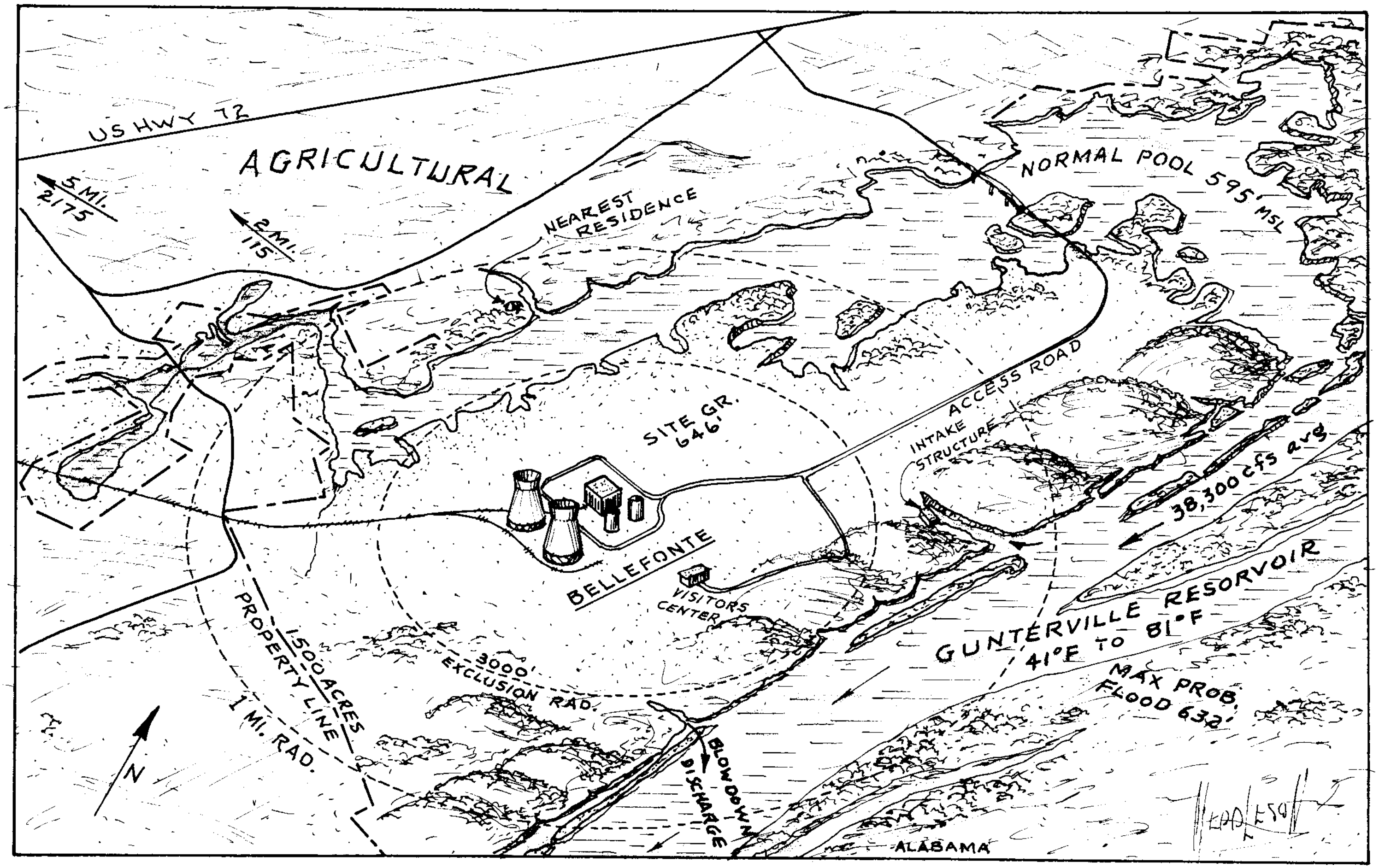
Heat Dissipated to Environment 8000×10^6 (Btu/hr)/reactor

Heat Removal Capacity of Condenser 7787×10^6 (Btu/hr)/reactor

Discharge Structure: A nozzle-type jet diffuser pipe will discharge effluents into the flow thru the reservoir. A 4' diam pipe with two 2' diam nozzles spaced 50' apart is suggested.

Cooling Tower(s): Description & Number - Two natural draft towers about 500 ft in diameter and 500 ft high.

Blowdown 33,300 gpm/reactor Evaporative loss 16,650 gpm/reactor


US HWY 72
AGRICULTURAL
5 MI.
2175
2 MI.
115
NEAREST RESIDENCE
NORMAL POOL 595' MSL
SITE GR. 646'
ACCESS ROAD
INTAKE STRUCTURE
38,300 cfs avg
BELLEFONTE
VISITORS CENTER
GUNTERVILLE RESERVOIR
41°F TO 81°F
MAX PROB. FLOOD 632'
3000' EXCLUSION RAD.
1500 ACRES
PROPERTY LINE
1 MI. RAD.
N
BLOWDOWN
DISCHARGE
ALABAMA

Data from PSAR Page 1 (BWR)

PERRY, 50-440, 50-441

Project Name: Perry Nuclear Power Plant Units 1 & 2
Location: Lake Co., Ohio
35 mi NE of Cleveland, Ohio
Owner: Joint ownership*

A-E: Gilbert Associates
Vessel Vendor:
NSS Vendor: General Electric
Containment Constructor: Kaiser Engineers

A. THERMAL-HYDRAULIC		B. NUCLEAR	
Thermal Output, MWt	3579	H_2O/UO_2 Volume Ratio	---
Electrical Output, MWe	1205	Moderator Temp Coef Cold, Δk/k/°F	(+4 to −14) × 10^{-5}
Total Heat Output, Safety Design, MWt	3758	Moderator Temp Coef Hot, No Voids	(+4 to −14) × 10^{-5}
Steam Flow Rate, lb/hr	153.96×10^6	Moderator Void Coef Hot, No Voids, Δk/k/%	-5.5×10^{-5}
Total Core Flow Rate, lb/hr	1050×10^6	Moderator Void Coef Operating	-9×10^{-4}
Coolant Pressure, psig	1040	Doppler Coefficient, Cold	---
Heat Transfer Area, ft^2	73,409	Doppler Coefficient, Hot, No Voids	-1.0×10^{-5}
Max Power per Fuel Rod Unit Lgth, kw/ft	13.40	Doppler Coefficient, Operating	-2.5×10^{-5}
Maximum Heat Flux, Btu/hr-ft^2	354,000	Initial Enrichment, % (BOL)	2.07
Average Heat Flux, Btu/hr-ft^2	159,570	Average Discharge Exposure, MWD/Ton	12,800
Maximum Fuel Temperature, °F	3325	Core Maximum Void Within Assembly, %	76
Average Fuel Rod Surface Temp, °F	560	k_{eff}, All Rods In	---
MCHFR	$\geq$1.9	k_{eff}, Max Rod Out	---
Total Peaking Factor	2.22	Control Rod Worth, %	0.01 Δk
Avg Power Density, Kw/ℓ	56.0	Curtain Worth, %	None
Peak Fuel Enthalpy on Rod Drop, Cal/gm	280	Burnable Poisons, Type and Form	Gadolina in UO_2
*Duquesne Light Company Ohio Edison Co. Toledo Edison Penn. Power Co. Cleveland Elect. Illum Co.		Number of Control Rods	177
		Number of Part-Length Rods (PLR)	None

Compiled by: F. A. Heddleson, Oct. '73
ORNL, Nuclear Safety Information Center

C. SAFETY-RELATED DESIGN CRITERIA

Reactor: PERRY

Exclusion Distance, Miles		0.57 radius	Design Winds in mph:
Low Population Zone Distance, Miles		5	At 0 — 50 ft elev 97
Metropolis	Distance	Population	
Cleveland, O.	33 mi.	2,064,194 (1970)	50 — 150 ft 113
Design Basis Earthquake Acceleration, g		0.15	150 — 400 ft 118
Operating Basis Earthquake Acceleration, g		0.075	Tornado: 300 mph tang. + 60 trans. ΔP = 3 psi/ 3 sec
Earthquake Vertical Shock, % of Horizontal		---	Is Intent of 55 Design Criteria Satisfied? Yes

Recirculation Pumping System & MCHFR: Controls the variable-position flow control discharge valve. Adjusting this valve changes coolant flow rate through the core which changes core power level. System adjusts power output to load demand.

Protective System: Initiates a rapid, automatic shutdown of reactor in time to prevent excessive fuel cladding damage or other damage following abnormal transients. System overrides all operator actions and process controls.

D. ENGINEERED SAFETY FEATURES

D1. CONTAINMENT

Drywell Design Pressure, psig	23.0	Primary Containment Leak Rate, %/day	0.2
Suppression Chamber Design Pressure, psig	15	Second Containment Design Pressure, in. water	0.25
Calculated Max Internal Pressure, psig	17.8	Second Containment Leak Rate, %/day	100

Type of Construction: The shield building, containment vessel, and drywell are all erected on a common reinforced concrete mat 8.5' thick and 136' in diameter. The shield building is a cylindrical concrete structure with 3'-0" thick walls and a domed roof. The containment vessel is a steel structure 1" to 1 1/2" thick just inside the shield building. A suppression pool surrounds the drywell. Total free volume in containment vessel is 1.2×10^6 cu ft.

Design Basis: Drywell suppression pool, and the containment vessel are designed to condense steam and contain fission product releases from a LOCA. The leak-tight containment vessel is designed to prevent release of fission products to the environment. The shield building is designed to provide radiation shielding and to protect the containment vessel from the weather and external missiles.

Vacuum Relief Capability: Purge valves are required as part of the annulus exhaust gas treatment system. Vacuum breakers are required for the containment vessel.

Post-Construction Testing: Leakage rate tests will be run at 15 psig and 8 psig right after construction. Periodic tests will be run thereafter.

Penetrations: Most penetrations are double sealed and individually testable.

D2. EMERGENCY CORE COOLING SYSTEMS — Reactor: PERRY

Core Spray Cooling System: There is a high-pressure system and a low-pressure system. One pump is provided for the high-pressure system rated 1465 gpm at 1130 psi. One pump for the low pressure system is rated at 6110. Both systems take suction from the suppression pool, although the primary source for high-pressure is the condensate storage tank. Systems are initiated by hi drywell pressure and/or low-low reactor water level.

Auto-Depressurization System: Safety relief valves (8 in number) open to vent steam and reduce reactor vessel pressure in the event of LOCA when the high-pressure cooling injection pumps cannot maintain water level. Low-pressure pumps start when pressure is sufficiently lowered.

Residual-Heat-Removal System (RHRS): Consists of 4 subsystems as follows: 1. Shutdown cooling & reactor vessel head spray can complete cooldown to 125 F within 20 hrs after control rods have been inserted. 2. Steam condensing mode transfers decay heat to RHR heat exchangers instead of suppression pool. 3. Low Pressure Coolant Injection System is described below. 4. Suppression pool cooling using RHR heat exchangers. The LCIS comprises the major part of the system which consists of three independent loops, two heat exchangers, three main system pumps, and service water pumps.

High-Pressure Coolant-Injection System: The high pressure coolant injection system function is provided by the High-Pressure Core Spray System described above.

Low-Pressure Coolant-Injection System: Three pumps each rated 7100 gpm with associated valves, piping, and instrumentation make up this system. Suction is taken from the suppression pool, initiated by high drywell pressure and/or low-low reactor water level.

E. OTHER SAFETY-RELATED FEATURES

Main-Steam-Line Flow Restrictors: Venturi-type flow restrictors installed in each main steam line inside containment. Designed to limit flow, in case of a line break outside containment so that isolation valves will have time to close before water level drops below top of core.

Control-Rod Velocity Limiters: An attachment on the end of each control rod limits velocity at which a rod can fall out of the core should it become detached from the rod drive. Scram speed of rod is not effected.

Control-Rod-Drive-Housing Supports: Located under the reactor vessel under the control rod drive housings. Supports limit the travel of a control rod housing if there is a rupture, max travel is about 2".

Standby Liquid-Control System: Provides a redundant, independent way to shut down the reactor in case control rods cannot be inserted. Natural boron 600 ppm is used.

E. OTHER SAFETY-RELATED FEATURES (cont'd) Reactor: PERRY
Standby Coolant System: No reference found, but it is expected that cooling water from Lake Erie can be cross-connected into a reactor cooling system.
Containment Atmospheric Control System: Containment air is cooled by fan-coil coolers. There is a purge system to exhaust air and pass it through the Annulus Exhaust Gas Treatment System. Also, there is a containment spray system which can spray 5700 gpm of water into the containment air for cooling.
Reactor Core Isolation Cooling System (RCICS): The reactor core isolation cooling system (RCIC) provides makeup water to the reactor vessel when the vessel is isolated. The RCIC uses a steam-driven turbine-pump unit and operates automatically in time and with sufficient coolant flow to maintain adequate water level in the reactor vessel.
Reactor Vessel Failure: No reference found.
Containment Floodability: In post LOCA conditions, the containment vessel will be flooded to a depth of 66 ft above the base mat.
Reactor-Coolant Leak-Detection System: Leaks are detected by monitoring for abnormally high pressure and temperature in the drywell, high fillup rates for sumps, excessive temperature difference between inlet and out water for drywell coolers, increased flow of condensate from coolers, decrease in reactor vessel water level, and high levels of fission products in the drywell atmosphere. Leakage rate limit for unidentifiable leakage is 50 gpm.
Failed-Fuel Detection Systems: Four gamma radiation monitors located externally to the main steam lines just outside containment will detect a gross release of fission products from the fuel. On detection, trip signals will initiate a reactor scram and close isolation valves on the steam lines.
Emergency Power: Engineered safety feature loads are designated I, II, and III. A diesel-generator set is provided for each division. Each diesel-generator is housed independently in seismic category I structures with all accessories provided independently. Each unit has a day tank with fuel for 3 hours with a storage tank having fuel for 7 days' operation. Division I and II generators are rated 4250 kw. Division III diesel-generator handles high pressure core spray equipment loads.
Rod-Block Monitor: Prevents fuel damage due to incorrect rod withdrawal. Rod block monitor channels will stop rod withdrawal by signaling rod blocks to stop movement at the next notch. Used during manual control of startup.
Rod-Worth Minimizer: Enforces operating procedures that prevent withdrawal of rod increments with worths higher than 0.01 Δk.

F. GENERAL	Reactor: PERRY

Windspeed, Direction Recorders, and Seismographs: April 1972, a 200 ft tower was erected with instrumentation for meteorological monitoring. One seismograph will be installed on containment vessel foundation mat and a second one on the outside wall of containment about 150' above the mat.

Plant Operation Mode: Designed for load following.

Site Description: Site is on Lake Erie about 50 ft above the lake. The site slopes toward the lake with a bluff about 40 ft high at the water surface. Two small streams drain across the site to the lake. Half of the site area is wooded and the other half is farm land and nursery stock. A 16" gas line crosses the property. Also, there are right-of-ways for some county and township roads. Except for Parmly Road, these roads will be closed.

Turbine Orientation: Ejected turbine blades could not strike containment.

Emergency Plans: Will be developed prior to operation to provide pre-arrangement and organization of personnel to deal with foreseeable emergencies. Plan will cover fire, injury and illness, radiation and contamination accidents, natural disasters, and civil disturbances. As much as possible, plant will be self-sufficient, but outside agencies will be called for assistance. Some of these agencies are AEC, Coast Guard, State Highway Patrol, police departments, fire departments, local and county agencies as required, and two hospitals as needed.

Environmental Monitoring Plans: Preoperational studies will investigate physical and chemical parameters of the lake, studies on water currents, and ecological parameters relative to plankton, benthos, and fish. Air pollutants will be studied as well as surface water, bottom sediments, vegetation, soil, milk, domestic meat and wild life. Results of these studies will dictate post-operational plans.

Radwaste Treatment: Gaseous Radwaste System uses Low-Temperature Condenser Off-gas System, which catalytically recombines hydrogen and oxygen. Gases are then dried, cooled to 45 F and passed through HEPA filters and charcoal beds. Charcoal beds are maintained at 0 F to increase adsorption of gases. Liquid Radwaste System, common to both units, collects, monitors, treats, stores, and recycles or releases the wastes. Wastes are processed on a batch basis, most of which are returned to the condensate system. Processed chemical and detergent wastes are normally released through the circulating water system. Solid wastes are collected, processed and packaged for storage in shielded compartments prior to off-site shipment.

Plant Vent: Vent from roof stack.

G. SITE DATA Reactor: PERRY

Nearby Body of Water: Lake Erie
Normal Level 571' (MSL)
Max Prob Flood Level 589' (MSL)

Size of Site 1065 Acres Site Grade Elevation 620' (MSL)

Topography of Site: Relatively flat.
of Surrounding Area (5 mi rad): Rolling.

Total Permanent Population: In 2 mi radius 1190 ; 10 mi 67,900
Date of Data: 1970 In 5 mi radius 7676 ; 50 mi 2,513,540

Nearest City of 50,000 Population: Euclid, Ohio.
Dist. from site 25 Miles, Direction SW, Population 71,552

Land Use in 5 Mile Radius: 90% is agricultural (nurseries) or vacant. Ornamental horticulture produces 80% of the agricultural income. The lake shore is used for recreation.

Meteorology: Prevailing wind direction SE winter, NW in summer. Avg. speed 6.5 mph
Stability Data - Slightly stable - 60%.

Miscellaneous Items Close to the Site: The site is 7 miles NE OF Painesville and about 33 miles NE of Cleveland, O. The site is adjacent to the small village of North Perry (population 851). Penn Central R.R. is about 3 mi SSE, and US hwy 20 is about 1 mi SSE. Four schools in Perry are within 2 or 3 mi. There are parks both E and W of the site. There is one dairy farm about 4 1/2 mi E.

H. CIRCULATING WATER SYSTEM

Type of System: Once through.

Water Taken From: Lake Erie

Intake Structure: Located ~3500' offshore in 24' of water. Diam of intake will be 110'. An intake tunnel 18' in diam will be cut out about 100' below water line. Pump house (on shore) has traveling screens and pumps. Velocity of water in pump house will be 1 fps.

Water Body Temperatures: Winter minimum 32 °F Summer maximum 81 °F

River Flow NA (cfs) minimum; NA (cfs) average

Service Water Quantity 26,000 gpm/reactor

Flow Thru Condenser 549,000 (gpm)/reactor Temp. Rise 32 °F

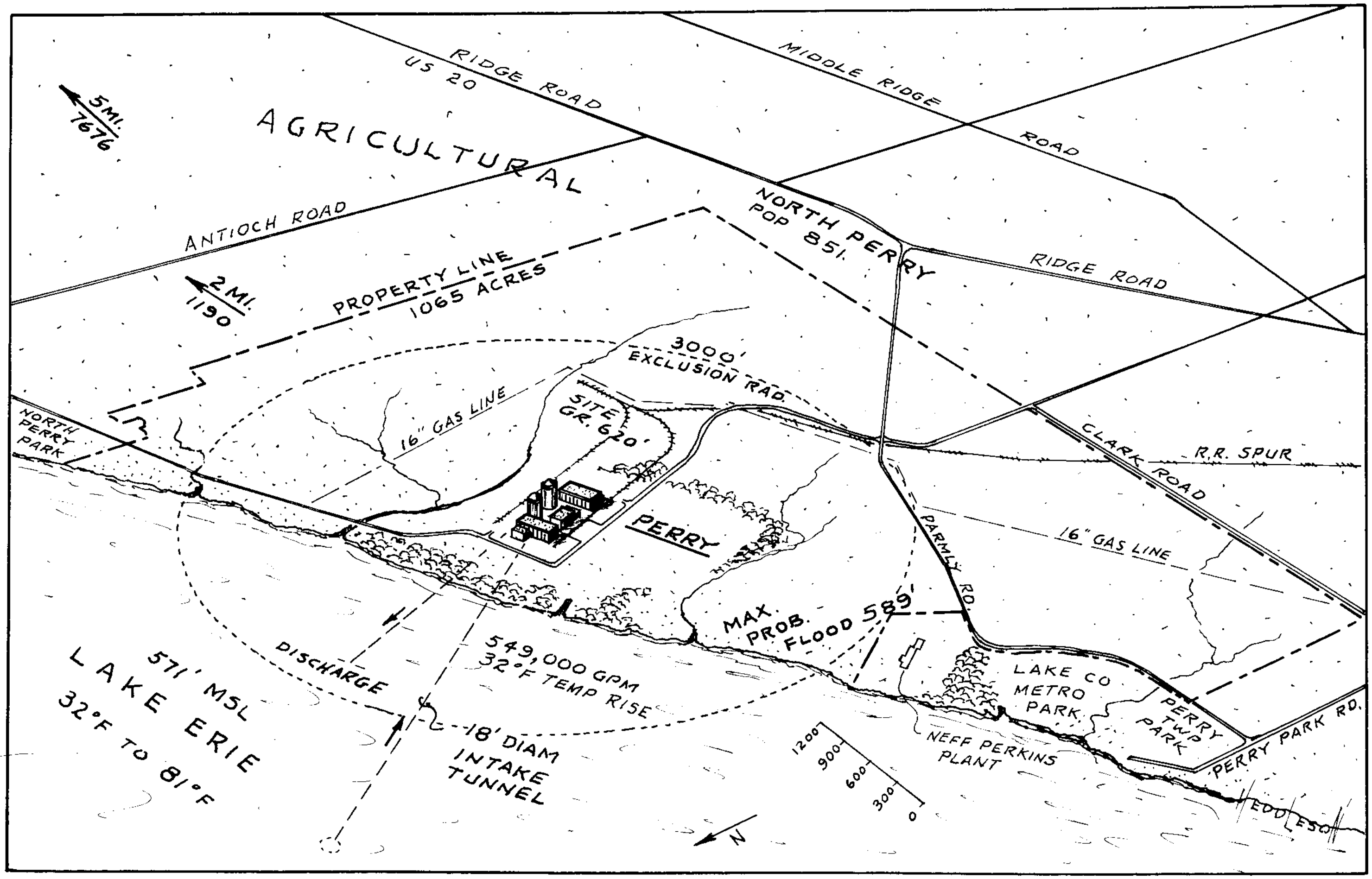
Heat Dissipated to Environment --- (Btu/hr)/reactor

Heat Removal Capacity of Condenser 8100×10^6 (Btu/hr)/reactor

Discharge Structure: An 18' diam tunnel will discharge back to the lake about 1400' from shore through a diffuser system located in 16' of water.

Cooling Tower(s): Description & Number - None

Blowdown ______ gpm/reactor Evaporative loss ______ gpm/reactor



NUCLEAR SAFETY INFORMATION CENTER

Data from PSAR & RESAR

Page 1 (PWR)

SEABROOK 50-443, 50-444

Project Name: Seabrook Station, Units 1&2

Location: Rockingham Co., N.H.

Owner: Several Utilities
11 mi S of Portsmouth, N.H.

A-E: United Engineers and Constructors
Vessel Vendor:
NSS Vendor: Westinghouse
Containment
Constructor: United Eng. & Const.

A. THERMAL-HYDRAULIC		B. NUCLEAR W RESAR 3	
Thermal Output, MWt	3411	H_2O/U, Cold	4.0
Electrical Output, MWe	1194	Avg 1st-Cycle Burnup, MWD/MTU	14,000
Total Heat Output, Safety Design, MWt	3579	First Core Avg Burnup, MWD/MTU	25,500 to 33,000
Total Heat Output, Btu/hr	$11,642\times10^6$	Maximum Burnup, MWD/MTU	50,000
System Pressure, psia	2250	Region-1 Enrichment, %	2.25
DNBR, Nominal	2.03	Region-2 Enrichment, %	2.80
Total Flowrate, lb/hr	142.2×10^6	Region-3 Enrichment, %	3.30
Eff Flowrate for Heat Trans, lb/hr	135.8×10^6	k_{eff}, Cold, No Power, Clean	1.225 to 1.60
Eff Flow Area for Heat Trans, ft^2	51.4	k_{eff}, Hot, Full Power, Xe and Sm	< 1.25
Avg Vel Along Fuel Rods, ft/sec	16.9	Total Rod Worth, %	∿ 9.74
Avg Mass Velocity, lb/hr-ft^2	2.65×10^6	Shutdown Boron, No Rods-Clean-Cold, ppm	< 1500
Nominal Core Inlet Temp, °F	557.3	Shutdown Boron, No Rods-Clean-Hot, ppm	< 1200
Avg Rise in Core, °F	62.3	Boron Worth, Hot, % Δk/k/ppm	1%/120 ppm
Nom Hot Channel Outlet Temp, °F	∿650	Boron Worth, Cold, % Δk/k/ppm	1%/60 ppm
Avg Film Coeff, Btu/hr ft^2-°F	6000	Full Power Moderator Temp Coeff, Δk/k/°F	-4.0×10^{-4}
Avg Film Temp Diff, °F	∿36.2	Moderator Pressure Coeff, Δk/k/psi	$(-0.04$ to $+3.0) \times 10^{-6}$
Active Heat Trans Surf Area, ft^2	52,200	Moderator Void Coeff, Δk/k/% Void	Negative
Avg Heat Flux, Btu/hr ft^2	217,200	Doppler Coefficient, Δk/k/°F	Negative at all power levels
Max Heat Flux, Btu/hr ft^2	521,300	Shutdown Margin, Hot 1 rod stuck, %Δk/k	1
Avg Thermal Output, kw/ft	7.05	Burnable Poisons, Type and Form	Borosilicate in sst tubes
Max Thermal Output, kw/ft	16.9	Number of Control Rods 53	1060
Max Clad Surface Temp, °F	∿660	Number of Part-Length Rods (PLR) 8	160
No. Coolant Loops	4	Compiled by: Fred Heddleson 11/73 Nuclear Safety Information Center	

W

C. SAFETY-RELATED DESIGN CRITERIA			Reactor: SEABROOK	
Exclusion Distance, Miles		0.61	Design Winds in mph:	
Low Population Zone Distance, Miles		1.50	At 0 — 50 ft elev	110
Metropolis	Distance	Population		
Lawrence, Mass.	20 mi	232,415	50 — 150 ft	135
Design Basis Earthquake Acceleration, g		0.20	150 — 400 ft	165
Operating Basis Earthquake Acceleration, g		None	Tornado 300 mph rot + 60 trans	
Earthquake Vertical Shock, % of Horizontal		66	ΔP = 3 psi/ 3sec	
Is Intent of 70 Design Criteria Satisfied?	Yes, see Section 3.1			

D. ENGINEERED SAFETY FEATURES

D1. CONTAINMENT		Design Pressure, psig	48
Max Leak Rate at Design Pressure, %/day	0.2	Calculated Max Internal Pressure, psig	43

Type of Construction:
A vertical right cylindrical concrete structure with a dome and flat base. Interior is lined with carbon steel plate for leak tightness. Dimensions are: inside diam, 140 ft; vertical wall thickness, 4 ft, 6 in.; dome thickness, 3 ft, 6 in.; and the foundation thickness, 9 ft. This structure is surrounded by a vertical right cylindrical concrete structure with a dome and flat base with inside diam 159 ft; vertical wall thickness 1 ft, 3 in., and dome thickness 1 ft, 3 in. Free vol is 2.7×10^6.

Design Basis:

Designed to withstand internal pressure and temperature resulting from LOCA. The outer structure is designed to entrap, filter, and then discharge any leakage from the containment structure. The annulus is maintained at a slightly negative pressure.

Vacuum Relief Capability:
Normal operating containment pressure is 0.5 psig.

Post-Construction Testing:
Two leakage-rates tests will be run — one at 22 psig and one at 42.9 psig. Periodic tests will be run thereafter. Structure will be pressure tested at 115% of design pressure.

Penetrations:
Found no reference on design characteristics of penetrations.

Weld Channels:
Figures 3.8-12 and 3.8-13 show channels over seam welds at base of liner to be used for leak testing.

D2. CONTAINMENT SAFETY FEATURES	Reactor: SEABROOK
Containment Spray System: Sprays water containing boron and sodium hydroxide into containment after a LOCA to cool it and remove iodine. Pumps initially take suction from refueling water storage tank and pump through spray headers in the containment dome. After a part of the water is removed from the tank, suction is transferred to the containment sump, and cooling continues by recirculating sump water.	
Containment Cooling: There are no fan-coil coolers for cooling after LOCA. All post LOCA cooling is done by containment spray. Six fan-coil units are provided (one is standby) to maintain containment temperatures within 50 F to 120 F limits during normal operation and/or shutdown.	
Containment Isolation System: Double-barrier protection is provided on all lines that penetrate containment and can be a valve, diaphram, or closed system. Several categories of isolation exist closing on different kinds of signals (Phase A and Phase B). Manual operation of containment valves is also possible.	
Containment Air Filtration: System collects, filters, and discharges containment leakage. System does not operate normally, but in event of LOCA it starts and maintains negative pressure in the annulus. HEPA and charcoal filters are used.	
Penetration Room: None found on sketches, but Table 1.3-1, sheet 6, discusses ventilation of the penetration area.	
D3. SAFETY INJECTION SYSTEMS	
Accumulator Tanks: There are 4 tanks, each containing 6360 gal. of borated water under nitrogen gas pressure of 660 psig. When system pressure drops to 660 psig or a minimum of 600, tanks' contents are discharged into each of the 4 cold legs of the reactor vessel — in time and of sufficient quantity to cover the core and prevent fuel damage.	
High-head Safety Injection: There are 2 pumps each rated 425 gpm at 1080 psig taking suction from the refueling water storage tank. These pumps can supply water lost by breaks up to 6-in. diam pipes. Initially, the high-head pumps sweep the concentrated boric acid from the boron injection tank. Also, there are 2 centrifugal charging pumps that operate in the same manner. They are rated 150 gpm at 2800 psig.	
Low-head Safety Injection: Two residual heat removal system pumps flood the core through cold legs when the pressure in the system drops to where the pumps will operate. Suction is taken from the Refueling Water Storage Tank until that supply is exhausted. Water is then recirculated from the sump. Capacity of these pumps could not be found.	

E. OTHER SAFETY-RELATED FEATURES Reactor: SEABROOK

Reactor Vessel Failure:
No reference found.

Containment Floodability:
No reference found.

Reactor-Coolant Leak-Detection System:
Variations in particulate activity, gaseous activity and specific humidity of containment atmosphere above a preset level give indication of leakage in the control room. Particulate and gaseous activity are monitored by containment air particulate and radiogas monitors. Specific humidity is monitored by condensate measuring system and dew point temperature system. Maximum permissible leakage from unidentifiable sources will be 1 gpm.

Failed-Fuel-Detection System:

No reference found.

Emergency Power:
Four diesel-generator sets each rated 4500 kW for continuous operation are arranged 2 units for each reactor. One unit can supply all engineered safety feature loads having the other unit for backup. Engines are started by independent compressed air supplies. Each unit has a skid mounted day tank with fuel for 3 hrs operation and a storage tank with 7 days' supply of fuel.

Control of Axial Xenon Oscillations By Burnable Shims, Part-Length Control Rods, In-Core Instrumentation: In-core instrumentation gives information on radial, axial, and azimuthal core characteristics giving fission power distribution. Burnable poison provides partial control of excess reactivity available during first fuel cycle.

Boron Dilution Control: In either automatic control, or in manual control, boron diluation cannot proceed so rapidly that operators do not have sufficient time for correction. There is a leeway of at least 15 minutes for correction. If no action is taken, power and temperature rise will cause the reactor to reach overtemperature at trip setpoint.

Long-Term Cooling: Residual heat removal system can circulate water through the reactor and cool it in the RHRS heat exchangers for long periods. Water from the ocean is probably available if additional water should be required.

Organic-Iodide Filter: No reference found.

Hydrogen Recombiner: Catalytic recombiners reduce hydrogen concentration in post-LOCA atmosphere. Emergency purge supplements recombiner.

F. GENERAL — Reactor: SEABROOK

Windspeed, Direction Recorders, and Seismographs:
A 30' tower was installed in March 1972 for dewpoint measurements. Wind data has been collected since Nov. 1971 at 30' above grade and 130'. Found no reference to seismographs.

Plant Operation Mode:
Designed for load following if that method of operation is required.

Site Description:
Site is adjacent to Hampton Harbor, N.H., on the south bank of the Brown River. Almost all of the land within compass readings of 0° to 180° is salt-water marshes. The resort areas along the ocean cause a high influx of summer residents and tourists to the area. Area west of the plant is mostly undeveloped with second growth scrub.

Turbine Orientation:
Ejected turbine blades could not strike containment.

Emergency Plans:
Plans and procedures will be developed in accordance with AEC guide lines. Plan purpose will be to classify emergencies according to severity, assign responsibilities, and to outline best course of action. Plan covers 3 basic activities: (1) direction of activities, (2) organization of off-site surveillance, and (3) notification of offsite authorities such as local or state agencies involved, particularly the N.H. Radiation Control Agency.

Environmental Monitoring Plans:
Preoperational monitoring started in the spring of 1973 to study physical and chemical parameters of the estuarine waters and the ocean. Also, benthic organisms will be studied. Since clams are the dominant organism in the estuary, their autecology will be monitored. Lobsters, crabs, finfish, plankton, and phytoplankton will be studied. Included in monitoring programs will be groundwater, air, and radiological parameters.

Radwaste Treatment:
Gases are compressed and stored in waste gas decay tanks for prescribed periods of time to allow radioactivity to decay prior to being released. Liquids are processed in evaporators, and can be recycled back into the plant or released if low enough in activity. Solids are solidified in drums or containers and stored onsite for decay prior to shipment offsite for burial.

Plant Vent:
A vent stack runs up the oustide of the containment structure.

G. SITE DATA — Reactor: SEABROOK

Nearby Body of Water: Hampton Harbor and Atlantic Ocean

Normal Level 0 (MSL)
Max Prob Flood Level 19.6' (MSL)

Size of Site 715 Acres — Site Grade Elevation 20' (MSL)

Topography of Site: Flat

of Surrounding Area (5 mi rad): Flat to rolling.

Total Permanent Population: In 2 mi radius 3,183 ; 10 mi 72,107

Date of Data: ______ In 5 mi radius 21,351 ; 50 mi ______

Nearest City of 50,000 Population: Lawrence, Mass.

Dist. from site 20 Miles, Direction SW, Population 68,000

Land Use in 5 Mile Radius: Easterly salt-water marshes except for residential along the ocean. NW there are some industries, and SW is undeveloped or low density residential.

Meteorology: Prevailing wind direction WNW Avg. speed ∿4mph

Stability Data - Stability Index D to E

Miscellaneous Items Close to the Site:
The nearest school is 1 1/4 mi S with 650 pupils. Another close school is 1 1/2 mi NW with 150. Amesbury Hospital is 5 1/2 mi SW. Hampton Beach Park is 2 mi E. U.S. Hwy #1 passes 1 mi W of site and I-95 is 1.6 mi W. The nearest airport is 4 1/2 mi NE. Center of Boston metropolitan area is about 40 mi SW.

H. CIRCULATING WATER SYSTEM

Type of System: Once through

Water Taken From: Atlantic Ocean

Intake Structure: In the ocean about 3000' off-shore. Structure is circular with water entering at perimeter. Flow to plant is thru an 18' diam tunnel about 240' below the ocean, into the pump house for circulation. Max entering velocity is 1.4 ft/sec.

Water Body Temperatures: Winter minimum 37 °F Summer maximum 55 °F

River Flow --- (cfs) minimum; --- (cfs) average

Service Water Quantity 18,500 gpm/reactor

Flow Thru Condenser 374,000 (gpm)/reactor Temp. Rise 44 °F

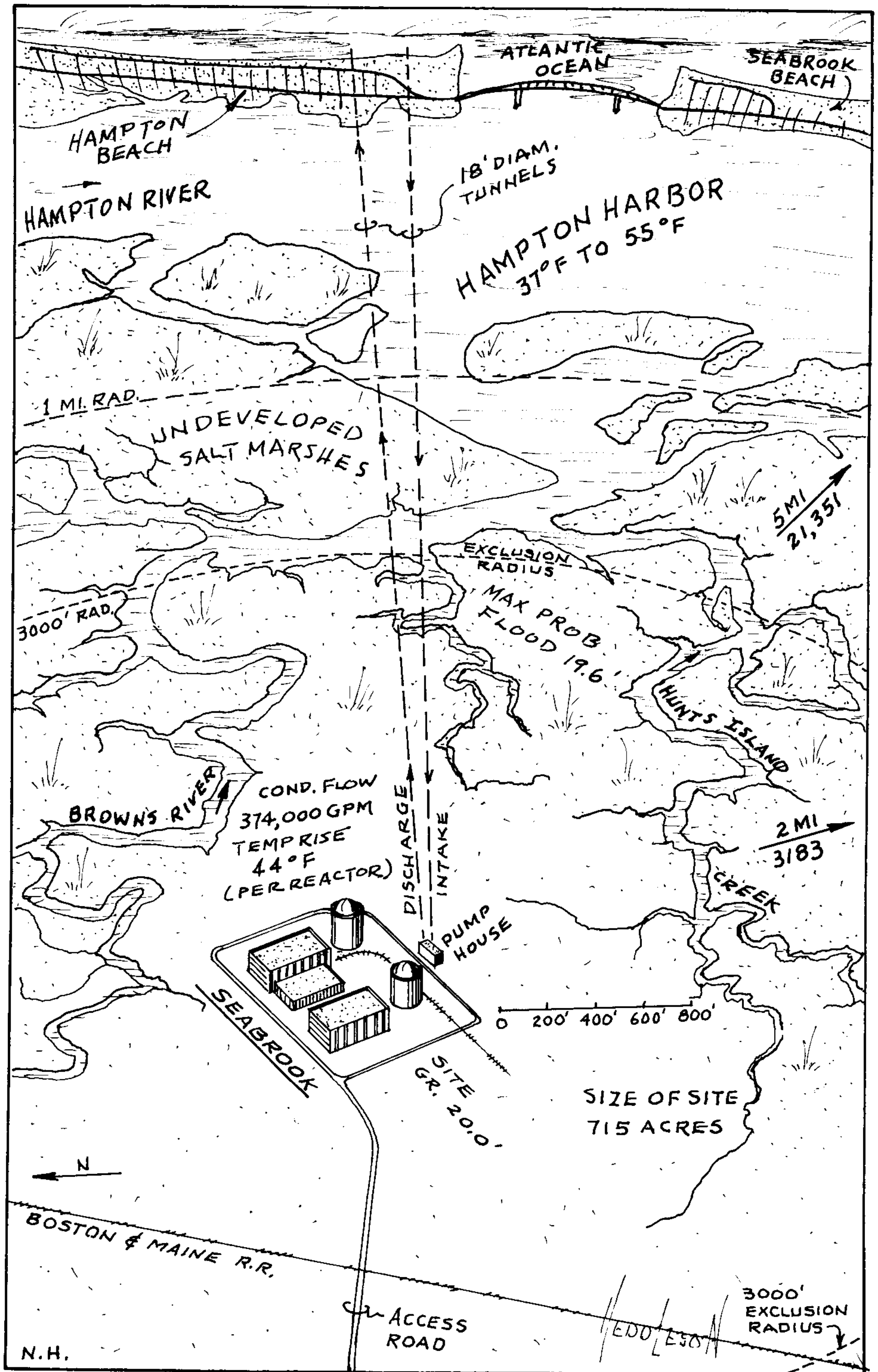
Heat Dissipated to Environment 8000×10^6 (Btu/hr)/reactor

Heat Removal Capacity of Condenser --- (Btu/hr)/reactor

Discharge Structure: Discharged to ocean thru 18' diam tunnel about 200' below the ocean. A single port discharge or a multiport diffusion system will be used. Final decision has not been made.

Cooling Tower(s): Description & Number - None

Blowdown --- gpm/reactor Evaporative loss --- gpm/reactor



NUCLEAR SAFETY INFORMATION CENTER

Data from PSAR & RESAR

COMANCHE PEAK, 50-445, 50-446

Project Name: Comanche Peak Steam Electric Station, Units 1 & 2
Location: Somerville County, 65 mi SW of Dallas/Fort Worth
Owner: Texas Utilities
A-E: Gibbs and Hill
Vessel Vendor: ---
NSS Vendor: Westinghouse
Containment Constructor: Brown and Root

A. THERMAL-HYDRAULIC		B. NUCLEAR	
Thermal Output, MWt	3411	H_2O/U, Cold	4.0
Electrical Output, MWe	1194	Avg 1st-Cycle Burnup, MWD/MTU	14,000
Total Heat Output, Safety Design, MWt	3579	First Core Avg Burnup, MWD/MTU	25,500 to 33,000
Total Heat Output, Btu/hr	$11{,}642\times10^6$	Maximum Burnup, MWD/MTU	50,000
System Pressure, psia	2250	Region-1 Enrichment, %	2.25
DNBR, Nominal	2.03	Region-2 Enrichment, %	2.80
Total Flowrate, lb/hr	142.2×10^6	Region-3 Enrichment, %	3.30
Eff Flowrate for Heat Trans, lb/hr	135.8×10^6	k_{eff}, Cold, No Power, Clean	1.225 to 1.60
Eff Flow Area for Heat Trans, ft^2	51.4	k_{eff}, Hot, Full Power, Xe and Sm	< 1.25
Avg Vel Along Fuel Rods, ft/sec	16.9	Total Rod Worth, %	∿ 9.74
Avg Mass Velocity, $lb/hr\text{-}ft^2$	2.65×10^6	Shutdown Boron, No Rods-Clean-Cold, ppm	< 1500
Nominal Core Inlet Temp, °F	557.3	Shutdown Boron, No Rods-Clean-Hot, ppm	< 1200
Avg Rise in Core, °F	62.3	Boron Worth, Hot, % Δk/k/ppm	1%/120 ppm
Nom Hot Channel Outlet Temp, °F	∿650	Boron Worth, Cold, % Δk/k/ppm	1%/60 ppm
Avg Film Coeff, Btu/hr ft^2-°F	6000	Full Power Moderator Temp Coeff, Δk/k/°F	-4.0×10^{-4}
Avg Film Temp Diff, °F	∿36.2	Moderator Pressure Coeff, Δk/k/psi	$(-0.04 \text{ to } +3.0)\times10^{-6}$
Active Heat Trans Surf Area, ft^2	52,200	Moderator Void Coeff, Δk/k/% Void	Negative
Avg Heat Flux, Btu/hr ft^2	217,200	Doppler Coefficient, Δk/k/°F	Negative at all power levels
Max Heat Flux, Btu/hr ft^2	521,300	Shutdown Margin, Hot 1 rod stuck, %Δk/k	1
Avg Thermal Output, kw/ft	7.05	Burnable Poisons, Type and Form	Borosilicate in sst tubes
Max Thermal Output, kw/ft	16.9	Number of Control Rods 53	1060
Max Clad Surface Temp, °F	∿660	Number of Part-Length Rods (PLR) 8	160
No. Coolant Loops	4	Compiled by: Fred Heddleson 11/73 Nuclear Safety Information Center	

W

C. SAFETY-RELATED DESIGN CRITERIA			Reactor: COMANCHE PEAK	
Exclusion Distance, Miles		0.88	Design Winds in mph:	
Low Population Zone Distance, Miles		4 (radius)	At 0 — 50 ft elev	80
Metropolis	Distance	Population	50 — 150 ft	95
Dallas — Fort Worth	55	2,318,000		
Safe Shutdown Earthquake (SSE) Acceleration, g		0.12	150 — 400 ft	110
1/2 SSE Earthquake Acceleration, g		0.06	Tornado 300 mph rot. + 60 Trans.	
Earthquake Vertical Shock, % of Horizontal		66	ΔP = 3 psi/ 3 sec	
Is Intent of 70 Design Criteria Satisfied?	A summary in Section 3.1 shows how design features meet the criteria.			

D. ENGINEERED SAFETY FEATURES

D1. CONTAINMENT		Design Pressure, psig	50
Max Leak Rate at Design Pressure, %/day	0.2	Calculated Max Internal Pressure, psig	44.14

Type of Construction: A steel lined (1/4" to 3/8" thk.), reinforced concrete structure with 4' 6" thk. vertical cylindrical walls, a hemispherical dome 2' 6" thk. supported on a flat foundation mat. Containment free volume is 2.5 X 10^6 cu. ft.

Design Basis: Designed to withstand the internal pressure and coincident temperature resulting from the energy release of a loss-of-coolant accident. This design accident pressure is 50 psig, and the coincident temperature is 280 F.

Vacuum Relief Capability: Found no reference.

Post-Construction Testing: Periodic leakage rate tests will be run during the life of the plant. Pressure tests will be run at 5 increments up to 1.15 design pressure. Deflections and leakage will be measured.

Penetrations: Hot pipe penetrations are double sealed; all others are single sealed.

Weld Channels: Leak chase channels will be provided at seams in the containment mat liner that are inaccessible for other means of inspection.

D2. CONTAINMENT SAFETY FEATURES Reactor: COMANCHE PEAK

Containment Spray System: Two separate spray systems are available, each with capacity for 100% cooling after LOCA. Each system has 2 pumps, each rated 2900 gpm at 275 psig, one heat exchanger (200 X 10^6 BTU/hr), a spray header and associated piping, valves, and nozzles. Pumps take suction from the refueling water storage tank. When that supply is used up, water is recirculated from the containment sump.

Containment Cooling: All cooling after LOCA is accomplished by the containment spray system which also sprays sodium hydroxide — borate solution for fission product removal. Four Fan-coil units remove generated heat from normal operation to hold temperature below 120 F. Three units have 100% capacity total. Each unit has a capacity of 2 X 10^6 BTU/hr.

Containment Isolation System: Lines connecting directly to the containment atmosphere have 2 isolation valve barriers in series where they penetrate containment, so that failure of one does not prevent isolation, thus providing greater reliability. Valve closing is automatic on the isolation signal and valves are designed to fail safe.

Containment Air Filtration: Air exhausted from containment is passed thru HEPA and charcoal filters and on to the discharge duct. A filtration inside containment cleans up the air, reducing fission product activity to a safe level for personnel access.

Penetration Room: Electrical penetration area is shown on drawings.

D3. SAFETY INJECTION SYSTEMS

Accumulator Tanks: Four tanks each with 6400 gal. of borated water and pressurized to 650 psi operating pressure with nitrogen gas are ready to dump their contents into the reactor when reactor pressure drops below 650 psig. Two check valves in series are the only operating parts. Each tank discharges into one of the reactor-coolant system cold legs.

W

High-head Safety Injection: Safety Injection System is started automatically from an abnormal condition in the pressurizer pressure or level, T avg., main steam press. or flow or the differential press., and the containment press. When the 'Injection Signal' is given, 3 sets of pumps start — 2 each of centrifugal charging pumps, safety injection pumps, and residual-heat-removal pumps. Charging pumps inject concentrated boric acid first and then borated water from the refueling water storage tank (150 gpm @ 2800 psig). Safety injection pumps deliver 400 gpm @ 1700 psig from refueling water storage tank into the 4 hot legs.

W

Low-head Safety Injection: This service is supplied by the Residual-Heat-Removal pumps, which start to deliver borated water from the refueling water storage tank when reactor pressure drops to about 170 psig. These pumps are rated 4500 gpm @ 600 psig. After an incident when the Safety Injection System is started, if all water in the refueling water storage tank is used, the residual-heat-removal pumps are then switched to the recirculation mode and water is circulated through the reactor from the containment sump.

W

E. OTHER SAFETY-RELATED FEATURES Reactor: COMANCHE PEAK

Reactor Vessel Failure:

Found no reference.

Containment Floodability:

Found no reference.

Reactor-Coolant Leak-Detection System:

Leakage is monitored and indicated in the control room by air particulate monitors, radioactive gas monitors and specific humidity monitors. Levels of airborne corrosion products, gaseous activity, and specific humidity above normal levels indicate leakage. Limit of unidentifiable leakage is 15 gpm. The air particulate monitor has a sensitivity of 1 gpm.

Failed-Fuel-Detection System:

Found no reference.

Emergency Power:

Three 100% capacity diesel-generator sets provide emergency power to both units, one generator set for each unit, and one set that can supply power to either reactor unit as backup. Diesel-generator sets are rated 4300 KW (continuous rating). Units are housed separately and have independent auxiliaries. A day tank on each diesel has fuel for 3 hours of operation. An underground storage tank has fuel capacity for 7 days.

Control of Axial Xenon Oscillations By Burnable Shims, Part-Length Control Rods, In-Core Instrumentation: In-core instrumentation gives information on radial, axial, and azimuthal core characteristics giving fission power distribution. Burnable poison provides partial control of excess reactivity available during first fuel cycle.

Boron Dilution Control:

In either automatic control, or in manual control, boron dilution cannot proceed so rapidly that operators do not have sufficient time for correction. There is a leeway of at least 15 minutes for correction. If no action is taken, power and temperature rise will cause the reactor to reach overtemperature at trip setpoint.

Long-Term Cooling:

The residual heat removal system provides long-term cooling by recirculation of coolant from the containment sump, being cooled by the RHRS heat exchangers.

Organic-Iodide Filter: Found no reference.

Hydrogen Recombiner: Two recombiners are provided for each reactor unit. A hydrogen purge system is available as backup.

F. GENERAL

Reactor: COMANCHE PEAK

Windspeed, Direction Recorders, and Seismographs:

Weather data collection was started at the site in May 1972 with a 200-ft tower. Triaxial strong motion accelerometers will be installed on containment and auxiliary building structures.

Plant Operation Mode:

Load following capabilities provided.

Site Description:

Situated along Squaw Creek adjacent to the proposed Squaw Creek Reservoir which is proposed for station cooling. The site is at the base of a peninsula which will project out into the reservoir about 3500 ft. Cooling water intake is on south side of the peninsula and discharge on the north. The area around the plant is rural with a small number of inhabitants.

Turbine Orientation: Ejected turbine blades could strike containment. Centerlines are about 225 ft apart.

Emergency Plans:

A preliminary plan has been prepared and the final plan will be presented in the FSAR. The plan is concerned with 4 main activities — (1) Identification and evaluation of the magnitude of the accident; (2) direction of activities to limit consequences of accident; (3) organization and control of offsite regulations effected by accidental release; and (4) protective measures to safeguard the public.

Environmental Monitoring Plans:

To measure whole-body dose from gaseous effluent and on-site sources, to measure I-131 in air; and to measure radionuclides (especially I-131) in milk. Radionuclides will also be measured in airborne particulate, surface water, well water, forage, beef, fish, sediment, benthic fauna, and aquatic plants. Frequency of measurements and location of measurements have been determined to maximize the data relating to the dose to humans.

Radwaste Treatment:

Facilities are designed so discharge of effluents and off-site shipments are in accordance with AEC regulations. Radioactive gases are pumped by compressors to a gas decay tank where they are held for decay. Cover gases of nitrogen for blanketing are reused to minimize gaseous wastes. During normal operation, gases are discharged at a controlled rate through the monitored plant vent. Liquid wastes are processed to remove most radioactive materials. Solid wastes will be either from filtering and demineralizer operation, or from low-radiation level paper, clothing, rags, towers, etc. Solids will be packed into 55-gal. drums and shipped offsite for disposal.

Plant Vent: Stack runs up the side of each containment structure.

G. SITE DATA — Reactor: COMANCHE PEAK

Nearby Body of Water: Squaw Creek Reservoir (proposed)
Normal Level 773' (MSL)
Max Prob Flood Level 790' (MSL)

Size of Site ~5000 Acres — Site Grade Elevation 810' (MSL)

Topography of Site: Flat with hills rising from the reservoir.
of Surrounding Area (5 mi rad): Rolling to hilly.

Total Permanent Population: In 2 mi radius 41 ; 10 mi 6554
Date of Data: 1970 — In 5 mi radius 1983 ; 50 mi ____

Nearest City of 50,000 Population: Fort Worth, Texas
Dist. from site 40 Miles, Direction NE , Population 360,000

Land Use in 5 Mile Radius:
Agricultural, rural farm/ranch land, most of which is range land.

Meteorology: Prevailing wind direction SSE Avg. speed 11 mph
Stability Data - Pasquill D 55% of time

Miscellaneous Items Close to the Site: The nearest community is Glen Rose which is SSE about 4 1/2 miles. U.S. highway 377 is about 9 mi NW and U.S. highway 67 is about 4 mi SW. State highway 144 is about 2 3/4 mi E. A 26-in. oil pipe line runs very near the site and a 36-in. natural gas line runs within 2 1/2 mi of the site. The nearest school is 5 1/2 mi SSE.

H. CIRCULATING WATER SYSTEM

Type of System: Once through

Water Taken From: Squaw Creek Reservoir (143,200 acre-feet) (~3135 acres)

Intake Structure:
Located south of the plant on Squaw Creek Reservoir consisting of trash racks, traveling screens and pumps. Entering velocity is 0.8 fps. Approach velocity to screens is 1 fps.

Water Body Temperatures: Winter minimum --- °F Summer maximum --- °F

River Flow --- (cfs) minimum; --- (cfs) average

Service Water Quantity 11,500 gpm/reactor

Flow Thru Condenser 1,100,000 (gpm)/reactor Temp. Rise 15 °F

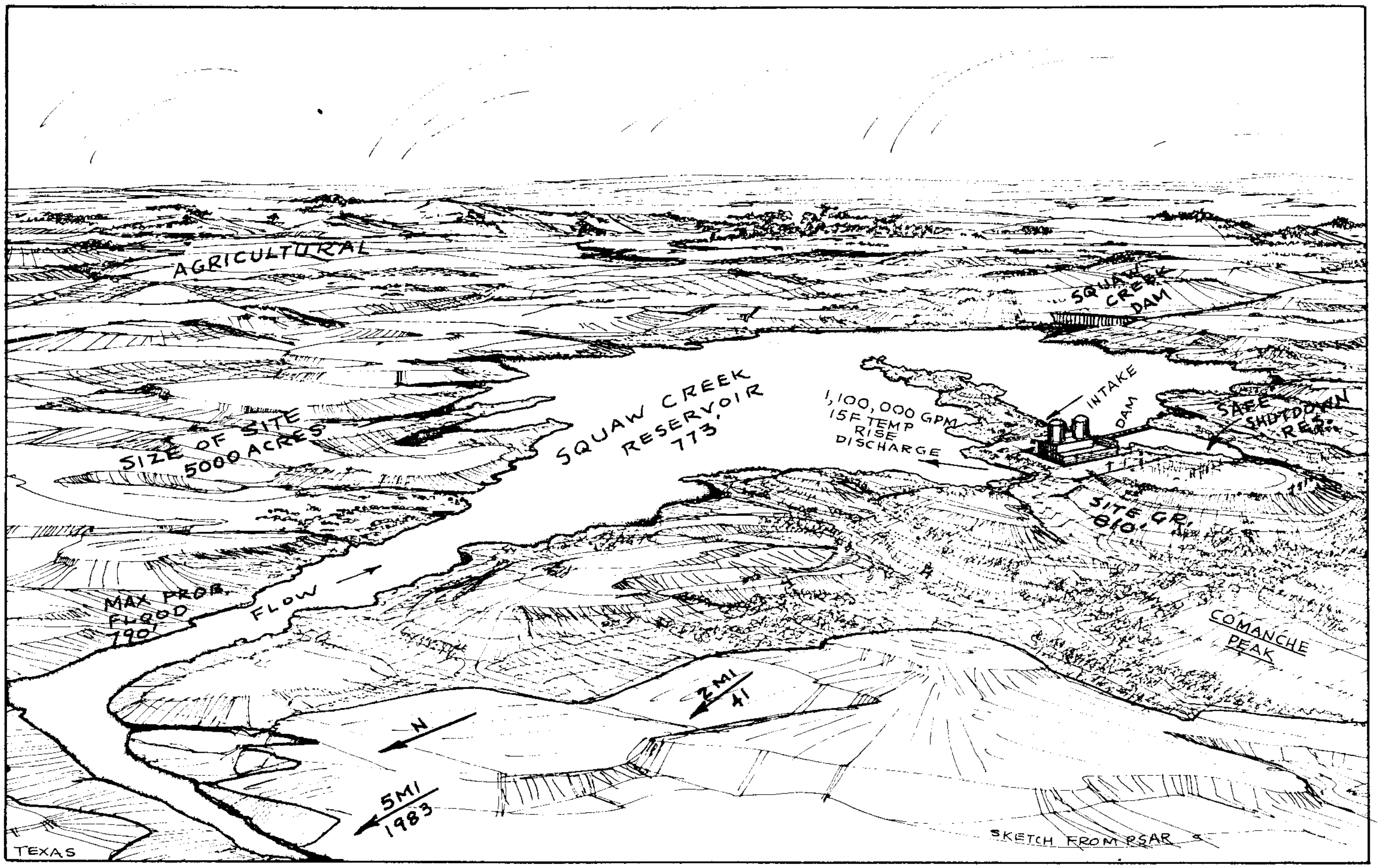
Heat Dissipated to Environment --- (Btu/hr)/reactor

Heat Removal Capacity of Condenser --- (Btu/hr)/reactor

Discharge Structure: Discharged water flows through a canal to the reservoir where it widens out to spread the discharge in a wide, thin layer on the surface.

Cooling Tower(s): Description & Number - None

Blowdown --- gpm/reactor Evaporative loss --- gpm/reactor



NUCLEAR SAFETY INFORMATION CENTER

Data from PSAR

DOUGLAS POINT, 50-448, 50-449

Project Name: Douglas Point Nuclear Generating Station, 1 & 2
Location: Charles Co., Md.*
Owner: Potomic Electric Power
* 30 mi SSW of Wash., D.C.

A-E: Ebasco Services, Inc.
Vessel Vendor:
NSS Vendor: General Electric
Containment Constructor: Ebasco Services

A. THERMAL-HYDRAULIC		B. NUCLEAR	
Thermal Output, MWt	3579	H_2O/UO_2 Volume Ratio	---
Electrical Output, MWe	1100	Moderator Temp Coef Cold, Δk/k/°F	---
Total Heat Output, Safety Design, MWt	3758	Moderator Temp Coef Hot, No Voids	---
Steam Flow Rate, lb/hr	15.4×10^6	Moderator Void Coef Hot, No Voids, Δk/k/%	-5.5×10^{-4}
Total Core Flow Rate, lb/hr	105×10^6	Moderator Void Coef Operating	-8×10^{-4}
Coolant Pressure, psig	1040	Doppler Coefficient, Cold	-1.7×10^{-5}
Heat Transfer Area, ft^2	73,409	Doppler Coefficient, Hot, No Voids	-1.05×10^{-5}
Max Power per Fuel Rod Unit Lgth, kw/ft	13.40	Doppler Coefficient, Operating	-1.2×10^{-5}
Maximum Heat Flux, Btu/hr-ft^2	354,000	Initial Enrichment, %	2.07
Average Heat Flux, Btu/hr-ft^2	159,570	Average Discharge Exposure, MWD/Ton	13,000
Maximum Fuel Temperature, °F	3325	Core Maximum Void Within Assembly, %	76
Average Fuel Rod Surface Temp, °F	∿ 560	k_{eff}, All Rods In	---
MCHFR	≥ 1.9	k_{eff}, Max Rod Out	---
Total Peaking Factor	2.22	Control Rod Worth,	0.01 Δk
Avg Power Density, Kw/ℓ	56	Curtain Worth, %	
Peak Fuel Enthalpy on Rod Drop, Cal/gm	280	Burnable Poisons, Type and Form	Gd_2O_3 mixed w/ UO_2 in fuel rods
BWR-6		Number of Control Rods	177
		Number of Part-Length Rods (PLR)	None

Compiled by: Fred Heddleson - Dec. 1973
ORNL, Nuclear Safety Information Center

C. SAFETY-RELATED DESIGN CRITERIA			Reactor: DOUGLAS POINT	
Exclusion Distance, Miles		0.57 radius	Design Winds in mph:	
Low Population Zone Distance, Miles		3.0	At 0 — 50 ft elev	85
Metropolis	Distance	Population	50 — 150 ft	110
Washington, D.C.	35 mi.	756,510	150 — 400 ft	140
Safe Shutdown Earthquake Acceleration, g		0.07	Tornado - 300 mph tang. + 60 trans.	
Operating Basis Earthquake Acceleration, g		---	ΔP = 3 psi/ 3 sec	
Earthquake Vertical Shock, % of Horizontal		67	Is Intent of 55 Design Criteria Satisfied?	Yes

Recirculation Pumping System & MCHFR: The recirculation flow control system controls a variable-position flow control valve. The system automatically adjusts the reactor power output to the load demand.

Protective System: Designed to monitor reactor parameters, sense abnormalities, and to scram the reactor to prevent fuel damage when trip points are exceeded. There is no case where scram trip set points al-~~low the core to exceed thermal hydraulic safety limits.~~

D. ENGINEERED SAFETY FEATURES

D1. CONTAINMENT

Drywell Design Pressure, psig	25	Primary Containment Leak Rate, %/day	0.5
Suppression Chamber Design Pressure, psig	NA	Second Containment Design Pressure, psig	15
Calculated Max Internal Pressure, psig	38	Second Containment Leak Rate, %/day	---

Type of Construction: Containment structure, designated Mark III, will consist of a reinforced concrete drywell and a steel containment vessel surrounded by a protective reinforced concrete Shield Building. Containment design incorporates the drywell/pressure suppression feature of previous BWR containment designs into a dry containment type structure. The pressure suppression pool will contain adequate water to act as heat sink for normal and accident conditions. Free air volume is 1.2×10^6 ft^3.

Design Basis: Designed to condense steam and contain fission product releases from design-basis-accident (doubled-ended rupture of largest line). Leak-tight containment vessel prevents release of fission products and the concrete shield bldg. provides shielding from radiation. Associated Engineered Safety Features are designed to function in the containment structure to safely sustain all environmental conditions.

Vacuum Relief Capability: There will be 2 independent vacuum relief lines each having a check valve and an automatic air operated butterfly valve.

Post-Construction Testing: Initial leak-rate testing will be done at design pressure per Appendix J of 10 CFR 50. Periodic leak-rate tests will be run thereafter.

Penetrations: All penetrations except cold lines will be double sealed with pressure taps for individual testing.

D2. EMERGENCY CORE COOLING SYSTEMS	Reactor: DOUGLAS POINT

Core Spray Cooling System: There are 2 core spray systems — the high press. core spray system and the low press. core spray system, the first of which is described below under HPCI. The low pressure core spray system consists of a pump (6000 gpm at 122 psid), a spray sparger in the reactor vessel above the core, piping, valves, and controls. This system starts automatically on low water level in the reactor, or high drywell pressure — with low water level in the reactor.

Auto-Depressurization System: If the high pressure core spray system cannot maintain reactor water level, the ADS vents steam through the pressure relief valves to lower the pressure so that flow from the low pressure core spray and low pressure coolant injection systems can flood the core in time to prevent fuel damage.

Residual-Heat-Removal System (RHRS): Designed for 4 modes of operation: (1) shut down cooling; (2) suppression pool cooling; (3) steam condensing; and (4) low pressure coolant injection. System consists of 2 loops each with 2 heat exchangers, 1 main pump, and associated valves, piping, and controls. Pumps are sized for the LPCI requirements, 7100 gpm each at 20 psid, and heat exchangers are sized for containment cooling function. There is a third standby loop housed in the Fuel Handling Building providing additional protection from one event destroying all capabilities.

High-Pressure Core Spray System: This system has one pump rated 1650 gpm at 1100 psid with necessary piping, valves and controls. This system operates to provide core flooding for large or small leaks or breaks. It continues to operate after other low pressure injection system begins operation. Pump suction is from the condensate storage tank or the suppression pool. Two semicircular sparger rings with nozzles spray water radially over the core and into the fuel assemblies.

Low-Pressure Coolant-Injection System: This system is part of the Residual Heat Removal system and has 3 pumps each rated 7100 gpm at 20 psid which start automatically at same time LPCS system starts. The purpose is to flood the core when reactor pressure drops to a low value along with low water level in the reactor. Pump suction is the suppression pool, providing the means for long-term recirculation.

E. OTHER SAFETY-RELATED FEATURES

Main-Steam-Line Flow Restrictors: In the case of a line break, this venturi device limits flow from the reactor vessel to a value of 200% rated line flow.

Control-Rod Velocity Limiters: Limits velocity at which a rod can fall out. Designed so that velocity is limited in one direction only. Scram velocity not effected.

Control-Rod-Drive-Housing Supports: Beams installed under the housings prevent the housing and rod from dropping more than about 2-in. in case of housing failure. Thus, rod travel would be limited to a safe value.

Standby Liquid-Control System: A manual system for injecting a boron neutron absorber solution into the reactor to either shut it down or keep it shut down in case the control rods will not do it.

E. OTHER SAFETY-RELATED FEATURES (cont'd) Reactor: DOUGLAS POINT
Standby Coolant System: Long-term cooling can be accomplished with the residual heat removal system by recirculation of borated water from the containment sump if necessary. River water can be made available for makeup if needed.
Containment Atmospheric Control System: The Standby Gas Treatment System will reduce concentration and quantity of fission products following LOCA by holding a subatmospheric pressure within the shield building to ensure that any leakage of activity passes through the charcoal filters. There is also a system to recombine hydrogen and also a hydrogen purge system.
Reactor Core Isolation Cooling System (RCICS): Provides makeup water to the reactor vessel when vessel is isolated. The RCICS uses a steam-driven turbine pump and operates automatically in time and with sufficient coolant flow to maintain adequate water level in the reactor vessel. Pump is rated 700 gpm at 1120 psid.
Reactor Vessel Failure: No reference found.
Containment Floodability: Drywell can be flooded with water from the suppression pool.
Reactor-Coolant Leak-Detection System: Leaks are detected by monitoring for abnormally high pressure and temperature in the drywell, high fill-up rates of equipment and floor drain sumps, excessive temperature difference between inlet and outlet cooling water for drywell coolers, increased flow rate of cooler condensate, a decrease in reactor vessel water level, and high levels of fission products. Total leakage rate limit is set at 25 gpm.
Failed-Fuel Detection Systems: Consists of four gamma radiation monitors located externally to the main steam lines just outside containment. Monitors are designed to detect a gross release of fission products from the fuel. On detection of high radiation, trip signals generated by monitors initiate a reactor scram and close main steam line isolation valves.
Emergency Power: There will be 3 diesel-generator sets for each reactor. Loads will be split into 3 divisions. Two divisions will have 5000 kW continuously rated sets and one division will have a 2600 kW continuously rated diesel-generator set. Each diesel will have independent starting system and auxiliaries. Each diesel will have a day tank and oil storage tank. Fuel will be pumped from the storage tank to the day tank. The 2 tanks will have enough fuel to run diesel at full power for 7 days.
Rod-Block Monitor: Prevents fuel damage due to a single rod withdrawal error. This system receives input from LPRM channels and initiates a signal to stop control rod withdrawal.
Rod-Worth Minimizer: A part of the computer system that enforces control-rod procedures for startup, shutdown, and low power level operation. It prevents operator from setting up control rod patterns not consistent with prestored sequences.

F. GENERAL Reactor: DOUGLAS POINT

Windspeed, Direction Recorders, and Seismographs: Meteorological measurements started in May 1972 using a 340-ft tall tower. Data is recorded continuously on strip charts. Found no reference to seismographs.

Plant Operation Mode: Load following, if required, using recirculation flow control.

Site Description: Located on the E. bank of the Potomac. The shoreline there is a natural earth cliff about 20-ft high. The area is generally marshy and swampy. About midway between the river and St. Rt. 224 a bluff rises up to elevation about 80-ft MSL providing a low plateau along the river and a higher plateau beyond. The area is wooded with very few inhabitants within 2 miles. The river here is about 3 miles wide and 12-ft deep. Water is partly saline.

Turbine Orientation: It is unlikely that ejected turbine blades could strike containment. Turbine to be supplied by Westinghouse.

Emergency Plans: Plans will be developed before operation. A proposed organization will be designed to deal with foreseeable emergencies arising from accidents, illnesses, or natural causes. For a radiological release incident, the plan will be to control and mitigate the consequences. Arrangements will be made with outside agencies for assistance in dealing with emergencies, such as police, coast guard, health departments, civil defense, AEC, fire and rescue groups, and medical groups including hospitals.

Environmental Monitoring Plans: Efforts are being made to monitor land areas and the river to learn of the characteristics of each. Soil erosion is one such study. The swamp land on the utility property provides an ecological study area. Water samples will be taken regularly as well as phytoplankton, zooplankton, benthos, fish, ichthyoplankton, air samples, and other contributing samples. Measurement of radioactivity around the site has started to establish a pre-operation base for later measurement.

Radwaste Treatment: Liquid radwastes are classified, contained, and treated as high or low conductivity, chemical, detergent, sludges or concentrated wastes. Processing includes filtration, ion exchange, analysis, and dilution. Liquid wastes are also decanted and sludge accumulated for disposal as solid radwaste. Wet solid wastes are packaged in shielded steel drums. Dry solid radwastes are packaged in shielded steel or fiber drums, cartons, or boxes. Solid wastes are shipped offsite for disposal. Gaseous radwastes are monitored, processed, recorded, and vented to the atmosphere so radiation doses are below those allowed by applicable regulations. Liquid wastes are discharged to the circulating water tunnel.

Plant Vent: 149 ft above auxiliary building, 24 ft below containment dome.

G. SITE DATA

Reactor: DOUGLAS POINT

Nearby Body of Water: Potomac River

Normal Level 0.5' (MSL)
Max Prob Flood Level 26.6' (MSL)

Size of Site 1440 Acres   Site Grade Elevation 57.5' (MSL)

Topography of Site: Flat with a rising bluff at center of site.
of Surrounding Area (5 mi rad): Rolling

Total Permanent Population: In 2 mi radius 159 ; 10 mi 21,832
Date of Data: 1970   In 5 mi radius 2244 ; 50 mi ____

Nearest City of 50,000 Population: Alexandria, Virginia
Dist. from site 25 Miles, Direction NNE, Population 110,938

Land Use in 5 Mile Radius: Potomac River, with land area undeveloped, rugged, and wooded.

Meteorology: Prevailing wind direction SSW NNW   Avg. speed ∿6
Stability Data - High air pollution potential

Miscellaneous Items Close to the Site: The nearest community is Nanjemoy (3 mi E) where there is the closest school with 215 elementary students. The nearest dairy cow is near this town. Aqua Po Beach (a county park) is 4 mi SW. Quantico Marine Station is 5 1/2 mi NNW. The nearest hospital is on this base. State Highway 224 passes through the site, and State Highway 6 runs generally N-S about 3 mi E.

H. CIRCULATING WATER SYSTEM

Type of System: Closed cycle with cooling tower.

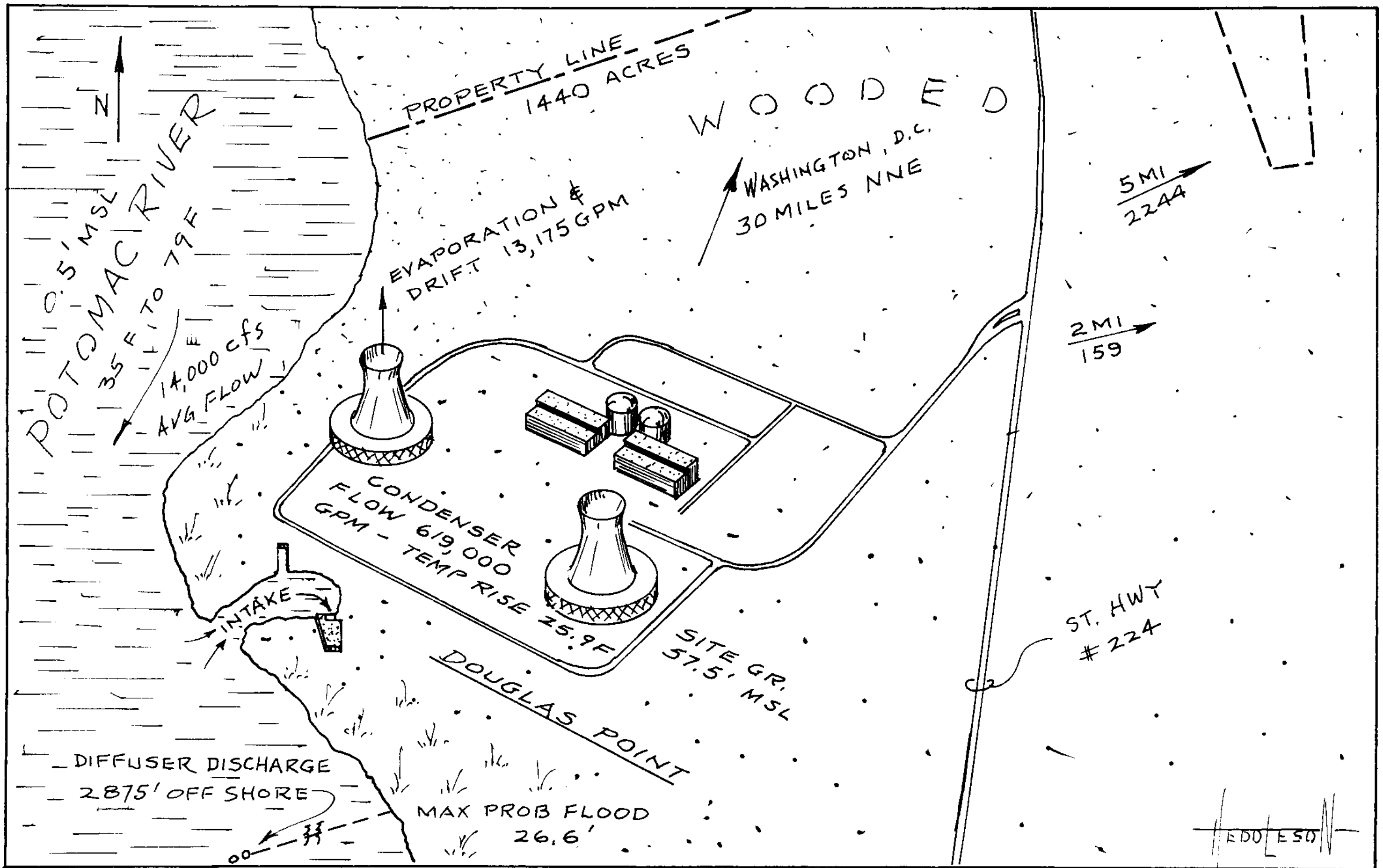
Water Taken From: Potomac for makeup.

Intake Structure: An area will be dredged back 600' from the river shore line to form a small inlet for the intake. A concrete structure will house trash racks, traveling screens, and pumps. Approach velocity to traveling screens will be 0.3 fps.

Water Body Temperatures: Winter minimum 35 °F   Summer maximum 79 °F
River Flow 800* (cfs) minimum; 14,000* (cfs) average
Service Water Quantity 54,000 gpm/reactor   *Estimated
Flow Thru Condenser 619,000 (gpm)/reactor   Temp. Rise 25.9 °F
Heat Dissipated to Environment 8000×10^6 (Btu/hr)/reactor
Heat Removal Capacity of Condenser 8000×10^6 (Btu/hr)/reactor

Discharge Structure: An 8-ft diam conduct will discharge into the river 2700 ft from shore. The difusser will be 275 ft long with 184 discharge ports 4 1/2 in. in diameter.

Cooling Tower(s): Description & Number - Two hyperbolic towers, one for each unit.
Blowdown 6600 gpm/reactor   Evaporative loss 13,175 + drift gpm/reactor



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