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(Vol. VI of ORNL/NSIC-55)

**Design Data and Safety Features of
COMMERCIAL NUCLEAR POWER PLANTS
Including
Cumulative Index for Volumes I through VI**

Fred A. Heddleson

Prepared for the U.S. Nuclear Regulatory Commission
Office of Nuclear Regulatory Research
Under Interagency Agreement ERDA 40-55175 and 40-55275

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**DESIGN DATA AND SAFETY FEATURES OF
COMMERCIAL NUCLEAR POWER PLANTS
INCLUDING
CUMULATIVE INDEX FOR VOLUMES I THROUGH VI**

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Engineering Technology Division**

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FOREWORD

The Nuclear Safety Information Center (NSIC), which was established in March 1963 at Oak Ridge National Laboratory, is principally supported by the U.S. Nuclear Regulatory Commission's Office of Nuclear Regulatory Research. Support is also provided by the Division of Reactor Development and Demonstration of the U.S. Energy Research and Development Administration. NSIC is a focal point for the collection, storage, evaluation, and dissemination of safety information to aid those concerned with the analysis, design, and operation of nuclear facilities. A system of key words is used to index the information cataloged by the Center. The title, author, installation, abstract, and key words for each document reviewed are recorded at the central computing facility in Oak Ridge. The references are cataloged according to the following categories:

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DESIGN DATA AND SAFETY FEATURES OF COMMERCIAL NUCLEAR POWER PLANTS

Vol. VI

ABSTRACT

Design data, safety features, and site characteristics are summarized for 12 nuclear power units in 6 power stations in the United States. Six pages of data are presented for each station, consisting of thermal-hydraulic and nuclear factors, containment features, emergency-core-cooling systems, site features, circulating water system data, and miscellaneous factors. In addition, an aerial perspective is presented for each plant. This volume covers plants with docket numbers 50-553 through 50-569 and two earlier plants not previously reported - Hope Creek (50-354, 50-355) and WPPSS 1 and 4 (50-460, 50-513). Indexes for this volume and the five earlier volumes are presented in three forms - by docket number, by plant name, and by participating utility.

INTRODUCTION

The data summaries for this report were taken from the Preliminary Safety Analysis Reports (PSARs) and the Environmental Reports generated for the U.S. Nuclear Regulatory Commission (USNRC) licensing authorities by applicants wishing to build and operate nuclear power plants. The PSAR and the Environmental Report sometimes contain as many as 9000 pages of information, presented in 22 volumes, which describe the reactor, reactor site, power generation system, auxiliaries, and other aspects of importance in the safety assessment of reactor design, fabrication, 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. Nuclear Regulatory Commission has issued a guide for organization of material which is generally followed for PSARs and Final Safety Analysis Reports (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 System
- 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 (NSIC) compile design data on light-water power reactors in a concise tabular format for their use. Since that time, reports have been prepared for each power reactor and made available on a limited-distribution basis to the ACRS, several ERDA and NRC Headquarters offices, and the NSIC staff. The data summaries, which contain over 200 of the more important nuclear power plant facts, have proved 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 issued in report form in order to make this information more widely available.

Volume II, published in January 1972, covered commercial nuclear power plants with docket numbers 50-296 (Browns Ferry No. 3) through 50-395 (Virgil Summer). Volume I, published in December 1973, covered power plants up to and including docket 50-295 (Zion Station). Volume III covered plants with docket numbers 50-397 through 50-449. Volume IV covered plants from Greenwood (50-452, 50-453) to Koshkonong (50-502,

50-503). Volume V covered plants from WPPSS 3 & 5 (50-508, 50-509) to Greene Valley (50-549) and included reports on high-temperature gas-cooled reactors [Peach Bottom No. 1 (50-171), Fort St. Vrain (50-267), Summit (50-450, 50-451), Fulton (50-463, 50-464)] and a report on the Clinch River Breeder Reactor (50-537). This volume (VI) covers plants from Phipps Bend (50-553, 50-554) to New England Power (NEP) (50-568, 50-569) plus two other stations - Hope Creek (50-354, 50-355) and WPPSS 1 & 4 (50-460, 50-513). In the index by sequential docket number, some numbers are missing; these docket numbers are for experimental and export reactors and/or reactors for which the application was withdrawn.

ORGANIZATION OF INFORMATION

Reactor summaries appear sequentially according to docket number. The format for the summaries is as follows:

- A. General - Plant name, location, utility, designers and builders.
- B. Site Data - Site description giving pertinent facts, plus nearby body of water, topography, population, land use, and meteorological facts.
- C. Containment and Structures - Design values, type of containment structure, heat removal systems, and safety features.
- D. Reactor Coolant - Pressure vessel data, leak detection system, etc.
- E. Thermal-Hydraulic and Nuclear - Tabulations of data values.
- F. Emergency-Core-Cooling Systems - Descriptions of the different types of injection systems, giving capacities and numbers of pumps, etc.
- G. Miscellaneous - Descriptions of residual heat removal system, rad-waste system, plant vent, emergency power, emergency plans, and environmental monitoring.
- H. Circulating Water System - Descriptions of intake, discharge, cooling towers, water body data, and flow quantities.

Facing the first page of data for each summary is an aerial perspective sketch of the plant.

All parameters are related to rated power output for a single reactor unit unless otherwise noted. For instance, where the reactor report covers two or three reactors of the same rating at one site, all

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data values given will be for one unit. The aerial perspective sketch presents a graphic description of the reactor and site features. The terms and features used in the sketch are explained in Fig. 1. In some cases, the sizes of the reactor building and turbine building in the sketch have been increased over true size to better show their relationship to the site.

ACCURACY OF DATA

All information presented in this publication was taken from the PSARs, the applicant's Environmental Report, or the 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 the plant, the author cannot guarantee the accuracy of all the information contained herein. However, if readers are aware of information which is not correct, NSIC would like to be informed.

Fig. 1. Explanation of terms for site sketch

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 consultant 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 $Q/A \Delta t_{lm} \equiv h$, where Q is the heat removed per unit time from fuel surface area A and Δt_{lm} 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 cladding 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 dry well 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 of a housing rupture.

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. Nuclear Regulatory 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 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.

DNER, 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. Flow Rate 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, etc.

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

Evaporative Loss — The loss of water from the cooling tower through evaporation 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 and which 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) — P_1 -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 of the circle 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 = 2005 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/g, and fuel rod rupture will occur about 400 cal/g. Thus the 280 cal/g, 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 - The number of atoms of ^{235}U per 100 atoms of a uranium mixture of ^{235}U and ^{238}U . This quantity may also mean the number of 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 an accident. In a BWR, the system includes the dry well, 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 leak-tight 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 for pumping makeup water into the reactor vessel during shutdown and in case of loss of flow from the feedwater system.

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.

Rod-Block Monitor — This subsystem prevents control rod withdrawal errors to protect against fuel damage. Two RBM monitoring channels are provided. Output signals from selected groups of low-power-range monitoring

(LP24) subsystem amplifiers are averaged to control rod movement. A computer system performs the averaging function.

Secondary Containment - Reactor building which is designed 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 - 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 in the event of a 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 - $100 \times$ 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 concern is in the possibility of ejected turbine blades striking or penetrating the 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 cooling 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.

HOPE CREEK, UNITS 1 & 2
Dockets 50-354, 50-355

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*Formerly NEMBOLD ISLAND
moved to a new site.

*HOPE CREEK, 50-354, 50-355

Page 1, BWR

A. GENERAL	
PROJECT NAME: Hope Creek Generating Station, Units 1 & 2	
LOCATION: S.W. New Jersey, Salem County	
OWNER: Public Service Elect. & Gas (90%) & Atlantic City Elect. (10%)	
OWNER'S ADDRESS & CONTACT: Frederick W. Schneider, Mgr. of Engg. 80 Park Place Newark, N.J. 07101	
ARCHITECT/ENGINEER: Bechtel	
REACTOR MANUFACTURER: G.E.	
CONTAINMENT CONSTRUCTOR: ---	
TURBINE MANUFACTURER: G.E.	DATE: May 1976
ESTIMATED STARTUP DATE: 1981	COMPILED BY: Fred Heddleson
NUCLEAR SAFETY INFORMATION CENTER	
B. SITE DATA	
<p><u>Site Description:</u> Former site was Newbold Island, but was moved because of site problems there. Location now is on about 300 acres of the applicant's 700-acre Salem site on Artificial Island which projects from the eastern shore of New Jersey about 1/3 rd of the width of the Delaware River. Wilmington and Dover, Delaware, are 20 miles away being 20 miles north and south respectively. There are no major highways within 7 mi of the site, and the access road built by the applicant is 3 mi long to the nearest road. The nearest residence is 3 mi away on the Jersey shore. The Mad Horse Wildlife Management area is 3 mi SW. Nearest school is 6.5 mi W. There are about 15 milk cows within 5 mi of the site, the closest being 8 cows, 3.8 mi W. Salem (pop 7,648) is the nearest town of some size-8 miles NNE.</p>	
<u>Nearby Body of Water:</u>	Normal Level <u>0</u> (MSL)
Delaware River	Max Prob Flood Level <u>~20'</u> (MSL)
Size of Site <u>700*</u> Acres	Site Grade Elevation <u>10.5'</u> (MSL)
<u>Topography of Site:</u> Flat	*300 for Hope Creek
<u>of Surrounding Area (5 mi rad):</u> Flat	
Total Permanent Population: In 2 mi radius <u>0</u> ; 10 mi <u>52,910</u>	
Date of Data: <u>1980 est.</u> In 5 mi radius <u>4,689</u> ; 50 mi <u>5,366,006</u>	
<u>Nearest City of 50,000 Population:</u> Wilmington, Del.	
Dist. from Site <u>19</u> Miles, Direction <u>N</u> , Population <u>80,386</u>	
<u>Land Use in 5-Mile Radius:</u> Undeveloped - Marsh lands and meadows, and agricultural.	
<u>Meteorology:</u> Prevailing wind direction <u>Varies</u> Avg. speed <u>13.5 mph</u>	
Stability Data - Neutral 70% of time.	
Meteorological Measurements - Measurements had been taken for 4 years at the Salem plant before location of a 300 ft tower (early '74) for Hope Creek.	

B. SITE DATA (Continued)			REACTOR: HOPE CREEK	
Exclusion Distance, Miles	0.5		<u>Design Winds in mph:</u>	
Low Population Zone Distance, Miles	radius		At 0 - 50 ft elev	108
<u>Metropolis</u>	<u>Distance</u>	<u>Population</u>	50 - 150 ft	131
Wilmington, Del.	19 mi	499,493	150 - 400 ft	160
Safe Shutdown Earthquake Acceleration, g	0.20		Tornado 360 mph trans + rot.	
Operating Basis Earthquake Acceleration, g	0.10		$\Delta P = \underline{3} \text{ psi} / \underline{3} \text{ sec}$	
Earthquake Vertical Shock, % of Horizontal	66 2/3			
C. CONTAINMENT AND STRUCTURES				
Drywell Design Pressure, psig	56		Primary Containment Leak Rate, %/day	0.5
Suppression Chamber Design Pressure, psig	56		Secondary Containment Design Pressure, psig	3
Calculated Max Internal Pressure, psig	47		Secondary Containment Leak Rate, %/day	10
<p><u>Type of Construction:</u> Primary containment is a steel shell in the form of an inverted light bulb enclosed in reinforced concrete. The drywell is interconnected to a torus-type steel suppression chamber supported by a reinforced concrete pad. Secondary containment is a cylindrical, reinforced concrete shell (2.5' thick) with a spherical dome. Drywell free volume is 165,000 cu. ft. Torus water volume is 117,500 cu. ft.</p>				
<p><u>Design Basis:</u> Designed to withstand LOCA with 4 sq ft break area in the coolant piping, simultaneously with forces imposed by the design-basis earthquake, and also to maintain design leak tightness during such an accident so the radioactive release will cause no off-site dose in excess of values specified in 10 CFR 100.</p>				
<p><u>Vacuum Relief Capability:</u> A vacuum relief system will be provided to prevent negative pressure more than 2 psid on either the drywell or suppression chamber.</p>				
<p><u>Post-Construction Testing:</u> Will be tested at 125% design pressure using halide leak detection, then at design pressure with soap suds. Leak rate tests will be run before startup and periodically during the plant life time.</p>				
<p><u>Penetrations:</u> Electrical and steam are double sealed and individually testable.</p>				
<p><u>Weld Channels:</u> Found no reference.</p>				

C. CONTAINMENT & STRUCTURES (Contd) REACTOR: HOPE CREEK

Containment Heat Removal System: The FRVS system described below has 3 cooling coils each with 1.3×10^6 Btu/hr heat removal capacity used in case of LOCA or other accident. During normal and accident conditions Equipment Area Cooling Systems (EACS) cools unit equipment areas. Local fan-coil units provide the cooling normally holding temperatures below 110 F.

Standby Gas Treatment System: The FRVS system Filters, Recirculates, and Ventilates in the event of a fuel handling accident or a LOCA. The normally used system during operation stops and FRVS starts. FRVS is an engineered safety feature. Air is filtered clean by multiple passes thru filters as required, before release to the environment. EACS cooling (above) runs also after LOCA.

Combustible Gas Control: Hydrogen recombiners will be used to control H_2 concentration following a LOCA. Recombiners will meet requirements of the Regulatory Guide.

Containment Floodability: An analysis will be made to determine capabilities for flooding.

Strong Motion Accelerometer: Two triaxial accelerographs will be installed, one in the basement of the containment structure and the second one near the top of containment above the other one.

Turbine Orientation: Ejected blades or other turbine parts could possibly strike the containment shell.

D. REACTOR COOLANT

Reactor Vessel Failure: Has extremely low probability of failure due to any known failure mechanism.

Reactor Vessel Design: Material - ASTM A533 Grade B

Shell ID, in. 251 Shell thickness, in. .37

Overall height, ft/in. ~84 ft. Cladding thickness, in. .125

Leak-Detection System: Leakage is designated as Identified or Unidentified. Four variables are used for detecting leaks: sump fill up and flow rates, drywell pressure, drywell temperature, and air sampling. Unidentified max. leakage rate limit is 15 gpm.

Failed-Fuel-Detection System: Four gamma-sensitive monitors located near main steam lines just outside primary containment will detect significant increases in radiation levels which could be caused by gross fuel failure. Detection of increased radiation levels initiate a scram and closure of steam line isolation valves, and also, a trip signal to the Cascoque Radiacare System.

Long-Term Cooling: Figure shows piping connection that allows Essential Service Water System to supply river water to the drywell spray, to the reactor coolant recirculation system, or to flood containment. Four low-head pumps are available.

E. REACTOR CHARACTERISTICS		REACTOR: HOPE CREEK	
E1. THERMAL-HYDRAULIC		E2. NUCLEAR	
Thermal Output, MWt	3293	Moderator Temp Coef Cold, $\Delta k/k/^{\circ}F$	-5.0×10^{-5}
Electrical Output, MWe (net)	1067	Moderator Temp Coef Hot, No Voids	-17.0×10^{-5}
Total Heat Output, Safety Design, MWt	3440	Moderator Void Coef Hot, No Voids, $\Delta k/k/Z$	-1.0×10^{-3}
Steam Flow Rate, lb/hr	14.2×10^6	Moderator Void Coef Operating	-1.6×10^{-3}
Total Core Flow Rate, lb/hr	106.5×10^6	Doppler Coefficient, Cold	-1.3×10^{-5}
Feedwater Flow Rate, million lb/hr	14.12	Doppler Coefficient, Hot, No Voids	-1.2×10^{-5}
Feedwater Temperature, $^{\circ}F$	420	Doppler Coefficient, Operating	-1.3×10^{-5}
Coolant Pressure, psig	1020	Initial Enrichment, %	2.25
Heat Transfer Area, ft^2	66,100	Average Discharge Exposure, MWD/Ton	19,000
Max Power per Fuel Rod Unit Lgth, kw/ft	18.35	Control Rod Worth, %	0.01 Δk max
Maximum Heat Flux, Btu/hr- ft^2	425,060	Burnable Poisons, Type and Form	Boron in 372 flat sst curtains
Average Heat Flux, Btu/hr- ft^2	163,230	Number of Moveable Control Rods	185
Maximum Fuel Temperature, $^{\circ}F$	4430	No. of In-Core Neutron Detectors (Fixed)	172
Average Fuel Rod Surface Temp., $^{\circ}F$	500	No. of In-Core Detector Assemblies	43
MFHR	> 1.9	Number of Fuel Assemblies	764
Coolant Enthalpy at Core Inlet, Btu/lb	527.4	Fuel Rod Array	7x7
Total Peaking Factor	2.6	No. Fuel Rods Per Fuel Assembly	49
Avg Power Density, Kw/l	50.8	MISCELLANEOUS:	
Peak Fuel Enthalpy on Rod Drop, Cal/gm	280	Fuel Rod Cladding - Zircaloy-2 Uranium weight - 372,112#	
Core Max. Exit Voids Within Assembly, %	77		
Number of Recirculation Loops	2		
Pipe Diameter, in.	28		
Recirculation Pump Flow, gpm	45,200		
Number of Jet Pumps in Reactor	20		
Number of Main Steam Lines	4		
Pipe Diameter, in.	26		

F. EMERGENCY CORE COOLING SYSTEMS REACTOR: HOPE CREEK

High-Pressure Coolant Injection System: Consists of 1 pump driven by a steam turbine, piping, controls, etc. Pump capacity is 5000 gpm at 1120 psid. Takes suction from Condensate Storage Tank or from the suppression pool. Injection water is piped to the core spray header. System starts only after main feed pumps and control rod drive pumps fail to maintain water level.

Auto-Depressurization System: When feedwater pumps, RCICS, or HPCIS cannot maintain adequate water level, safety relief valves open and vent steam to the suppression pool. With the reactor depressurized, the LPCI and core spray systems begin to flood the core.

Core Spray System: Two independent loops are provided, each loop having 2 centrifugal pumps driven by electric motors, a spray sparger in the reactor vessel, piping, etc. Pumps take suction from the suppression pool. Pumps start automatically in case of low water level in the reactor vessel or high pressure in the drywell.

Low-Pressure Coolant-Injection System: Four 1/3 capacity pumps flood the core at low pressure from 0 to 300 psi. Each pump can supply 10,000 gpm @ 20 psid from the suppression pool. These pumps are part of the Residual Heat Removal System. Low water level in the reactor vessel or high pressure in the drywell initiates the system. Pump start on same signals as Core Spray System.

G. MISCELLANEOUS

Residual-Heat-Removal System (RRRS): System consists of 2 heat exchangers, 4 main pumps (each 1/3 cap), and service water system to cool heat exchangers. Four modes of operation are: (1) LPCI - main pumps transfer water from condensate storage or suppression pool to reactor to maintain cooling (30,000 gpm total flow); (2) Containment Spray - water pumped from suppression pool to spray headers in drywell; (3) Reactor Isolation Mode - suppression pool water pumped thru heat exchangers to hold pool temperature below 170 F; and (4) Shutdown Cooling used to remove residual heat from the reactor core.

Radwaste Treatment: Designed to control release of radioactive effluents by collection, filtration, holdup for decay, dilution, and concentration. Liquids will be collected, treated and stored, and released in the water discharge canal for dilution. Solids will be collected and processed for storage in drums. Gaseous wastes are collected and held for decay, being released within established limits. Design bases for 30 second decay is annual average rate of 100,000 $\mu\text{c}/\text{sec}$. With 3 day holdup of Krypton and 25 day holdup of Xenon, rate is about 115 $\mu\text{c}/\text{sec}$.

Plant Vent: Vent runs up the side of the reactor building for both units 1 & 2.

G. MISCELLANEOUS (Continued) REACTOR: HOPE CREEK	
Emergency Power: Four diesel generator sets are provided, sized so any 3 can supply all necessary power for one unit under design basis accident. Each diesel is physically separated from the others and has independently operating auxiliaries. Units are rated 4200 KW continuously. Each engine has a 550 gallon day tank and a 30,000 gal storage tank that will run the diesel at full load for 4 1/2 days.	
Emergency Plans: The emergency plan submitted for Salem will be used with changes as required for addition of the 2 Hope Creek units. Main objective of the plan will be protection of the general public and station personnel. Plan will identify levels of action and define personnel duties and course of action. Federal, State, and local authorities will be used as required. Fire, injuries, radiation and contamination will be covered both on-site and off-site. The US Coast Guard will assist to minimize hazards to vessels on the Delaware River.	
Environmental Monitoring: The plan used for the Salem plant will be followed and expanded as required. Two years of pre-operational monitoring has established that radioactivity levels are consistent with other eastern USA regions. Fish and invertebrate organisms have been studied for the Delaware River 10 miles above and below the site. Pre-operational and post-operational biological and physiochemical history will be recorded. Terrestrial ecological studies were carried out in 1972 when a brief detailed survey was made.	
H. CIRCULATING WATER SYSTEM	
Type of System: Closed loop using cooling towers.	
Water Taken From: Delaware River - Tower makeup 24,500 gpm/reactor Tidal Flow in river exceeds 400,000 cfs	
Intake Structure: Four Service Water pumps for each unit are installed - 2 per bay with traveling screens and trash racks. A skimmer wall will prevent an oil slick from entering the structure. After use, service water provides makeup for the towers. Inlet velocity is <1 fps.	
Water Body Temperatures: Winter minimum 33 °F; Summer maximum 80 °F	
River Flow	NA (cfs) minimum; 12,000 (cfs) average
Service Water Quantity	42,500 gpm/reactor
Flow Thru Condenser	552,000 (gpm)/reactor Temp. Rise 28 °F
Heat Dissipated to Environment	7760 × 10 ⁶ (Btu/hr)/reactor
Heat Removal Capacity of Condenser	--- (Btu/hr)/reactor
Discharge Structure: Amount of discharge is about 60,000 gpm and will be discharged by jet tube about 200 feet from shore at a velocity of 8.5 fps.	
Cooling Tower(s): Description & Number - 1 hyperbolic tower/reactor Blowdown 12,000 gpm/reactor Evaporative loss 12,500 gpm/reactor	

WPPSS, UNITS 1 & 4
Dockets 50-460, 50-513

NUCLEAR SAFETY INFORMATION CENTER

A. GENERAL**PROJECT NAME:** WPPSS Nuclear Project No. 1 and No. 4**LOCATION:** South Central Washington on the Hanford Reservation**OWNER:** Washington Public Power Supply System**OWNER'S ADDRESS & CONTACT:** J. J. Stein, Managing Director**ARCHITECT/ENGINEER:** United Engrs.Wash. Public Power Supply System
301 Fifth Ave. P.O. Box 968**REACTOR MANUFACTURER:** B&W

Richland, Wash. 99352

CONTAINMENT CONSTRUCTOR: United Engrs.**TURBINE MANUFACTURER:** ---**DATE:** July 1976**COMPILED BY:** Fred Heddleson**ESTIMATED STARTUP DATE:** 1980-1982**NUCLEAR SAFETY INFORMATION CENTER****B. SITE DATA**

Lat 46°28'03.72" N

Unit 1

Long 119°18'51.50" W

Site Description: The site is located on the ERDA Hanford Reservation and the 972 acres that will be used for the 2 plants were leased from the former AEC. These 2 units will be adjacent to WPPSS-2 (1100 MWe unit). Plants will be about 2.5 miles from the Columbia River and right-a-way is available to the river for makeup water and discharge. River mile here is 352. Since the site is on the Reservation, all roads are controlled by access to the reservation. State Highway 240 is about 7 mi SW. Within 5 mi. of the site there are no public facilities, and only 138 inhabitants. The nearest school is 6 mi ESE with 200 students. The nearest town is Richland 8 mi S. The FFTF site is about 3 mi. SW.

Nearby Body of Water:

Normal Level 3350' (MSL)

Columbia River

Max Prob Flood Level 3425' (MSL)

Size of Site 972 Acres Site Grade Elevation 451' (MSL)

Topography of Site: Flat - sloping to the west**of Surrounding Area (5 mi rad):** Flat - sloping NE to the Columbia R.**Total Permanent Population:** In 2 mi radius 0 ; 10 mi 2868**Date of Data:** 1980 In 5 mi radius 138 ; 50 mi 197,018**Nearest City of 50,000 Population:** Spokane, Wash.**Dist. from Site** 125 Miles, **Direction** NE, **Population** 184,000**Land Use in 5-Mile Radius:** Semi-arid desert, a part of the Hanford Reservation.**Meteorology:** Prevailing wind direction NNW Avg. speed 7.6 mph**Stability Data** - Area has high air pollution potential - many calms.**Meteorological Measurements** - Data is available from the Hanford Reservation and from WPPSS 2.

B. SITE DATA (Continued)		REACTOR: UPPSS 1&4	
Exclusion Distance, Miles	1.2 radius	Design Winds in mph: At 0 - 50 ft elev 100 50 - 150 ft 120 150 - 400 ft 140 Tornado 190 mph tang. + 50 trans. $\Delta P = 1.5 \text{ psi} / 2.5 \text{ sec}$	
Low Population Zone Distance, Miles	4 radius		
<u>Metropolis</u>	<u>Distance</u> <u>Population</u>		
Spokane, Wa.	125 mi. 287,487 1970		
Safe Shutdown Earthquake Acceleration, g	0.25		
Operating Basis Earthquake Acceleration, g	0.125		
Earthquake Vertical Shock, % of Horizontal	66 2/3		
C. CONTAINMENT AND STRUCTURES			
Design Pressure, psig	46.4	Free Volume, cu ft	3.09×10^6
Calculated Max Inter- nal Pressure, psig		Max Leak Rate at Design Pressure, %/day	0.2
<p>Type of Construction: Reinforced concrete cylindrical structure with 4'-6" thk side walls and 3'-6" thk hemispherical dome roof. ID is 150 ft and the top of the dome is 192 ft above grade, inside height is 235 ft. Steel liner plate on vertical side walls is 3/8" thick, 1/2" thk on dome, and 1/4" thk on bottom liner.</p>			
<p>Design Basis: Designed to withstand the effects of the safe shutdown earthquake and to resist the various combinations of seismic loads, tornado, etc. during normal accident conditions. Also designed to withstand the DBA (max. size pipe rupture) without loss of structural integrity.</p>			
<p>Vacuum Relief Capability: Found no reference.</p>			
<p>Post-Construction Testing: Structural Integrity Test will be run by increasing internal pressure to 115% of design pressure and measuring deflections and crack widths. A Type-A leakage rate test will be run to verify leakage rates. Periodic tests will be run thereafter.</p>			
<p>Penetrations: Found no reference.</p>			
<p>Weld Channels: Sketches show test channels over a seam in the bottom liner, so test channels must be used.</p>			

C. CONTAINMENT & STRUCTURES (Contd.) REACTOR: WPPSS 164

Containment Spray System: Consists of 2 parallel subsystems each of 100% capacity. Each system has 1 spray pump, 1 recirculation heat exchanger, one 360° spray header etc. Pump capacity is 2500 gpm each and takes suction from the borated water storage tank. Sodium hydroxide is added to the spray for iodine removal.

Containment Cooling: Two systems remove heat - Containment Spray described above and recirculating cooling units. There are 4 of these fan-coil units which remove heat during normal operation. One unit at full capacity can hold concrete temperatures below 150°F. These units do not operate after a LOCA.

Containment Air Filtration: Air in containment is recirculated through HEPA and activated charcoal filters to remove iodine and other radioactivity. The purge system operating in recirculation mode cleans the air.

Combustible Gas Control: System has 2 independent 100% capacity recombiners to remove hydrogen from the air. Units are started manually from the control room.

Containment Floodability: Found no reference.

Strong Motion Accelerometer: One triaxial unit will be installed near the base of containment and a 2nd unit will be installed directly above it at the operating floor level, a 3rd unit in the field.

Turbine Orientation: Turbine and reactor are on the same or parallel centerlines so it is improbable that missiles from the turbine could strike containment.

D. REACTOR COOLANT

Reactor Vessel Failure: Found no reference.

Reactor Vessel Design: Material SA-533, Gr. B steel

Shell ID, in. 182 Shell Thickness 9 1/4"

Overall Height, ft/in. 43.0 Cladding Thickness, in. .125

Reactor-Coolant Leak-Detection System: Leaks can be detected by makeup tank water levels, containment sump level and pump operation, and by containment radioactive gas analysis. A 1 gpm leak can be detected in 30 minutes by observing sump pump operation. Max. allowable leakage rate is 25 gpm.

Failed-Fuel-Detection System: Wet-sipping technique is used. There are also radiation detectors on steam lines that would indicate radioactivity and the possibility of failed fuel.

E. REACTOR CHARACTERISTICS		REACTOR: WPPSS 144	
E1. THERMAL-HYDRAULIC		E2. NUCLEAR	
Thermal Output, MWt	3600	H ₂ O/U, Cold	2.93
Electrical Output, MWe (net)	1206	Avg 1st-Cycle Burnup, MWD/MTU	16,056
Total Heat Output, Safety Design, MWt	3760	Maximum Burnup, MWD/MTU	55,000
Total Heat Output, Btu/hr $\times 10^6$	12,287	Region-1 Enrichment, %	---
System Pressure, psia	2250	Region-2 Enrichment, %	2.77 avg.
DNBR, Nominal	1.82	Region-3 Enrichment, %	---
Total Flowrate, lb/hr $\times 10^6$	150.2	k _{eff} , Cold, No Power, Clean	---
Eff Flowrate for Heat Trans, lb/hr	142.4 $\times 10^6$	k _{eff} , Hot, Full Power, Xe and Sm	---
Eff Flow Area for Heat Trans, ft ²	56.6	Total Rod Worth, % BOL Equi.	7.8
Avg Vel Along Fuel Rods, ft/sec	16.2	Shutdown Boron, No Rods-Clean-Cold, ppm	1630
Heat Generated in Fuel, %	97.3	Shutdown Boron, No Rods-Clean-Hot, ppm	1530
Hot Channel Factors, Fq	2.71	Boron Worth, Hot, % $\Delta k/k/ppm$	1/105
Nominal Core Inlet Temp, °F	572.3	Boron Worth, Cold % $\Delta k/k/ppm$	1/80
Avg Rise in Core, °F	601.9	Full Power Moderator Temp Coeff, $\Delta k/k/^{\circ}F$	$+0.12 \times 10^{-4}$
Hot Channel Outlet Temp, °F	652.7	Moderator Pressure Coeff, $\Delta k/k/psi$	-3×10^{-7} to $+3 \times 10^{-6}$
Avg Film Coeff, Btu/hr ft ² -°F	---	Moderator Void Coeff, $\Delta k/k/\%$ Void	$\sim -1.6 \times 10^{-2}$
Avg Film Temp Diff, °F	---	Doppler Coefficient, $\Delta k/k/^{\circ}F$	$(-1.25 \text{ to } -1.98) \times 10^{-5}$
Active Heat Trans Surf Area, ft ²	63,991	Shutdown Margin, Hot 1 rod stuck, % $\Delta k/k$	1
Avg Heat Flux, Btu/hr ft ²	186,822	Burnable Poisons, Type and Form	Al ₂ O ₃ -B ₄ C sintered pellets
Max Heat Flux, Btu/hr ft ²	507,044	Number of Control Rods	1632
Avg Thermal Output, kw/ft	186,822	Number of Part-Length Rods (PLR)	192
Max Thermal Output, kw/ft	14.74	Number of Fuel Assemblies	205
Max Clad Surface Temp, °F	657	Overall Dimensions, inches	8.536 $\times$ 8.536
No. Coolant Loops	2	Number of Fuel Rods	54,120
		Fuel Rod Cladding Material	Zircaloy-4
		Weight of Uranium, lbs. (UO ₂)	233,884

F. SAFETY INJECTION SYSTEMS REACTOR: WPPSS 1&4

Core Flooding System: Two tanks, each holding a minimum of 10,000 gal of borated water are held at 600 psig by nitrogen cover gas. When coolant system pressure drops below 600 psig, check valves open and contents of the 2 tanks are injected into the reactor to cover the core.

High-Pressure Injection System: There are 3 pumps in the system each rated 700 gpm at 1125 psig. One pump has capacity for small breaks. When the actuation signal is received, 2 pumps will start injection. Pumps take suction from the borated water storage tanks. These pumps can be run in conjunction with low-pressure pumps when operating in the recirculation mode.

Low-Pressure Injection System: Two low pressure pumps, each rated 5000 gpm at 150 psig flood the core after the coolant system pressure has dropped to about 100 psig. Two separate flow paths are available. Pumps are part of the Decay Heat Removal System and take suction from the borated water storage tank. When supply in the storage tank is exhausted, pump suction is switched to the containment sump.

G. MISCELLANEOUS

Decay Heat Removal System: System has 2 pumps each rated 5000 gpm at 150 psig, 2 heat exchangers with capacity of 41.35×10^6 Btu/hr, and required pipes, valves, and controls. System functions are: (1) removes decay heat from reactor core during later stages of cooldown, (2) maintains reactor coolant temperature during refueling, (3) provides a means of filling and draining refueling canal, and (4) provides low-pressure injection after LOCA (see above).

Radwaste System: Liquid wastes will be collected and monitored, and then processed or stored. After processing, liquids will be reused or disposed of in the blowdown drain. Radioactive impurities that cannot be processed for reuse will be concentrated, solidified, and packaged for offsite disposal. Radioactive gases will be collected, compressed, passed through a recombiner for hydrogen removal and then stored in a decay tank. Gases will be held at least 60 days, then filtered and released if activity has sufficiently decayed. Solid wastes consisting of dry wastes, spent demineralizer resins, boron recovery bottoms, condensate polishing bottoms filter effluents, etc. will be solidified as required, packed in 50 and 10 cu ft containers and shipped offsite for disposal.

Plant Vent: Releases from the Radwaste System will be vented from the roof area of the General Services Buildings.

G. MISCELLANEOUS (Continued) REACTOR: WTPSS 1&4

Emergency Power: Two redundant diesel-generator sets are provided, each rated 6800 KW continuously. Each unit is independent with its own auxiliary. Units have 2 starting systems (compressed air) and will accept load 10 second after starting. A bunker-type fuel oil storage tank is adjacent to each diesel-generator enclosure.

Emergency Plans: Will be a manual comprised of procedures, check lists, and necessary supporting information to establish onsite and offsite actions in cases of emergency. Plans will provide communications; liaison with offsite groups such as local, county, state, and federal agencies; training of personnel and practice drills, post-accident recovery and re-entry procedures, and use of medical facilities in Richland, Wash.

Environmental Monitoring: Hanford works have monitored and studied the Columbia River for 30 years. This data is available. Major preoperational monitoring will include studies of plankton, benthos, and fish. Also being monitored are ground water, meteorological data, air quality, local flora and fauna, small animals, large mammals, and birds. Soils and geology have already been effectively studied by Hanford. A radiological program will be started 2 years prior to operation.

H. CIRCULATING WATER SYSTEM

Type of System: Closed loop using cooling towers.

Water Taken From: Columbia River for makeup - 24,000 gpm max.

Intake Structure: Pump house is 30' to 35' above the river and houses three 12,000 gpm pumps for each reactor. Three 36" perforated pipes project into the river for suction and run back about 600' into the pump house sump. Approach velocity to perforations is 0.4 fps.

Water Body Temperatures: Winter minimum 36 °F; Summer maximum 65 °F

River Flow 36,000 (cfs) minimum; 115,000 (cfs) average

Service Water Quantity 24,000 gpm/reactor

Flow Thru Condenser 593,000 (gpm)/reactor Temp. Rise 28 °F

Heat Dissipated to Environment 8300×10^6 (Btu/hr)/reactor

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

Discharge Structure: A 24" line will run from cooling tower basins to the river and project out into the river about 125 ft. Line is designed for 7500 gpm discharge from each plant, although 3800 gpm per plant is probable max.

Cooling Tower(s): Description & Number - 2 mech. draft 80' x 740'

Blowdown 3800 gpm/reactor Evaporative loss 15,200 gpm/reactor

PHIPPS BEND, UNITS 1 & 2
Dockets 50-553, 50-554

A. GENERAL

PROJECT NAME: Phipps Bend Nuclear Plant Units 1&2

LOCATION: Hawkins Co. (N.E. Tenn.) 15 mi SW of Kingsport, TN

OWNER: TVA

OWNER'S ADDRESS & CONTACT: James E. Watson, Mgr. of Power

ARCHITECT/ENGINEER: TVA & C. F. Braun TVA
818 Power BldgREACTOR MANUFACTURER: G.E. Chattanooga, TN
37401

CONTAINMENT CONSTRUCTOR: TVA

TURBINE MANUFACTURER: Browns-Boveri DATE: January 1976

COMPILED BY: Fred Heddleson

ESTIMATED STARTUP DATE: 1982

NUCLEAR SAFETY INFORMATION CENTER

B. SITE DATA Lat 36°27'47" N, Long 82°48'34" W Unit 1

Site Description: Located on a peninsula formed by a large sweeping curve of the Holston River. The peninsula, it's point near River Mile 121, is about 11,000 ft long with an average width of 7500 ft. The area is mostly flat with level flood plains along the NE and SE sides, having a 100 to 200 ft high hill running along the SW side. The Holston River valley runs generally NE-SW, this topography naturally effecting meteorological conditions. Within 4 mi of the site, mountains rise up to over 5000 ft. The nearest community is Surgoinsville (pop 1132) W of the site about 2 1/2 mi. Kingsport (pop 31,938) is the nearest city ENE about 15 mi. Several cities with 12,000 or over population surround the site within 30 miles. The Southern RR passes within 1 1/2 mi NW from which a spur will be built to the plant. US highway 11W passes within 2 mi. I-81 runs NE-SW about 10 mi SSE of the site. Alladin Plastics employing 100 is within 1 1/2 mi of the plant.

Nearby Body of Water:	Normal Level <u>~1100</u> (MSL)
Holston River	Max Prob Flood Level <u>1179.6'</u> (MSL)

Size of Site <u>1270</u> Acres	Site Grade Elevation <u>1181.5'</u> (MSL)
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Topography of Site: Rolling**of Surrounding Area (5 mi rad):** Hilly to Mountainous**Total Permanent Population:** In 2 mi radius 585; 10 mi 17,714**Date of Data:** 1970 In 5 mi radius 5265; 50 mi ~840,000**Nearest City of 50,000 Population:** Asheville**Dist. from Site** 62 Miles, Direction SSE, Population 57,681**Land Use in 5-Mile Radius:** Not reported in PSAR, but area is probably wooded with limited agriculture.**Meteorology:** Prevailing wind direction ENE Avg. speed ~5 mph

Stability Data - WSW
High occurrence of low wind speed and atmospheric
Meteorological Measurements - Data collected since stability.
Dec-73 with 150' tower.

B. SITE DATA (Continued)			REACTOR: PHIPPS BEND	
Exclusion Distance, Miles	0.47		<u>Design Winds in mph:</u>	
Low Population Zone Distance, Miles	3		At 0 - 50 ft elev	95
<u>Metropolis</u>	<u>Distance</u>	<u>Population</u>	50 - 150 ft	110
Asheville, N.C.	62 mi.	145,056	150 - 400 ft	145
Safe Shutdown Earthquake Acceleration, g	0.20		Tornado 300 mph tang + 60 mph trans.	
Operating Basis Earthquake Acceleration, g	0.10		$\Delta P = \underline{3} \text{ psi} / \underline{3} \text{ sec}$	
Earthquake Vertical Shock, % of Horizontal	100			
C. CONTAINMENT AND STRUCTURES				
Drywell Design Pressure, psig	25		Primary Containment Leak Rate, %/day	0.5
Suppression Chamber Design Pressure, psig	15		Secondary Containment Design Pressure, psig	0.2
Calculated Max Internal Pressure, psig	26		Secondary Containment Leak Rate, %/day	0.1
G.E.	<u>Type of Construction:</u> Mark III type using drywell/pressure suppression concept in a dry containment structure. The cylindrical suppression pool surrounds the drywell but is inside the free standing steel containment vessel which is cylindrical with a domed roof. A reinforced concrete shield building surrounds the steel containment vessel leaving an annulus space between the two structures. Free volume of containment is 1.16×10^6 cu ft. Drywell free volume is 280,000 cu ft. Suppression pool water volume is 152,600 cu ft.			
G.E.	<u>Design Basis:</u> Designed to control release of radioactivity to the environment using the leak-tight steel shell, the shield building, standby gas treatment system, and auxiliaries after LOCA. Design based on double-ended break of the largest reactor coolant pipe. Containment temperature and pressure are limited following LOCA by the Engineered Safety Features, Suppression Pool, and Residual Heat Removal System.			
G.E.	<u>Vacuum Relief Capability:</u> There will be 2 vacuum relief lines with a check valve and an automatic air-operated butterfly valve.			
G.E.	<u>Post-Construction Testing:</u> Structural acceptance test will be run at 115% of design pressure and held for 1 hr. After the structural test, a leak-rate test will be run at design pressure. Three leak-rate tests will be performed during each 10-yr period after startup.			
<u>Penetrations:</u> PSAR references GESSAR which in turn references the applicants SAR - see Section 3.8.6.				
<u>Weld Channels:</u> Found no reference.				

C. CONTAINMENT & STRUCTURES (Contd) REACTOR: PHIPPS BEND

- G.E. Containment Heat Removal System: Steam dumped into containment in case of LOCA will vent to the suppression pool. As the steam condenses there, the suppression pool water will be heated. It will be pumped back to the reactor vessel, through the Residual Heat Removal heat exchangers for cooling. System is designed to limit suppression pool to a maximum of 185 F. A reactor vessel head spray can be operated to condense steam in the vessel before it is vented to containment.
- G.E. Standby Gas Treatment System: Consists of two 100% capacity (5000 cfm) systems with demister, electric heater, prefilter, HEPA filter, charcoal absorber, and a final HEPA filter that maintains a slight vacuum in the annulus during operation and cleans up all air discharged to the atmosphere after LOCA. A vacuum system prevents annulus pressure from exceeding atmospheric after LOCA.
- G.E. Combustible Gas Control: Containment air will be mixed with drywell air after LOCA to dilute hydrogen. Also, a recombiner will limit long term hydrogen buildup. A backup system can purge containment.
- G.E. Containment Floodability: Can be flooded to the top of the weir wall.
- G.E. Strong Motion Accelerometer: One unit will be placed in the basement of containment and another one higher in the structure. Peak recording accelerographs will be installed and will read out in the control room.
- Turbine Orientation: Turbine and reactor are essentially on the same centerline. Ejected turbine parts would probably not strike containment.

D. REACTOR COOLANT

Reactor Vessel Failure: Found no reference to vessel failure.

- G.E. Reactor Vessel Design: Material — Low alloy steel SA533 Gr.B
 Shell ID, in. 228 Shell thickness, in. 5.70
 Overall height, ft/in. about 73' Cladding thickness, in. 1/8
- G.E. Leak-Detection System: Small leaks are detected by temperature and pressure changes, fill-up rate of drain sumps, and fission product concentrations. Changes in water level and/or flow rates are best indication of large leaks. Large leak detection initiates automatic isolation, small leaks initiate an alarm in the control room. The total leakage rate limit is set at 50 gpm.
- G.E. Failed-Fuel-Detection System: Four gamma radiation monitors are located external to the main steam lines just outside containment. On detection of high radiation, the reactor will be scrammed and main steam line isolation valves will close.

Long-Term Cooling: Cooling water could be supplied from the Essential Service Water spray ponds, the cooling tower basins, or from the river water makeup system to provide long-term cooling.

E. REACTOR CHARACTERISTICS		REACTOR: PHIPPS BEND	
E1. THERMAL-HYDRAULIC		E2. NUCLEAR	
Thermal Output, MWt	3579	Moderator Temp Coef Cold, $\Delta k/k/^{\circ}F$	$+4 \times 10^{-5}$
Electrical Output, MWe (net)	1205	Moderator Temp Coef Hot, No Voids	-14×10^{-5}
Total Heat Output, Safety Design, MWt	3758	Moderator Void Coef Hot, No Voids, $\Delta k/k/Z$	$\sim -5 \times 10^{-4}$
Steam Flow Rate, lb/hr	15.39×10^6	Moderator Void Coef Operating	$\sim -20 \times 10^{-4}$
Total Core Flow Rate, lb/hr	105×10^6	Doppler Coefficient, Cold	-1.7×10^{-5}
Feedwater Flow Rate, million lb/hr	15.63	Doppler Coefficient, Hot, No Voids	-1.05×10^{-5}
Feedwater Temperature, $^{\circ}F$	420	Doppler Coefficient, Operating	-1.1×10^{-5}
Coolant Pressure, psig	1040	Initial Enrichment, Z	2.07
Heat Transfer Area, ft^2	73,409	Average Discharge Exposure, MWD/Ton	12,000 to 19,000
Max Power per Fuel Rod Unit Lgth, kw/ft	13.4	Control Rod Worth, Z	0.01 Δk
Maximum Heat Flux, Btu/hr- ft^2	354,000	Burnable Poisons, Type and Form	Gd_2O_3 mixed with UO_2
Average Heat Flux, Btu/hr- ft^2	159,570	Number of Moveable Control Rods	177
Maximum Fuel Temperature, $^{\circ}F$	3325	No. of In-Core Neutron Detectors (Fixed)	164
Average Fuel Rod Surface Temp., $^{\circ}F$	~ 565	No. of In-Core Detector Assemblies	41
MCHFR	> 1.9	Number of Fuel Assemblies	732
Coolant Enthalpy at Core Inlet, Btu/lb	527.8	Fuel Rod Array	8×8
Total Peaking Factor	2.22	No. Fuel Rods Per Fuel Assembly	63
Avg Power Density, Kw/l	56.0	MISCELLANEOUS:	
Peak Fuel Enthalpy on Rod Drop, Cal/gm	280	BWR/6 238-732 General Electric design G.E. designates material from GESSAR Fuel rod cladding - Zircaloy-2 Uranium weight 304,200#	
Core Max. Exit Voids Within Assembly, Z	76		
Number of Recirculation Loops	2		
Pipe Diameter, in.	22/24		
Recirculation Pump Flow, gpm	35,400		
Number of Jet Pumps in Reactor	20		
Number of Main Steam Lines	4		
Pipe Diameter, in.	26		

G.E.

F. EMERGENCY CORE COOLING SYSTEMS REACTOR: PHIPPS BEND

- G.E. High-Pressure Core Spray: Consists of one motor-driven pump, 1465 gpm at 1130 psid or 6000 gpm at 200 psid, piping, valves, etc., the pump and motor located outside containment. Suction is from the RCIC condensate storage tank, or the suppression pool. Piping inside the reactor vessel has spray nozzles which spray water over the core. Low water level or high drywell pressure starts the pump. System is designed to cool the core sufficiently to limit cladding temperatures to less than 2300 F.
- G.E. Auto-Depressurization System: If the RCIC and HPCS cannot maintain reactor water level, the AES causes steam to be released to the suppression pool through pressure relief valves so pressure in the vessel is lowered to where low pressure emergency core cooling systems can operate. ADS will not reduce pressure unless LPCS and LPCI pumps are operating.
- G.E. Low-Pressure Core Spray: Consists of one pump (6000 gpm at 122 psid), spray sparger in the reactor vessel above the core, piping, etc. Suction is taken from the suppression pool. Pump is actuated by low water in the reactor vessel or high pressure in the drywell. System can spray enough water on the core to hold cladding temperatures below 2300 F.
- G.E. Low-Pressure Coolant-Injection System: This is one of the independent operating subsystems of the RHRS. It is actuated by low water level in the reactor or high pressure in the drywell. There are 3 pumps (each rated 7100 gpm at 20 psid) with associated valves, piping, etc. that take suction from the suppression pool, thus providing closed loop recirculation capability.

G. MISCELLANEOUS

- G.E. Residual-Heat-Removal System (RHRS): The system has 3 pumps rated 7100 gpm each at 20 psid, 2 heat exchangers rated 45×10^6 Btu/hr each, piping, etc. There are 4 modes of operation:
1. Shutdown cooling to 125F in 20 hours after reactor shutdown.
 2. Use heat exchangers to condense steam from the reactor vessel.
 3. Low-Pressure Coolant-Injection System - described above.
 4. Containment Heat Removal System - discussed at top of page 3.
- The heat exchangers are cooled by RHR service water.
- G.E. Radwaste System: Both reactors will share one treatment facility. Liquid wastes will be processed on a batch basis (filtration, evaporation, and demineralization). Processed liquids will be recycled with little or no liquid released to the environment. Off-gas from the main condensers is treated using catalytic recombining and low temp charcoal absorption (RECHAR). There will be 12 charcoal absorbers (8 needed for normal operation) and 3 gas coolers. A turbine bldg roof vent is mentioned in PSAR but it is not clear if this is the main vent. Solid wastes will be either wet or dry. Wet will be shipped offsite in 170 cu ft steel containers; Dry wastes in 55 gal drums.

Plant Vent: PSAR references GESSAR. GESSAR references PSAR.

G. MISCELLANEOUS (Continued) REACTOR: PHIPPS BEND

G.E. Emergency Power: Each reactor will have 3 diesel-generator sets for emergency power. One set will be used exclusively for the HPCS which has a 3050 HP pump. Each of the other 2 diesel will be connected to a separate load group. Each set will be independent with separate fuel day tanks and storage tanks with 7 days supply of fuel.

Emergency Plans: Emergency plans will cover precautionary planning, delegation of authority, actions taken to protect the public, plant, employees and equipment. TVA general plans will be used plus Phipps Bend Plant Annex to cover emergencies such as fires, personal injury, tornadoes or high winds, and incidents that could result in release of radioactive products. Plans will be formulated for medical assistance, help from local and state agencies especially for actions needed to protect off-site areas and personnel.

Environmental Monitoring: vegetation, birds, small mammals, and reptiles & amphibians will be sampled in the terrestrial ecology studies. Baseline aquatic studies will include monitoring of water quality, benthos, plankton, periphyton, and fish. This program will be continued and modified as needed when plant startup occurs. Preoperational radiological monitoring will investigate radiation levels and radioactivity in the plant environs for 2 years prior to operation namely atmospheric and terrestrial.

H. CIRCULATING WATER SYSTEM *Information not given in PSAR.

Type of System: Closed system with one hyperbolic natural draft cooling tower for each reactor.

Water Taken From: Holston River at River Mile 121.3

Intake Structure: Could find no description in the PSAR.

Water Body Temperatures: Winter minimum * °F; Summer maximum * °F

River Flow 800 (cfs) minimum; 3600 (cfs) average

Service Water Quantity 22,000 gpm/reactor (normal operation)

Flow Thru Condenser 375 to 500 × (gpm)/reactor Temp. Rise * °F

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

Heat Removal Capacity of Condenser 7999×10^6 (Btu/hr)/reactor

Discharge Structure: Discharged into the Holston River with a diffuser system at River Mile 120.5.

Cooling Tower(s): Description & Number -- 1 natural draft tower/unit

Blowdown 12,500 gpm/reactor Evaporative 600 ft high 100s *gpm/reactor

BLACK FOX, UNITS 1 & 2
Dockets 50-556, 50-557

A. GENERAL

PROJECT NAME: Black Fox Station Units 1 & 2

LOCATION: NE Okla 23 miles east of Tulsa in Rogers County

OWNER: Public Service Co. of Okla (74%) and Associated Electric Coop.

OWNER'S ADDRESS & CONTACT: Mr. B. H. Morphis, Asst. Vice Pres. -

ARCHITECT/ENGINEER: Black & Veatch

Nuclear

REACTOR MANUFACTURER: GE

Public Service Co. of Oklahoma

P.O. Box 201

CONTAINMENT CONSTRUCTOR: ---

Tulsa, Okla. 74102 - 918-583-

3611 ext.

TURBINE MANUFACTURER: GE

DATE:

2288

COMPILED BY: Fred Heddleson

ESTIMATED STARTUP DATE: 1983

NUCLEAR SAFETY INFORMATION CENTER

B. SITE DATA Lat 36°7'1" N Long 95°32'54" W

Site Description: On the E bank of the Verdigris River (River Mile 39 to 43) which is the county line, and within the expanded city limits of Inola (pop 1176) 3 mi NE. The nearest highway, State Rt 33 passes within 2 mi N of the site. There is no industry near the site, but it is expected that an industrial development will take place north of the site and south of route 33. Several recreational sites are being developed along the river, 2 of these being along the site border. Three pipe lines pass within 4 to 5 miles of the site on the NW side. The Missouri Pacific RR runs NW-SE about 3 mi NE of the site. Nearest school is in Inola. The Newt Graham Lock and Dam (#18) is about 4 miles downstream. Access to the site is from State Rt 33. No visitor center is planned for the site. There is a high potential for tornados - within a 100 mi radius of the plant - avg of 9/year.

Nearby Body of Water:

Normal Level 500'

(MSL)

Verdigris River

Max Prob Flood Level 571'

(MSL)

Size of Site 2206 Acres Site Grade Elevation 575' (MSL)

Topography of Site: Flat to Rollingof Surrounding Area (5 mi rad): Flat to RollingTotal Permanent Population: In 2 mi radius 92; 10 mi 7,253Date of Data: 1970 In 5 mi radius 1753; 50 mi 694,299Nearest City of 50,000 Population: Tulsa, Okla.Dist. from Site 23 Miles, Direction W, Population 330,350Land Use in 5-Mile Radius: Agricultural - farming and beef cattle raising.Meteorology: Prevailing wind direction S Avg. speed 10.7 mph

Stability Data - Site has a very low potential for air pollution.

Meteorological Measurements - Data collection started in Nov. 1973.

B. SITE DATA (Continued)			REACTOR: BLACK FOX	
Exclusion Distance, Miles		0.5 radius	<u>Design Winds in mph:</u> At 0 - 50 ft elev 80 50 - 150 ft 95 150 - 400 ft 110 Tornado 290 mph tang + 70 trans. $\Delta P = \underline{3} \text{ psi} / \underline{1 \frac{1}{2}} \text{ sec}$	
Low Population Zone Distance, Miles		2.5 radius		
<u>Metropolis</u>	<u>Distance</u>	<u>Population</u>		
Tulsa, Okla	23 mi	476,945		
Safe Shutdown Earthquake Acceleration, g		0.12		
Operating Basis Earthquake Acceleration, g		0.06		
Earthquake Vertical Shock, % of Horizontal		66 2/3		
C. CONTAINMENT AND STRUCTURES				
Drywell Design Pressure, psig		30	Primary Containment Leak Rate, %/day 0.1	
Suppression Chamber Design Pressure, psig		15	Secondary Containment Design Pressure, psig 15	
Estimated Max Internal Pressure, psig		~25	Secondary Containment Leak Rate, %/day 100	
<u>Type of Construction:</u> Mark III type using drywell/pressure suppression concept in a dry containment structure. The cylindrical suppression pool surrounds the drywell but is inside the free standing steel containment vessel which is cylindrical with a domed roof. A reinforced concrete shield building surrounds the steel containment vessel leaving an annulus space between the two structures. Free volume of containment is 1.14×10^6 cu ft. Drywell free volume is 275,000 cu ft. Suppression pool water volume is 163,700 cu ft. ID is 130 ft and overall height is about 197 ft.				
<u>Design Basis:</u> Designed to control release of radioactivity to the environment using the leak-tight steel shell, the shield building, standby gas treatment system, and auxiliaries after LOCA. Design based on double-ended break of the largest reactor coolant pipe. Containment temperature and pressure are limited following LOCA by the Engineered Safety Features, Suppression Pool, and Residual Heat Removal System.				
<u>Vacuum Relief Capability:</u> Containment designed for negative pressure of 0.8 psig. Two vacuum relief pipes connect containment with the annulus area. Each pipe has 2 valves.				
<u>Post-Construction Testing:</u> A pneumatic pressure test will be run in accordance with Article NE-6300 of Sect. III of the ASME Code, and leakage rate tests will be run in accordance with App. J of 10 CFR Part 50.				
<u>Penetrations:</u> Two types - one for cold pipes and one for hot pipes. Some are double sealed and some single sealed.				
<u>Weld Channels:</u> Foundation mat steel liner seam welds are covered with leak chases (weld channels), subdivided and manifolded for pressure testing.				

C. CONTAINMENT & STRUCTURES (Contd) REACTOR: BLACK FOX	
G.E.	<u>Containment Heat Removal System:</u> Steam dumped into containment in case of LOCA will vent to the suppression pool, where the pool water will be heated. Pool water will be pumped to the reactor vessel thru heat exchangers which will cool the water. Pool water temp is limited to 185 F. A reactor vessel head spray and containment spray can be operated to condense steam either in the vessel or containment. Two 100% capacity spray systems are available.
G.E.	<u>Standby Gas Treatment System:</u> Consists of two 100% capacity (5000 cfm) systems with demister, electric heater, prefilter, HEPA filter, charcoal absorber, and a final HEPA filter that maintains a slight vacuum in the annulus during operation and cleans up all air discharged to the atmosphere after LOCA. A vacuum system prevents annulus pressure from exceeding atmospheric after LOCA.
G.E.	<u>Combustible Gas Control:</u> Containment air will be mixed with drywell air after LOCA to dilute hydrogen. Also, a recombiner will limit long term hydrogen buildup. A backup system can purge containment.
G.E.	<u>Containment Floodability:</u> Can be flooded to the top of the weir wall.
G.E.	<u>Strong Motion Accelerometer:</u> One unit will be placed in the basement of containment and another one higher in the structure. A 3rd unit will be in free field. Peak recording and peak deflections units provided.
G.E.	<u>Turbine Orientation:</u> Turbine and reactor are essentially on the same centerline. Ejected turbine parts would probably not strike containment.
D. REACTOR COOLANT	
<u>Reactor Vessel Failure:</u> Found no reference to vessel failure.	
G.E.	<u>Reactor Vessel Design:</u> Material — Low alloy Steel Shell ID, in. 228 Shell thickness, in. 5.70 Overall height, ft/in. 70'-10" Cladding thickness, in. 1/8
G.E.	<u>Leak-Detection System:</u> Small leaks are detected by temperature and pressure changes, fill-up rate of drain sumps, and fission product concentrations. Changes in water level and/or flow rates are best indication of large leaks. Large leak detection initiates automatic isolation, small leaks initiate an alarm in the control room. The total leakage rate limit is set at 50 gpm.
G.E.	<u>Failed-Fuel-Detection System:</u> Four gamma radiation monitors are located external to the main steam line just outside containment. On detection of high radiation, the reactor will be scrammed and main steam line isolation valves will close.
<u>Long-Term Cooling:</u> Cooling water could be supplied from the cooling tower basins which have 30 days supply, or from the river water makeup system to provide long-term cooling.	

E. REACTOR CHARACTERISTICS		REACTOR: BLACK FOX	
E1. THERMAL-HYDRAULIC		E2. NUCLEAR	
Thermal Output, MWt	3579	Moderator Temp Coef Cold, $\Delta k/k/^{\circ}F$	$+4 \times 10^{-5}$
Electrical Output, MWe (net)	1150	Moderator Temp Coef Hot, No Voids	-14×10^{-5}
Total Heat Output, Safety Design, MWt	3758	Moderator Void Coef Hot, No Voids, $\Delta k/k/\%$	$\sim 5 \times 10^{-4}$
Steam Flow Rate, lb/hr	15.39×10^6	Moderator Void Coef Operating	$\sim 20 \times 10^{-4}$
Total Core Flow Rate, lb/hr	105×10^6	Doppler Coefficient, Cold	-1.7×10^{-5}
Feedwater Flow Rate, million lb/hr	15.36	Doppler Coefficient, Hot, No Voids	-1.05×10^{-5}
Feedwater Temperature, $^{\circ}F$	420	Doppler Coefficient, Operating	-1.1×10^{-5}
Coolant Pressure, psig	1040	Initial Enrichment, %	2.07
Heat Transfer Area, ft^2	73,409	Average Discharge Exposure, MWD/Ton	12,000 to 19,000
Max Power per Fuel Rod Unit Lgth, kw/ft	13.4	Control Rod Worth, %	0.01 ΔK
Maximum Heat Flux, Btu/hr- ft^2	354,300	Burnable Poisons, Type and Form	Gd ₂ O ₃ mixed with UO ₂
Average Heat Flux, Btu/hr- ft^2	159,570	Number of Moveable Control Rods	177
Maximum Fuel Temperature, $^{\circ}F$	3337	No. of In-Core Neutron Detectors (Fixed)	164
Average Fuel Rod Surface Temp., $^{\circ}F$	~ 565	No. of In-Core Detector Assemblies	41
MCHFR	≥ 1.9	Number of Fuel Assemblies	732
Coolant Enthalpy at Core Inlet, Btu/lb	527.8	Fuel Rod Array	8 x 8
Total Peaking Factor	2.22	No. Fuel Rods Per Fuel Assembly	63
Avg Power Density, Kw/l	56.0	MISCELLANEOUS:	
Peak Fuel Enthalpy on Rod Drop, Cal/gm	280	Fuel rod cladding - Zircaloy-2 Uranium weight - 304,200 # G.E. indicates that data came from GES3AR (50-550) or (50-447) for BWR/6 238-732 Plant	
Core Max. Exit Voids Within Assembly, %	76		
Number of Recirculation Loops	2		
Pipe Diameter, in.	22/24		
Recirculation Pump Flow, gpm	35,400		
Number of Jet Pumps in Reactor	20		
Number of Main Steam Lines	4		
Pipe Diameter, in.	26		

G.E.

F. EMERGENCY CORE COOLING SYSTEMS REACTOR: BLACK FOX

- G.E. **High-Pressure Core Spray:** Consists of one motor-driven pump, 1465 gpm at 1130 psid or 6000 gpm at 200 psid, piping, valves, etc., the pump and motor located outside containment. Suction is from the RCIC condensate storage tank, or the suppression pool. Piping inside the reactor vessel has spray nozzles which spray water over the core. Low water level or high drywell pressure starts the pump. System is designed to cool the core sufficiently to limit cladding temperatures to less than 2300 F.
- G.E. **Auto-Depressurization System:** If HPCS cannot maintain reactor water level, the ADS causes steam to be released to the suppression pool through pressure relief valves so pressure in the vessel is lowered to where low pressure emergency core cooling systems can operate. ADS will not reduce pressure unless LPCS and LPCI pumps are operating.
- G.E. **Low-Pressure Core Spray:** Consists of one pump (6000 gpm at 122 psid), spray sparger in the reactor vessel above the core, piping, etc. Suction is taken from the suppression pool. Pump is actuated by low water in the reactor vessel or high pressure in the drywell. System can spray enough water on the core to hold cladding temperatures below 2300 F.
- G.E. **Low-Pressure Coolant-Injection System:** This is one of the independent operating subsystems of the RHRs. It is actuated by low water level in the reactor or high pressure in the drywell. There are 3 pumps (each rated 7100 gpm at 20 psid) with associated valves, piping, etc. that take suction from the suppression pool, thus providing closed loop recirculation capability.

G. MISCELLANEOUS

- G.E. **Residual-Heat-Removal System (RHRs):** The system has 3 pumps rated 7100 gpm each at 20 psid, 2 heat exchangers rated 45×10^6 Btu/hr each, piping, etc. There are 4 modes of operation:
1. Shutdown cooling to 125F in 20 hours after reactor shutdown.
 2. Use heat exchangers to condense steam from the reactor vessel.
 3. Low-Pressure Coolant-Injection System - described above.
 4. Containment Heat Removal System - discussed at top of page 3.
- The heat exchangers are cooled by RHR service water.
- G.E. **Radwaste System:** Both reactors will share one treatment facility. Liquid wastes will be processed on a batch basis (filtration, evaporation, and demineralization). Processed liquids will be recycled with little or no liquid released to the environment. Off-gas from the main condensers is treated using catalytic recombining and low temp charcoal absorption (RECHAR). There will be 12 charcoal absorbers (8 needed for normal operation) and 3 gas coolers. Location of vent has not yet been determined. Solid wastes will be either wet or dry. Wet will be shipped offsite in 170 cu ft steel containers; Dry wastes in 55 gal drums.

Plant Vent: Released 75' above ground.

G. MISCELLANEOUS (Continued) REACTOR: BLACK FOX

G.E.

Emergency Power: Each reactor will have 3 diesel-generator sets for emergency power. One set will be used exclusively for the HPCS which has a 3050 HP pump. Each of the other 2 diesel will be connected to a separate load group. Each set will be independent with separate fuel day tanks and storage tanks with 7 days supply of fuel.

Emergency Plans: Plans will cover organization, training, and responsibility of station personnel to classify emergencies as to severity, and to define actions to be taken. The Okla. State Dept. of Health is the coordinating agency for Radiological Emergency Response and they will be utilized in the overall plan. Two hospitals in Tulsa have agreed to assist in treatment of injured people who might be contaminated. NRC and other state, federal, and local agencies will be used. Emergencies are classified as LOCAL, SITE, and GENERAL.

Environmental Monitoring: Preoperational monitoring will involve elaborate sampling of river and ground waters, aquatic organisms and fish, terrestrial mammals, birds, and insects, vegetation soils and geological structures. Radiological monitoring will establish current levels of radioactivity. Operational monitoring is not detailed and will be presented in the FSAR, however, these plans and procedures will be based upon the pre-operational phase.

H. CIRCULATING WATER SYSTEM

Type of System: Closed System using cooling tower.

Water Taken From: Verdigris River — Total make up for both units running 27,900 gpm max.

Intake Structure: Reinforced concrete, 3 bay, with 3-20,000 gpm pumps. Screen structure will have 3/8" diam holes; approach velocity will be 0.5 fps. Will be at shoreline of the river.

Water Body Temperatures: Winter minimum 34 °F; Summer maximum 89 °F

River Flow 380 (cfs) minimum; 3600 (cfs) average

Service Water Quantity ~14,700 gpm/reactor

Flow Thru Condenser 622,000 (gpm)/reactor Temp. Rise 25.4 °F

Heat Dissipated to Environment 8100×10^6 (Btu/hr)/reactor

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

Discharge Structure: Waters discharged to the Verdigris River at an angle and on the surface, water conveyed in an open channel.

Cooling Tower(s): Description & Number — 3 round mech. draft/unit

Blowdown 1500 gpm/reactor **Evaporative loss** 12,200 gpm/reactor

YELLOW CREEK, UNITS 1 & 2
Dockets 50-566, 50-567

NUCLEAR SAFETY INFORMATION CENTER

A. GENERAL

PROJECT NAME: Yellow Creek Nuclear Plant, Units 1 and 2

LOCATION: Northeast corner of Mississippi on Pickwick Reservoir

OWNER: TVA

OWNER'S ADDRESS & CONTACT: Godwin Williams, Jr., Manager of Power
830 Power Building
Chattanooga, TN 37401

ARCHITECT/ENGINEER: TVA

REACTOR MANUFACTURER: Combustion Engg.

CONTAINMENT CONSTRUCTOR: TVA

TURBINE MANUFACTURER: G.E.

DATE: October 1976

COMPILED BY: Fred Heddleson

ESTIMATED STARTUP DATE: 1983

NUCLEAR SAFETY INFORMATION CENTER

B. SITE DATA Lat. 34°57'24.188 N Unit 1
Long. 88°12'57.256 W

Site Description: Plant is located on a peninsula in the Pickwick Reservoir having the Tennessee River on the east and Yellow Creek embayment on the west. The peninsula land slopes gradually to the north. The site is about 15 miles east of Corinth, Miss. Three small towns with a total population of 3086 are located between 5 and 10 miles of the plant. The site tends to be in the center of a triangle with Memphis, Nashville, and Birmingham on the corners 108 to 125 miles away. The Tennessee-Tombigbee Water Way will pass the site through Yellow Creek. Several recreational areas are within 10 miles of the site. State route #25 runs N-S about 2 mi. W. Main line of the Southern RR runs E-W 9.5 mi. SSW.

<u>Nearby Body of Water:</u>	Normal Level	414'	(MSL)
<u>Pickwick Reservoir</u>	Max Prob Flood Level	446'	(MSL)

Size of Site	1160	Acres	Site Grade Elevation	520'	(MSL)
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Topography of Site: Rollingof Surrounding Area (5 mi rad): RollingTotal Permanent Population: In 2 mi radius 245 ; 10 mi 6125Date of Data: 1970 In 5 mi radius 955 ; 50 mi ----Nearest City of 50,000 Population: Huntsville, Ala.Dist. from Site 93 Miles, Direction ESE, Population 137,802Land Use in 5-Mile Radius: Predominantly rural

Meteorology: Prevailing wind direction Southern Avg. speed 4-1/2 mph
Stability Data - Atmospheric stagnation occurs once or twice a year.
Meteorological Measurements - Data collection started in July 1974 with a 150' tower.

B. SITE DATA (Continued)			REACTOR: YELLOW CREEK		
Exclusion Distance, Miles	0.42	Design Winds in mph: At 0 - 50 ft elev 85 50 - 150 ft 97 150 - 400 ft 109 Tornado 290 rot + 70 trans (mph) $\Delta P = \underline{\quad 3 \quad} \text{ psi} / \underline{1-1/2} \text{ sec}$			
Low Population Zone Distance, Miles	3				
Metropolis	Distance				Population
Huntsville, Ala.	93 mi.				228,239
Safe Shutdown Earthquake Acceleration, g	0.30				
Operating Basis Earthquake Acceleration, g	0.15				
Earthquake Vertical Shock, % of Horizontal	100				
C. CONTAINMENT AND STRUCTURES					
Design Pressure, psig	45.25	Free Volume, cu ft	3.58 x 10 ⁶		
Calculated Max Internal Pressure, psig	38.15	Max Leak Rate at Design Pressure, %/day	0.2		
<p>Type of Construction: A spherical steel vessel 1.5 to 1.75 inches thick will serve for containment. This vessel will be supported by the concrete foundation pad. Inside diameter will be 200'. A separate reinforced concrete enclosure (shield building) will surround the steel sphere with space between the 2 - in no way touching. Concrete walls and spherical dome will be 3 ft thick. About 1/3 of the steel vessel is underground. After a LOCA, the annulus will be maintained at a negative pressure exhausting through the Emergency Gas Treatment System.</p>					
<p>Design Basis: The spherical shell is designed to withstand the loads imposed by LOCA with minimal leakage. The concrete enclosure acts to protect the steel shell from external missiles, to provide shielding, and to form the annulus from which leakage control is maintained.</p>					
<p>Vacuum Relief Capability: Found no reference.</p>					
<p>Post-Construction Testing: Structural integrity test shall be run at no less than 110% of calculated peak accident pressure. Integrated leakage rate tests will be run at not less than the peak accident pressure and at 1/2 this value to establish values for later periodic leak rate testing.</p>					
<p>Penetrations: Piping penetrations are of 2 kind - high energy (high press or high temp) and low energy. These are single barrier type.</p>					
<p>Weld Channels: Found no reference.</p>					

C. CONTAINMENT & STRUCTURES (Contd.) REACTOR: YELLOW CREEK

C-80 Containment Spray System: Consists of 2 independent systems, either one capable of 100% capacity for cooling after LOCA. Borated water is sprayed downward from the top of containment to cool the atmosphere. There are 2 pumps, each rated 3500 gpm at 650 psig. Pumps take suction from the refueling water storage tank. Also sodium hydroxide is added to the spray water for removal of iodine.

Containment Cooling: After LOCA cooling will be done with the containment spray system. Normal operational cooling will use several fan-coil units located for good air distribution. These units will also heat. Temperatures will be held between 40 F and 120 F. During refueling the maximum temperature will be 90 F.

Containment Air Filtration: Emergency Gas Treatment System collects leakage in the annulus area and filters it thru HEPA and charcoal filters before exhausting to atmosphere. Two centrifugal fans of 12,000 scfm are provided.

Combustible Gas Control: There will be 2 redundant hydrogen recombiners and associated instrumentation and controls.

Containment Floodability: Found no reference.

Strong Motion Accelerometer: Five strong motion units will be installed along with 1 peak accelerograph, seismic switches and alert mechanism in the control room.

Turbine Orientation: Turbine centerline runs through the center of containment. It is unlikely that ejected turbine blades would strike containment.

D. REACTOR COOLANT

C-80 Reactor Vessel Failure: By analysis per ASME Code, the vessel is adequate for all normal operating and transient conditions during the life of the facility. Inservice inspection gives further assurance.

C-80 Reactor Vessel Design: Material SA-533 Gr.B, Class 1 steel
 Shell ID, in. 182 1/4 Shell Thickness 9 1/6"
 Overall Height, ft/in. 48'-3/8" Cladding Thickness, in. 1/8 min.

Reactor-Coolant Leak-Detection System: Leakage will be detected by particulate and gas activity monitors, by condensate flow rate from the fan-coil coolers, by the containment sump levels and pump action, and by water make-up flow rates. Maximum allowable leakage will be 10 gpm.

Failed-Fuel-Detection System: Found no reference.

E. REACTOR CHARACTERISTICS		REACTOR: YELLOW CREEK	
E1. THERMAL-HYDRAULIC		E2. NUCLEAR	
Thermal Output, MWt	3817	H ₂ O/U, Hot	2.09
Electrical Output, MWe (net)	1280	Avg 1st-Cycle Burnup, MWD/MTU	13,740
Total Heat Output, Safety Design, MWt	4100	Maximum Burnup, MWD/MTU	less than 55,000
Total Heat Output, Btu/hr	$13,000 \times 10^6$	Region-1 Enrichment, %	1.9
System Pressure, psia	2250	Region-2 Enrichment, %	2.4
DNBR, Nominal	2.22	Region-3 Enrichment, %	2.9
Total Flowrate, lb/hr	164×10^6	k _{eff} , Cold, No Power, Clean	1.169
Eff Flowrate for Heat Trans, lb/hr	157.4×10^6	k _{eff} , Hot, Full Power, Xe and Sm	1.071
Eff Flow Area for Heat Trans, ft ²	60.84	Total Rod Worth, %	7.3 - 8.9
Avg Vel Along Fuel Rods, ft/sec	16.6	Shutdown Boron, No Rods-Clean-Cold, ppm	990
Heat Generated in Fuel, %	0.965	Shutdown Boron, No Rods-Clean-Hot, ppm	1010
Hot Channel Factors, F _q	—	Boron Worth, Hot, ppm/% Δp	84
Nominal Core Inlet Temp, °F	565	Boron Worth, Cold, ppm/% Δp	65
Avg Rise in Core, °F	58	Full Power Moderator Temp Coeff, Δk/k/°F	-2.5×10^{-4} per °F
Hot Channel Outlet Temp, °F	653	Moderator Pressure Coeff, Δk/k/psi	(+.06 to +2.6) $\times 10^{-6}$
Avg Film Coeff, Btu/hr ft ² -°F	6300	Moderator Void Coeff, Δk/k/% Void	(-.03 to -1.22) $\times 10^{-3}$
Avg Film Temp Diff, °F	30	Doppler Coefficient, Δk/k/°F	(-1 to -1.8) $\times 10^{-5}$
Active Heat Trans Surf Area, ft ²	69,000	Shutdown Margin, Hot 1 rod stuck, Δk/k	1
Avg Heat Flux, Btu/hr ft ²	182,200	Burnable Poisons, Type and Form	Al ₂ O ₃ - B ₂ C
Max Heat Flux, Btu/hr ft ²	425,700	Number of Control Rods	81
Avg Thermal Output, kw/ft	5.34	Number of Part-Length Rods (PLR)	8
Max Thermal Output, kw/ft	12.5	Number of Fuel Assemblies	241
Max Clad Surface Temp, °F	656	Overall Dimensions, inches	16 × 16
No. Coolant Loops	2	Number of Fuel Rods	56,876
Combustion Engineering "System 80" Design. Data from CESSAR is indicated C-80.		Fuel Rod Cladding Material	Zircaloy-4
		Weight of Uranium, Equilibrium	102,780 kg

F. SAFETY INJECTION SYSTEMS REACTOR: YELLOW CREEK

- C-80 Core Flooding System: Four tanks are provided to flood the core with borated water in case of LOCA and a drop in system pressure to 600 psig. Tanks are pressurized to 600 psig with nitrogen gas. Check valves open automatically to dump contents into the reactor vessel. Each tank holds about 14,000 gallons of liquid.
- C-80 High-Pressure Injection System: There are 2 pumps each rated 700 gpm at 1370 psig. They are used to inject borated water into the system if small breaks should occur. Pumps take suction from the refueling water storage tank. One pump has sufficient capacity to keep the core covered for small breaks. These pumps are used also for long term cooling.
- C-80 Low-Pressure Injection System: There are 2 pumps in this system each rated 4200 gpm at 150 psig. These pumps inject large quantities of borated water into the core after LOCA. Pumps take suction from the refueling water storage tank. These pumps also function to provide shutdown cooling, by pumping through the heat exchangers.

G. MISCELLANEOUS

- C-80 Decay Heat Removal System: Long term decay heat removal uses one of the 2 high-pressure safety injection pumps and recirculates borated water from the containment sump, passing the water through the shutdown cooling heat exchangers for cooling. Each pump is rated about 1200 gpm at 500 psig. Both pumps could be used if necessary, but one pump has the required capacity.

Radwaste System: Liquid wastes are processed by the Miscellaneous Waste System or by the Laundry Waste System. Liquids are filtered for solids removal, and then run through concentrators to remove dissolved solids and radioactivity. If possible, the remaining water is recycled or it can be discharged in the cooling tower blowdown line. Gaseous wastes are collected, stored for decay and then released under controlled conditions. Storage tanks are available for a 1 year holdup. Monitors will halt release if activity is too high. Solids will be collected, dewatered, compacted and packaged into 55 gallon drums for off-site disposal.

Plant Vent: Release point is the top of containment 163' above grade.

G. MISCELLANEOUS (Continued) REACTOR: YELLOW CREEK

Emergency Power: Each reactor system will have 2 diesel generators, each generator connected to a separate load group, one redundant to the other. The diesel generator sets are completely independent, separately housed with independent auxiliaries. Each diesel will have a day tank with 4 hr fuel supply and a storage tank with 7 days supply.

Emergency Plans: Contains precautionary planning, delegation of authority and responsibility, to protect the public, plant employees, and equipment in case of unusual incidents. These plans are for use at the local level for the control of emergencies such as fire, personnel injury, tornadoes, and incidents that could result in the release of significant amounts of radioactivity. The TVA Radiological Emergency Plan (REP) for the Yellow Creek plant will contain the overall TVA REP, the Nuclear Emergency Medical Assistant Plan, and the Yellow Creek Nuclear Plant Annex.

Environmental Monitoring: Consists of four phases: 1. Baseline data to identify critical species, assess impacts of alternate systems, and to provide a data base; 2. Monitoring of construction effects; 3. Operational monitoring to determine changes in the base line data; and 4. Related programs which will monitor the effects of other TVA or other organization's programs in the area.

H. CIRCULATING WATER SYSTEM

Type of System: Closed system using cooling towers.

Water Taken From: Yellow Creek embayment of Pickwick Reservoir.
Make-up flow 16,600 gpm average.

Intake Structure: Reinforced concrete structure with four pumps. Stop log racks which prevent large trash from entering the enclosure. Traveling screens will clean out fish and smaller items.

Water Body Temperatures: Winter minimum 38 °F; Summer maximum 86 °F

River Flow 10 (cfs) minimum; 250 (Yellow Crk) (cfs) average

Service Water Quantity --- gpm/reactor

Flow Thru Condenser 512,700 (gpm)/reactor Temp. Rise 34 °F

Heat Dissipated to Environment 8580 × 10⁶ (Btu/hr)/reactor

Heat Removal Capacity of Condenser 8331 × 10⁶ (Btu/hr)/reactor

Discharge Structure: Discharge is piped easterly across the peninsula and discharged into the Tennessee River side of Pickwick Reservoir.

Cooling Tower(s): Description & Number - 2 round mechanical draft
Blowdown 4240 gpm/reactor **Evaporative loss** 13,300 gpm/reactor

NEP, UNITS 1 & 2
Dockets 50-568, 50-569

A. GENERAL**PROJECT NAME:** New England Power Units 1 and 2**LOCATION:** South East Rhode Island along the coast**OWNER:** New England Power Co. & 30 municipal electric companies**OWNER'S ADDRESS & CONTACT:** Joseph Harrington, Project Manager**ARCHITECT/ENGINEER:** United Engrs.

New England Power Co.

20 Turnpike Road

REACTOR MANUFACTURER: Westinghouse

Westborough MA 01581

CONTAINMENT CONSTRUCTOR: —**TURBINE MANUFACTURER:** Westinghouse**DATE:** November 1976**COMPILED BY:** Fred Heddleson**ESTIMATED STARTUP DATE:** 1984**NUCLEAR SAFETY INFORMATION CENTER****B. SITE DATA** Long 71° 39' 41" Lat 41° 21' 47"

Site Description: Located in SE Rhode Island about 1 mile off the coast of Block Island Sound, 8.5 miles E of Westerly and 35 mi. WSW of Providence. The site was formerly a Naval Auxiliary Landing Field and is now under the jurisdiction of GSA of the U.S. Government. NEP is in the process of purchasing the site-runways, building, and all. Site is bounded on the west and south by a salt water pond, on the N by U.S. highway #1, and on the E by a residential area. A private airport is 1 mi. W of the reactor buildings. The nearest school is in Westerly, 5 mi. WNW. The nearest residence is 1/2 mile NE. Buildings will be founded on granite which underlies the site. Other nearby towns are Charlestown (pop. 3700) 1.5 NE, and South Kingston (21,000) 7 mi. NE. Because of the recreational areas, and the beach houses there is a large number of transient population.

Nearby Body of Water:

Normal Level	0'	(MSL)
Max Prob Flood Level	17.6'	(MSL)

Size of Site	549	Acres	Site Grade Elevation	20'	(MSL)
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Topography of Site: Flat**of Surrounding Area (5 mi rad):** Generally flat — some rolling hills**Total Permanent Population:** In 2 mi radius 1182 ; 10 mi 43,801**Date of Data:** 1975 In 5 mi radius 5260 ; 50 mi 1,948,288**Nearest City of 50,000 Population:** Warwick, R.I.**Dist. from Site** 30 Miles, **Direction** ENE, **Population** 83,694**Land Use in 5-Mile Radius:** Recreational and residential with most of area forested or unused land. Area is zoned mostly as residential.

Meteorology: Prevailing wind direction SW-WSW Avg. speed 7.6 mph
Stability Data — Stable 53%, unstable 17%.

Meteorological Measurements — Data collection was started in June 1974 with a 300' tower.

B. SITE DATA (Continued)		REACTOR: NEP 1&2	
Exclusion Distance, Miles	0.4 mi or 2130' rad.	Design Winds in mph:	
Low Population Zone Distance, Miles	1.5 mi. rad.	At 0 - 50 ft elev	110
Metropolis	Distance	Population	
Providence,			
Cranston, Warwick	34 mi.	910, 781	
Safe Shutdown Earthquake Acceleration, g	0.25	Tornado	290 mph rot. + 70 trans.
Operating Basis Earthquake Acceleration, g	0.13	$\Delta P =$	3 psi/1-1/2sec
Earthquake Vertical Shock, Z of Horizontal	66		
C. CONTAINMENT AND STRUCTURES			
Design Pressure, psig	50.7	Free Volume, cu ft	2.7×10^6
Calculated Max Inter- nal Pressure, psig	46.1	Max Leak Rate at Design Pressure, %/day	0.1
<p><u>Type of Construction:</u> Vertical right cylinder reinforced concrete structure with dome roof set on a flat base 9' thick. Concrete walls are 4'-6" thick and dome is 3'-6". Interior is lined with a steel shell. Inside diameter is 140'; height-215'. The containment penetration area, a structure between the containment structure and primary auxiliary building, is 23' wide x 108' long x 33' below grade and 2' above grade. This area is held at negative pressure after LOCA so leakage will be to this area, and eventually exhausted through high efficiency filters.</p>			
<p><u>Design Basis:</u> Designed to withstand the internal pressure and temperature resulting from the energy release of the design basis LOCA. Also designed to withstand earthquakes and tornados without loss of integrity. Designed for a simultaneous LOCA and earthquake.</p>			
<p><u>Vacuum Relief Capability:</u> In operation, containment will be held at 0.5 psig max positive pressure. The penetration area will be held at 0.25 in. of water negative pressure following a LOCA. Found nothing on vacuum relief.</p>			
<p><u>Post-Construction Testing:</u> Leakage rate tests will be run at 23 and 46.1 psig. Periodic tests will be run thereafter. The structure will be pressure tested at 115% of design pressure.</p>			
<p><u>Penetrations:</u> Containment has a special penetration area that is described above under Type of Construction.</p>			
<p><u>Weld Channels:</u> Figures 3.8-12 and 3.8-13 show channels over seam welds at base of liner to be used for leak testing.</p>			

C. CONTAINMENT & STRUCTURES (Contd.) REACTOR: KEP 162

Containment Spray System: Used for post accident heat removal by spraying borated water and sodium hydroxide into the containment atmosphere. Pumps, take suction from the borated water storage tank. Actuation signal is generated by high containment pressure. There are 2 independent systems.

Containment Cooling: This system is not used for post LOCA cooling. There are 6 fan-coil units (one standby) to hold temperature between 50 F and 120 F. [Also, there is a purge system (40,000 cfm) and a containment air recirculation system (4000 cfm) using charcoal filters.]

Containment Air Filtration: After LOCA, all air leakage will be to the containment penetration area where the filter system of demisters, HEPA filters, and charcoal filters will filter all air exhausted to atmosphere.

Combustible Gas Control: Catalytic hydrogen recombiners reduce hydrogen concentration. An emergency purge system is backup for the recombiners.

Containment Floodability: The containment is located on a raised plant grade which is surrounded on three sides by embankments which prevent flood waters and associated wave runup from entering the plant site.

Strong Motion Accelerometer: Three peak shock recorders are located near the time-history accelerograph on the basement floor. Peak units are also located in 2 other bldg. locations and in aux. bldg.

Turbine Orientation: Reactor and turbine are on the same centerline so it is unlikely that ejected turbine parts could strike the containment structure. Westinghouse will supply the turbine.

D. REACTOR COOLANT

Reactor Vessel Failure: Found no direct discussion of vessel failure, but vessel design, fabrication, material selection, and inspection make failure incredible.

W Reactor Vessel Design: Material SA533 GrA, B, or C, Class 1 or 2

Shell ID, in. 173 Shell Thickness 8 1/2"

Overall Height, ft/in. 43'-10" Cladding Thickness, in. 1/8" min

Reactor-Coolant Leak-Detection System: Detection methods are containment sump monitor, air particulate monitor, radioactive gas monitor, humidity detector, and tank levels. Leakage detection is indicated in the control room. Max. permissible leakage from unidentified sources is 1 gpm.

Failed-Fuel-Detection System: The Reactor Coolant Letdown Gross Activity Monitor provides on-scale indication of primary coolant gross radionuclide concentration over a wide range of operation conditions. (PSAR pg. 11.4-5).

E. REACTOR CHARACTERISTICS		REACTOR: NEP 162	
E1. THERMAL-HYDRAULIC		E2. NUCLEAR	
Thermal Output, MWt	3411	H ₂ O/U, Cold	2.41
Electrical Output, MWe (net)	1150	Avg 1st-Cycle Burnup, MWD/MTU	14,200
Total Heat Output, Safety Design, MWt	3479	Maximum Burnup, MWD/MTU	50,000
Total Heat Output, Btu/hr	$11,642 \times 10^6$	Region-1 Enrichment, %	2.1
System Pressure, psia	2250	Region-2 Enrichment, %	2.6
PMR, Nominal	1.77	Region-3 Enrichment, %	3.1
Total Flowrate, lb/hr	142.2×10^6	k _{eff} , Cold, No Power, Clean	1.225
Eff Flowrate for Heat Trans, lb/hr	135.8×10^6	k _{eff} , Hot, Full Power, Xe and Sm	<1.25
Eff Flow Area for Heat Trans, ft ²	51.1	Total Rod Worth, %	6.2
Avg Vel Along Fuel Rods, ft/sec	16.8	Shutdown Boron, No Rods-Clean-Cold, ppm	1500
Heat Generated in Fuel, %	97.4	Shutdown Boron, No Rods-Clean-Hot, ppm	1500
Hot Channel Factors, F _q	2.32	Boron Worth, Hot, % $\Delta k/k/ppm$	(-)1%/114 ppm
Nominal Core Inlet Temp, °F	557.3	Boron Worth, Cold % $\Delta k/k/ppm$	(-)1%/59 ppm
Avg Rise in Core, °F	62.3	Full Power Moderator Temp Coeff, $\Delta k/k/°F$	-4.0×10^{-4}
Max Hot Channel Outlet Temp, °F	645	Moderator Pressure Coeff, $\Delta k/k/psi$	(-0.04 to +3.0) $\times 10^{-6}$
Avg Film Coeff, Btu/hr ft ² -°F	6400	Moderator Void Coeff, $\Delta k/k/\% \text{ Void}$	Negative
Avg Film Temp Diff, °F	30	Doppler Coefficient, $\Delta k/k/°F$	Negative at all power levels
Active Heat Trans Surf Area, ft ²	59,900	Shutdown Margin, Hot 1 rod stuck, $\Delta k/k$	1
Avg Heat Flux, Btu/hr ft ²	189,400	Burnable Poisons, Type and Form	Borosilicate in sst tubes
Max Heat Flux, Btu/hr ft ²	454,600	Number of Control Rods	1272
Avg Thermal Output, kw/ft	5.43	Number of Part-Length Rods (PLR)	192
Max Thermal Output, kw/ft	13.0	Number of Fuel Assemblies	193
Max Clad Surface Temp, °F	~660	Overall Dimensions, inches	8.426 $\times$ 8.426
No. Coolant Loops	4	Number of Fuel Rods	50,942
All this data from Westinghouse RESAR; other areas from RESAR is designated W		Fuel Rod Cladding Material	Zircaloy-4
		Weight of Uranium, lbs.	222,739

F. SAFETY INJECTION SYSTEMS REACTOR: NEP 162	
W	Core Flooding System: 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.
W	High-Pressure Injection System: There are 2 pumps each rated 150 gpm at 2800 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 an additional 2 pumps rated at 425 gpm at 1500 psig that deliver water from the refueling water storage tank when reactor coolant pressure is reduced below their shutoff head.
W	Low-Pressure Injection System: 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 re-circulated from the sump. Capacity of these pumps is 3000 gpm at 160 psig.
G. MISCELLANEOUS	
W	Residual Heat Removal System: Transfers heat from Reactor Coolant System to the Component Cooling System thru the 2 heat exchanger during shutdown. The 2 pumps, each rated 3000 gpm at 160 psig, take suction from the refueling water storage tank when operating as injection pumps after LOCA. This system is also used for long term cooling by recirculating the coolant from the reactor thru the heat exchangers for cooling. The pumps are used for low-pressure injection in case of a LOCA. Heat removal capacity of the heat exchangers is 37.4×10^6 Btu/hr. each.
	Radwaste System: Liquid wastes will be collected and processed for recycle or for release to the ocean. Bulk of liquids released from the reactor coolant system will be processed by the boron recycle system. There will be 2 main processing systems - one for liquids that will be recycled and one for liquids that will be discharged. Discharge will be in circulating water system to the ocean. Gaseous wastes will be collected, degassified, passed through charcoal absorbers for iodine removal, dehumidified. Gases can be released to the environment or recycled. Gases are compressed and then recycled, stored in the hydrogen surge tank or released. Solid wastes are compressed and packaged in drums or containers for shipment to offsite disposal areas. Wastes from both plants are processed in one common facility.
	Plant Vent: On top of each reactor containment structure at elevation 198'. Stack runs up the side of containment.

G. MISCELLANEOUS (Continued) REACTOR: NEP 1&2

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.

Emergency Plans: Designed to cope with uncontrolled release of radioactivity, fire, weather conditions, equipment failure or any other emergency so that plant personnel and/or the public will be protected. Purpose of the plan is to classify emergencies according to severity, to assign responsibilities, and to setup a course of action. Final plans will be presented with the operating license application. Local, state, and Federal agencies will be used.

Environmental Monitoring: Monitoring started early in 1974 and has covered the ocean waters, salt water and fresh water ponds for physical chemical, aquatic organisms, and vegetable life. On land, monitoring includes the air and meteorology studies, ground water, vegetation, soil and geology, mammals, and amphibians. Also, a radiological plan has been established to set base lines before operation starts. Post-operational monitoring will be about the same, modified as required.

H. CIRCULATING WATER SYSTEM

Type of System: Once through

Water Taken From: Block Island Sound of the Atlantic Ocean

Intake Structure: Pump house is divided into 2 parts, one for each reactor unit. Each section has a forebay and 3 pump bays each with traveling screen. Water flows into forebay from the ocean intake which is about 2000' from the beach thru a 14' ID pipe.

Water Body Temperatures: Winter minimum 35 °F; Summer maximum 67 °F

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

Service Water Quantity 22,000 gpm/reactor

Flow Thru Condenser 406,000 (gpm)/reactor Temp. Rise 37 °F

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

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

Discharge Structure: Discharge to the ocean is thru a 14' ID pipe about 2400' from the shore, one for each reactor system. Discharge into the ocean is thru a multi-port diffuser in 30' depth of water.

Cooling Tower(s): Description & Number - Two units as ultimate heat sink.
Blowdown --- gpm/reactor Evaporative loss --- gpm/reactor

APPENDIX A
CUMULATIVE INDEX
FOR
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