VOLUME I (of 4 vols)

PRESSURIZED WATER REACTOR PLANT

1000-MWE CENTRAL STATION POWER PLANTS INVESTMENT COST STUDY

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ATOMIC ENERGY COMMISSION ★ UNITED STATES OF AMERICA ★

JUNE 1972

Prepared for the
UNITED STATES ATOMIC ENERGY COMMISSION
DIVISION OF REACTOR DEVELOPMENT AND TECHNOLOGY
Contract no. AT (30-1)-3032

For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402
Price $2.60 Domestic Postpaid or $2.25 GPO Bookstore

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I N D E X

INTRODUCTION

This report on a 1000 MWe nominally rated Pressurized Water Reactor Plant is one of a series of investment cost studies covering detailed cost and unit quantities performed under AEC contract number AT(30-1)-3032, formerly AT(30-1)-3770, modifications 9 and 10. Modification 9 consists of the following studies:

I

Volume No.	Title
I	Pressurized Water Reactor Plant
II	Boiling Water Reactor Plant
III	Coal-Fired Fossil Plant
IV	Oil-Fired Fossil Plant

Modification 10 consists of a study on a pool-type Liquid Metal Fast Breeder Reactor Plant.

The cost data for the nuclear plant studies are presented in accordance with Appendix A of "Guide For Economic Evaluation of Nuclear Reactor Plant Designs", USAEC Report Number NUS-531. This guide was modified for the fossil plant studies.

The intent of these studies is to present detailed cost information for a series of 1000 MWe electric generating plants to permit cost comparisons, evaluations and projections based on equivalent assumptions relative to site, labor, performance, and reference dates for cost data.

The cost data included in these reports is based on prices effective as of January 1971, and reflects to the maximum extent actual construction experience for units nearing completion or in operation. Table I-1 presents a summary of the detailed cost estimate that appears in section V of this report. This data should be adjusted to reflect normal contingency costs for material, labor and professional services. Use of this data for projection to a future operating date should be adjusted for escalation and interest during construction.

Similarly it is emphasized that a fundamental assumption of these reports is the unrestricted availability of water for once thru cooling with no provision for extended discharge, restricted intake velocities or dilution. These factors should be considered in applying these data to a specific site.

Table I-1

SUMMARY OF ESTIMATES

1000 MWe Pressurized Water Reactor Plant

Description	PWR Material	PWR Labor	PWR Total
Land & Land Rights	$ 1,000,000	$ -	$ 1,000,000
Structures & Improvements			
Yardwork	1,037,000	1,339,000	2,376,000
Main Power Station Building	-	-	-
Containment Building	5,068,800	8,772,200	13,841,000
Turbine Room & Heater Bay	2,094,000	2,694,000	4,788,000
Intake & Discharge Structures	844,000	1,754,000	2,598,000
Primary Auxiliary Building	1,144,900	3,037,000	4,181,900
Radwaste Building	-	-	-
Fuel Handling Building	453,800	919,100	1,372,900
Control Room Building	404,600	924,300	1,328,900
Diesel-Generator Building	168,200	436,800	605,000
Administration Building	470,000	440,500	910,500
Service Building	497,250	546,750	1,044,000
Fan Room Building	79,000	253,000	332,000
Aux. Feed Pump Enclosure	60,000	100,000	160,000
Stacks	-	-	-
Total Structures & Improvements,-	12,321,550	21,216,650	33,538,200
Reactor Plant Equipment			
Reactor Equipment	$13,852,000	$ 726,000	$14,578,000
Reactor Coolant System	20,887,500	2,426,500	23,314,000
Safeguards Cooling Systems	1,741,800	1,479,500	3,221,300
Radioactive Waste Systems	614,850	378,100	992,950
Nuclear Fuel Handling Sys.	948,850	586,300	1,535,150
Other Reactor Plant Equipt.	2,811,400	2,736,900	5,548,300
Instruments & Controls	4,227,700	1,055,000	5,282,700
Total Reactor Plant Equipment,-	45,084,100	9,388,300	54,472,400

Table I-1 (Cont'd)

Description	PWR Material	PWR Labor	PWR Total
Boiler Plant Equipment			
Steam Generating Equipt.			
Draft System			
Fossil Fuel Equipment		(Not Applicable)	
Ash Handling System			
Instruments & Controls			
Miscellaneous Suspense Items			
Total Boiler Plant Equipment,-			
Turbine Plant Equipment			
Turbine Generator Equipt.	$30,666,500	$ 2,777,500	$33,444,000
Condenser Water System	2,468,600	2,276,900	4,745,500
Condensing Systems	4,320,000	2,778,000	7,098,000
Feedwater Systems	4,649,400	3,398,000	8,047,400
Other Turbine Plant Equipt.	3,345,100	4,040,000	7,385,100
Instruments & Controls	975,000	650,000	1,625,000
Total Turbine Plant Equipment,-	46,424,600	15,920,400	62,345,000
Electric Plant Equipment			
Switchgear	1,073,800	191,000	1,264,800
Station Service Equipment	3,819,500	755,500	4,575,000
Switchboards	470,000	80,000	550,000
Protective Equipment	102,000	155,000	257,000
Elect. Struct. & Wiring Cont.	405,500	1,188,500	1,594,000
Power & Control Wiring	2,417,200	3,810,500	6,227,700
Total Electric Plant Equipment,-	8,288,000	6,180,500	14,468,500

Table I-1 (Cont'd)

Description	PWR Material	PWR Labor	PWR Total
Miscellaneous Plant Equipt.			
Transportation & Lifting Eqt.	$ 545,000	$ 153,000	$ 698,000
Air, Water & Steam Serv. Sys.	1,301,000	1,827,000	3,128,000
Communications Equipt.	50,000	75,000	125,000
Furnishing & Fixtures	238,000	30,500	268,500
Total Miscellaneous Plant Equipment,-	2,134,000	2,085,500	4,219,500
Subtotal:	115,252,250	54,791,350	170,043,600
Undistributed Costs			
Professional Services	$ -	$ -	$ 23,750,000
Other Undistributed Costs			
Temporary Facilities	1,260,000	2,820,000	4,080,000
Construction Equipment	6,035,000	745,000	6,780,000
Construction Services	1,965,000	665,000	2,630,000
Operator training, spare parts, Owner's Gen'l Offices and Administ. Costs	4,200,000	-	4,200,000
Total Other Undistributed Costs,-	13,460,000	4,230,000	17,690,000
Total Base Const. Costs			211,483,600

1000 MW PRESSURIZED WATER REACTOR POWER PLANT

TECHNICAL DESCRIPTION

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SECTION 1

INTRODUCTION AND SUMMARY

1.1 Introduction

This report presents a technical description of the Middletown Nuclear Power Generating Station utilizing a pressurized water reactor as the nuclear steam supply system. The station is located on the east bank of the North River at a distance of twenty-five miles south of Middletown, the nearest large city.

The report is divided into eleven sections and uses a standard Final Safety Analysis Report format wherever possible. Section 1 describes the report and summarizes the principal design features of the plant; Section 2 identifies the site and environs; Section 3 and 4 describe the reactor and the Reactor Coolant System; Section 5, the Containment System; Section 6, the Engineered Safety Features; Section 7, Plant Instrumentation and Control; Section 8, the Electrical System; Section 9, the Auxiliary and Emergency System; Section 10, the Steam and Power Conversion System; Section 11, Radioactive Wastes and Radiation Protection.

1.2 Summary Plant Description

The plant incorporates a closed-cycle pressurized water nuclear steam supply system, a turbine-generator and their necessary auxiliaries. A radioactive waste disposal system, fuel handling system and all auxiliaries, structures, and other on-site facilities required for a complete and operable nuclear power plant are provided. The heat balance shown on plate 9 reflects typical steam conditions for a 1000 MWe nominally rated plant.

General arrangements, cross sections, and flow diagrams of the plant are shown on Plates 1 through 9.

Nuclear Steam Supply System

The nuclear steam supply systems consist of a pressurized water reactor, Reactor Coolant System, and associated auxiliary fluid systems. The Reactor Coolant System is arranged as four closed reactor coolant loops, each containing a reactor coolant pump and a steam generator, connected in parallel to the reactor vessel. An electrically heated pressurizer is connected to one of the loops.

The reactor core is composed of uranium dioxide pellets enclosed in Zircaloy tubes with welded end plugs. The tubes are supported in assemblies by a spring clip grid structure. The mechanical portion of control rods consists of clusters of stainless steel clad absorber rods and guide tubes located within the fuel assembly. The core is initially loaded in three regions of different enrichments with new fuel being introduced into the outer region at successive refuelings, moved into the inner regions, and discharged to spent fuel storage.

The steam generators are vertical U-tube units employing Inconel tubes. Integral separating equipment reduces the moisture content of the steam leaving the steam generators to 1/4 per cent or less.

The reactor coolant pumps are vertical, single stage, centrifugal pumps equipped with controlled leakage shaft seals.

Auxiliary systems are provided to perform the following functions:

a) Charge the reactor coolant system
b) Add makeup water
c) Purify reactor coolant water
d) Provide chemicals for corrosion inhibition and reactor control
e) Cool system components
f) Remove residual heat when the reactor is shutdown
g) Cool the spent fuel storage pool
h) Sample reactor coolant water
i) Provide for emergency core cooling
j) Collect reactor coolant drains
k) Provide containment spray
l) Provide containment ventilation and cooling
m) Dispose of liquid, gaseous and solid wastes
n) Provide seal water for pipes penetrating containment following LOCA

o) Provide cooling for containment penetrations with hot pipes

p) Provide redundant means of removing hydrogen from containment following LOCA

q) Provide RCS leak detection system

Reactor and Plant Control

The reactor is controlled by a coordinated combination of chemical shim and mechanical control rods. The control system allows the unit to accept step load changes of ± 10% and ramp load changes of ± 5% per minute over the load range of 15% to, but not exceeding, 100% power under normal operating conditions subject to xenon limitations.

Turbine and Auxiliaries

The turbine is a tandem-compound-unit, comprising one high pressure and three low pressure cylinders at 1800 rpm having 44 inch last stage exhaust blading in the low pressure cylinders. Six combination moisture separator-reheater units are employed to dry and super heat the steam between the high and low pressure turbine cylinders. The turbine-generator is capable of a 50% loss of external electrical load without turbine or reactor trip. The turbine auxiliaries include deaerating surface condensers, steam jet air ejector, turbine driven main feed pumps, motor driven condensate pumps, and six stages of feedwater heating.

The turbine generator can deliver 1066 MWe, allowing for 66 MWe of auxiliary power requirements, at 1.5 in Hg absolute exhaust pressure with zero per cent make up and six stages of feedwater heating.

Electrical System

The main generator feeds electrical power through an isolated phase bus to two half-sized main power transformers. Station auxiliaries receive power during normal operation from the unit auxiliary transformer connected to the isolated phase bus and the station auxiliary transformer connected to an outside 138 kv source.

The Auxiliary Electrical System provides power to those auxiliary and engineered safeguard components which are required to operate during any of the plant's normal and emergency conditions of operation.

Power required for plant start-up and after reactor trip is furnished by a 138 kv off site source or an alternate on site 23.4 MVA gas turbine-generator.

Emergency power supply for vital instruments and controls is from two 125 volt d.c. station batteries.

The system design provides sufficient independence, isolation capability, and redundancy between the different power sources to avoid complete loss of auxiliary power.

Control Room

The plant is provided with a reactor and turbine-generator control room in the control building designed according to seismic, tornado and flooding criteria, and contains all the necessary instrumentation and control for the plant's operation under normal and accident conditions.

Adequate shielding and air conditioning facilities permit occupancy during all normal operating and accident conditions.

Diesel Generators

Three diesel generator sets supply emergency power for plant shutdown and essential safeguards operation in the event of the loss of all other a.c. auxiliary power simultaneously with the maximum credible accident.

Waste Disposal System

The Waste Disposal System collects and processes liquids, gases and solid wastes from plant operation for removal from the plant site. All removals are made in accordance with applicable guidelines for the process. It also provides hydrogen and nitrogen to the primary system as required by the plant's normal operating condition.

Fuel Handling System

The fuel handling system provides the ability to fuel and refuel the reactor core. Administrative procedures carefully established plus the design of the system minimize the probability of the potential fission product release during the refueling operation.

The system also includes the following features:

a) Safe accessibility for operating personnel.

b) Provisions for preventing fuel storage criticality.

c) Visual monitoring of the refueling procedures at all times.

Engineered Safety Features

The Engineered Safety Features for this plant have sufficient redundancy in component and power sources such that under the conditions of a hypothetical loss-of-coolant, the system can, even when operating with partial effectiveness, maintain the integrity of the containment and keep the exposure of the public below the limits of 10CFR100.

The major engineered safeguards systems are as follows:

a) The Containment System which incorporates continuously pressurized and monitored penetrations and liner weld channels; and an isolation valve seal water injection system which provides a highly reliable, essentially leak-tight barrier against the escape of radioactivity which might be released to the containment atmosphere.

b) The Safety Injection System (which constitutes the Emergency Core Cooling System) provides borated water to cool the core in the event of a loss of coolant accident.

c) The Containment Air Recirculation Cooling and Filtration System which provides a heat sink to cool the containment atmosphere and provides filtration of the containment atmosphere to remove airborne particulate and halogen fission products which form the source for potential public exposure.

d) The Containment Spray System which provides a spray of cool, chemically treated borated water to the containment atmosphere as a backup heat sink and iodine removal capability for the Containment Air Recirculation Cooling and Filtration System.

Structures

The major Class I structures are the reactor containment building, the auxiliary building, the control building, the spent fuel pit and the service water intake structure. The turbine building and heater bay are designed as Class III.

The reactor containment is a steel lined reinforced concrete cylinder with a hemispherical dome and a flat base. The containment is designed to withstand the internal pressure accompanying a loss-of-coolant accident. It is subjected to an integrated structural and leak rate test prior to operation and provides adequate radiation shielding for both normal operation and accident conditions.

Continuously pressurized double containment is provided at all liner seams and penetrations including access openings and ventilation ducts.

When required, the containment isolation valve seal water system permits automatic rapid sealing of pipes which penetrate the containment so that in the event of any loss-of-coolant accident, there will be no leakage from containment to the environment through those pipes.

Ground accelerations for the operational basis earthquake used for containment design purposes and for all Safety Class I structures are .075g applied horizontally. In addition, ground accelerations for the design basis earthquake of .15g horizontally are used. The vertical acceleration is based on 2/3rds the horizontal ground acceleration response spectra.

SECTION 2

SITE AND ENVIRONMENT

This section sets forth the site and environmental data, as defined in Appendix A of "Guide For Economic Evaluation of Nuclear Reactor Plant Designs", USAEC Report NUS-531, modified to reflect current requirements. This data forms a basis of the criteria for designing the facility and for evaluating the routine and accidental release of radioactive liquids and gases to the environment.

2.1 Topography and General Site Characteristics

The site is located on the east bank of the North River at a distance of twenty-five miles south of Middletown, the nearest large city. The North River flows from north to south and is one-half mile (2600 feet) wide adjacent to the plant site. A flood plain extends from both river banks an average distance of 1/2 miles, ending with hilltops generally 150 to 250 feet above the river level. Beyond this area, the topography is gently rolling, with no major critical topographical features. The plant site itself extends from river level to elevations of fifty feet above river level. The containment building, other Class I structures and the switchyard will be located on level ground at an elevation of eighteen feet above the mean river level. This elevation is ten feet above the 100-year maximum river level, according to U. S. Army Corps of Engineers studies of the area.

In order to optimize land area requirements for the nuclear power plant site, maximum use of the river location was employed. The containment structure is located 400 feet from the east bank of the river. The site land area was taken as approximately 500 acres. In order to conform to the dose criteria specified in 10CFR100, single-barrier containment was supplemented by additional engineered safeguards. The minimum cross sectional area of the containment building is 1400 square meters.

2.2 Site Access

Highway access is provided to the Hypothetical Site by five miles of secondary road connecting to a state highway; this road is in good condition and needs no additional improvements. Railroad access will be provided by constructing a railroad spur which intersects the B&M Railroad. The length of the required spur from the main line to the plant site is assumed to be five miles in length for all plant sizes. The North River is navigable throughout the year with a forty-foot wide channel, 12 feet deep. The distance from the shoreline to the center of the ship channel is 2000 feet. All plant shipments will be made overland except that heavy equipment (such as reactor vessel and generator stator) may be transported by barge. The Middletown Municipal Airport is located 3 miles west of the State highway, 15 miles south of Middletown, and 10 miles north of the site.

2.3 Population Density and Land Use

The Hypothetical Site is near a large city (Middletown, 250,000 population) but in an area of low population density. Variation in population with distance from the site boundary is:

Miles	Cumulating Population
0.5	0
1.0	310
2.0	1,370
5.0	5,020
10.0	28,600
20.0	133,000
30.0	1,010,000

There are five industrial manufacturing plants within 15 miles of the Hypothetical Site. Four are small plants employing less than 100 people each. The fifth, near the airport, employs 2500 people. Closely populated areas are found only in the centers of the small towns so the total land area used for housing is small. The remaining land, including that across the river, is used as forest or cultivated crop land, except for railroads and highways.

2.4 Cooling Water and Public Utility Services

Utilities are available as follows:

The North River provides an adequate source of raw make up and condenser cooling water for the ultimate station capacity. The average maximum temperature is 75°F and the average minimum is 39°F. The mean annual temperature is 57°F. (These temperatures are such as to enable the turbine back-pressure to be specified as 1.5 inches Hg. absolute).

Natural gas service is available two miles from the site boundary on the same side of the river.

Communication lines will be furnished to the project boundaries at no cost.

Power and water for construction activities are available at the southwest corner of the site boundary.

2.5 Meteorology and Climatology

Prevailing Wind

According to Weather Bureau records at the Middletown Airport, located ten miles north of the site on a low plateau just east of the North River, surface winds are predominantly southwesterly 4 - 10 knots during the warm months of the year, and westerly 6 - 13 knots during the cool months.

There are no large diurnal variations in wind speed or direction. Observations of wind velocities at altitudes indicate a gradual increase in mean velocity and a gradual veering of the prevailing wind direction from southwest and west near the surface to westerly and northwesterly aloft.

In addition to the above, studies of the area indicated that there is a significant channeling of the winds below the surrounding hills into the north-south orientation of the North River. It is estimated that winds within the river valley blow approximatley parallel to the valley orientation in excess of 50 percent of the time.

Atmospheric Diffusion Properties

During the warm months of the year, according to analysis of Weather Bureau records, the atmospheric conditions near the surface are 25 percent unstable (Pasquill A, B, and C), 40 percent neutral (Pasquill D), and 35 percent stable (Pasquill E and F). Average wind speeds are approximatley six miles per hour during unstable conditions, ten miles per hour during neutral conditions, and four miles per hour during stable conditions.

During the cool months of the year, the atmospheric conditions are 15 percent unstable, 50 percent neutral, and 35 percent stable. Average wind speeds are six miles per hour during unstable conditions, twelve miles per hour during neutral conditions, and four miles per hour during stable conditions.

Severe Meteorological Phenomena

A maximum instantaneous wind velocity of 100 mph has been recorded at the site. During the past 50 years, three tropical storms, all of them in the final dissipation stages, have passed within 50 miles of the site. Some heavy precipitation and winds in excess of 40 miles per hour were recorded, but no significant damage other than to crops resulted.

The area near the site experiences an average of 35 thunderstorms a year, with maximum frequency in early summer. High winds near 60 mph, heavy precipitation, and hail are recorded about once every four years.

In forty years of record, there have been twenty tornadoes reported within fifty miles of the site. This moderately high frequency of tornado activity indicates a need to design Class I structures at the site for the possibility of an on-site tornado occurrence. Maximum tornado frequency occurs in May and June.

During the past forty years, there have been ten storms in which freezing rain has caused power transmission line disruptions. Most of these storms have occurred in early December.

Potential Accidental Release Meteorology

Meteorological Diffusion Evaluation

In the event of an accidental release of fission products to the atmosphere, transport and dispersal will be determined by the meteorological conditions at the site for the duration of the accident, which is assumed to be 30 days.

The calculation of the potential doses for the various design base accidents is based on meteorological conditions described in AEC's Safety Guide 3. The assumptions used in Safety Guide 3 are shown in the following:

Elevated Release

The basic equation for atmospheric diffusion for an elevated release is:

$$X/Q = \frac{e^{-H^2/2\sigma_Z^2}}{u\,\sigma_y\,\sigma_z}$$

where:

X = the short term average centerline value of the ground level concentration (curies/meter^3)

Q = material release rate (curies/sec)

σu = wind speed (meters/sec)

σ_y = the horizontal standard deviation of the plume (meters)

z = The vertical standard deviation of the plume (meters)

H = effective height of release (meters)

The equation used for releases with time periods of greater than 8 hours, to determine the atmospheric diffusion from an elevated release assumed to meander and spread uniformly over a 22.5^o sector is:

$$X/Q = \frac{2.032\, e^{-(H/\sigma_z)^2}}{\sigma_z\, ux}$$

where:

x = distance from the release point (meters)

The atmospheric diffusion model for an elevated release as a function of the distance from the reactor is based on the following:

0-8 hrs: Envelope of Pasquill diffusion categories based on figure A7 of "Meteorology and Atomic Energy - 1968", with 100 m stack height, windspeed 1 meter/sec, uniform direction. A fumigation condition is assumed to exist at the time of the accident and continues for 4 hours. The dispersion factor for fumigation conditions is shown in Figure 2-1.

8-24 hrs: Envelope of Pasquill diffusion categories, windspeed 1 meter/sec, variable direction within a 22.5^{o} sector

1-4 days: Envelope of Pasquill diffusion categories with the following relationship used to represent maximum plume concentrations as a function of distance:

Atmospheric Condition Case 1

40% Pasquill A, 60% Pasquill C

Atmospheric Condition Case 2

50% Pasquill C, 50% Pasquill D

Atmospheric Condition Case 3

33.3% Pasquill C
33.3% Pasquill D
33.3% Pasquill E

Atmospheric Condition Case 4

33.3% Pasquill D
33.3% Pasquill E
33.3% Pasquill F

Atmospheric Condition Case 5

50% Pasquill D
50% Pasquill F

wind speed 2 meters/sec Pasquill Types A, B, E, F,
wind speed 3 meters/sec Pasquill Types C and D
variable direction within a 22.5^{o} sector

4-30 days same diffusion relations as given above; wind speed variable dependent on Pasquill Type used; wind direction 33.3% frequency in a 22.5^{o} sector.

The diffusion factor for an elevated release of 100m stack height is shown in Figure 2-2.

Ground-Level Release

The atmospheric diffusion model as a function of the distance from the reactor is based on the following assumptions:

1. The basic equation for atmospheric diffusion from a ground level point source is:

$$X/Q = \frac{1}{u \sigma_y \sigma_z}$$

where:

X = the short term average centerline value of the ground level concentration (curies/meter^3)

Q = material release rate (curies/sec)

u = wind speed (meters/sec)

σ_y = the horizontal standard deviation of the plume (meters)

σ_z = the vertical standard deviation of the plume (meters)

2. For time periods of greater than 8 hrs the plume is assumed to meander and spread uniformly over a 22.5^{o} sector. The resultant equation is

$$X/Q = \frac{2.032}{\sigma_z u x}$$

where x = distance from the point of release (meters)

3. The atmospheric diffusion model for ground level releases is based on the information in the table below.

Time Following Accident	Atmospheric Conditions
0-8 hrs.	Pasquill Type F, windspeed 1 meter/sec, uniform direction
8-24 hrs.	Pasquill Type F, windspeed 1 meter/sec, variable direction within a 225^{o} sector
1-4 days	(a) 40% Pasquill Type D, windspeed 3 meter/sec (b) 60% Pasquill Type F, windspeed 2 meter/sec (c) wind direction - variable within a 22.5^{o} sector
4-30 days	(a) 33.3% Pasquill Type C, wind speed 3 meter/sec (b) 33.3% Pasquill Type D, wind speed 3 meter/sec (c) 33.3% Pasquill Type F, wind speed 2 meter/sec (d) Wind direction - 33.3% frequency in a 22.5^{o} sector

Figure 2-3 gives the ground level release atmospheric diffusion factor based on the above parameters.

Inhalation Dose to the Thyroid

The thyroid dose due to the inhalation of radioiodines contained in the cloud (plume) of fission products is calculated from:

$$D = \sum_i Di = \frac{\chi(x)}{Q} R \sum Ki\ Qi\ e^{-\lambda i \frac{x}{\bar{u}}}$$

where:

D = Total thyroid dose (rems)

Di = thyroid dose due to ith isotope.

x = Distance from the source of release (m)

$\frac{\chi(x)}{Q}$ = meteorological dispersion factor (sec/m^3)

Ki = dose conversion factor for a unit amount inhaled for ith iodine isotope, (rems/curie inhaled)

Q_i = quantity of the i^{th} iodine isotope released to the environment over a given time interval, (curies)

λ_i = decay constant of i^{th} iodine isotope, (sec^{-1})

$\bar{u}$ = average wind speed, (m/sec)

R = breathing rate of standard man (m^3/sec)

The dose conversion factors for radioiodines are shown as follows:

$K_1 = 1.48 \times 10^6$ rem/Ci inhaled
$K_2 = 5.35 \times 10^4$ rem/Ci inhaled
$K_3 = 4.00 \times 10^5$ rem/Ci inhaled
$K_4 = 2.50 \times 10^4$ rem/Ci inhaled
$K_5 = 1.24 \times 10^5$ rem/Ci inhaled

The breathing rates used for all inhalation dose calculation are as prescribed in Safety Guide 3 are as follows:

0-8 hours	3.47×10^{-4} m^3/sec
8-24 hours	1.75×10^{-4} m^3/sec
1-30 days	2.32×10^{-4} m^3/sec

2.6 Geology and Seismology

Soil Profiles and Load Bearing Characteristics

Soil profiles for the site show alluvial soil and rock fill to a depth of eight feet; Brasfield limestone to a depth of 30 feet; blue weathered shale and fossiliferous Richmond limestone to a depth of 50 feet; and bedrock over a depth of 50 feet. Allowable soil bearing is 6000 psf and rock bearing characteristics are 18,000 psf and 15,000 psf for Brassfield and Richmond strata, respectively. No underground cavities exist in the limestone.

Seismology

This is a Zone 1 site, as designated by the Uniform Building Code, based on the observation of three earthquakes of seismic intensities 4-6 on the Modified Mercall scale during the period 1870-1958, causing minor damage to towns in the surrounding area.

2.7 Sewage and Radioactive Waste Disposal

Sewage

All sewage must receive primary and secondary treatment prior to discharge into the North River.

Gaseous and Liquid Radioactive Wastes

Maximum permissible concentrations or dosages shall be as prescribed in the current revision of 10 CFR 20. The activity level of the liquid effluent shall be measured as it leaves the plant. No credit for dilution in the North River will be assumed.

Solid Radioactive Wastes

Storage on site for decay will be permissible but no ultimate disposal on site will be made.

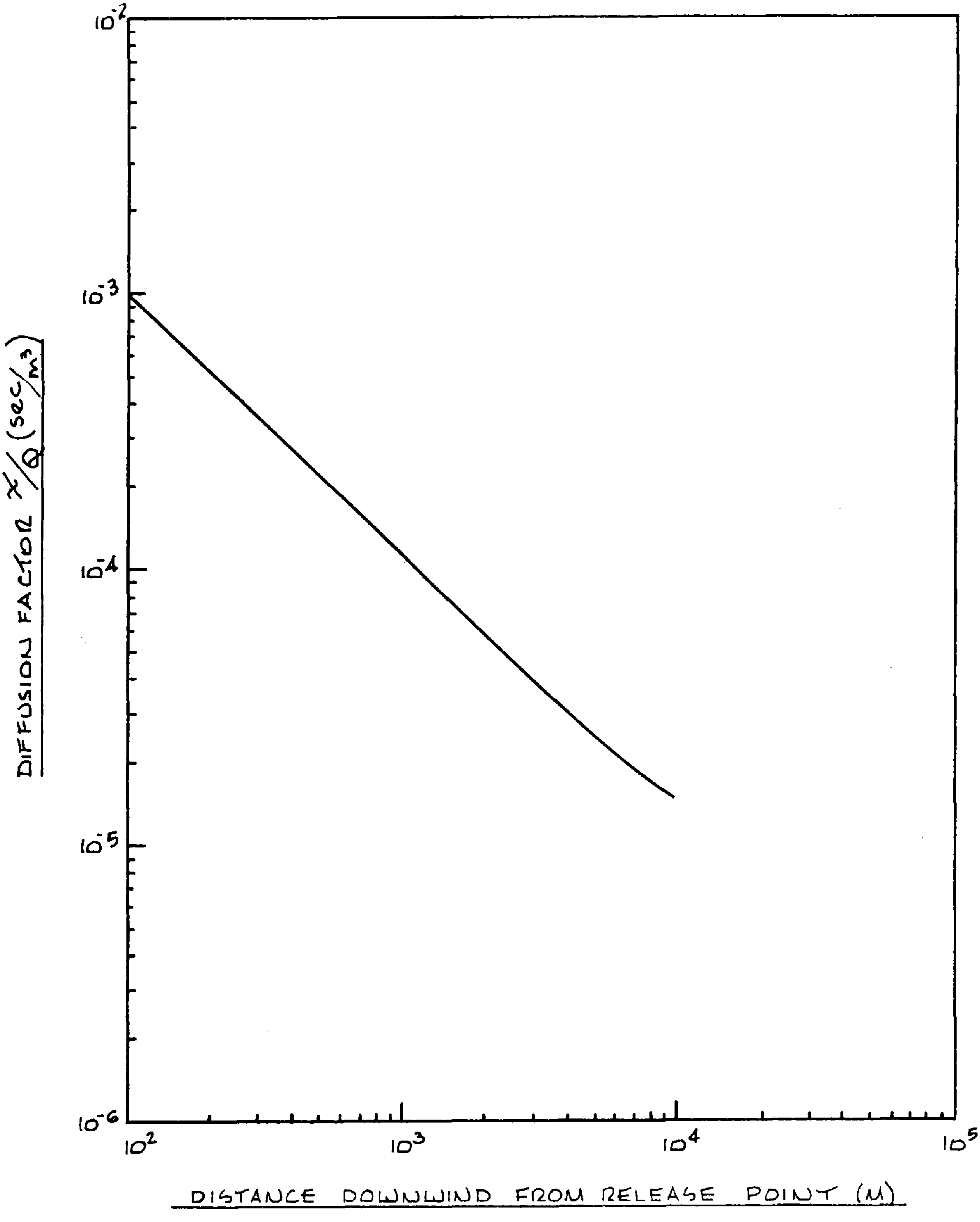


FIG. 2.1
ELEVATED RELEASE (100M)
ATMOSPHERIC DISPERSION FACTORS FOR
FUMIGATION CONDITIONS
PWR

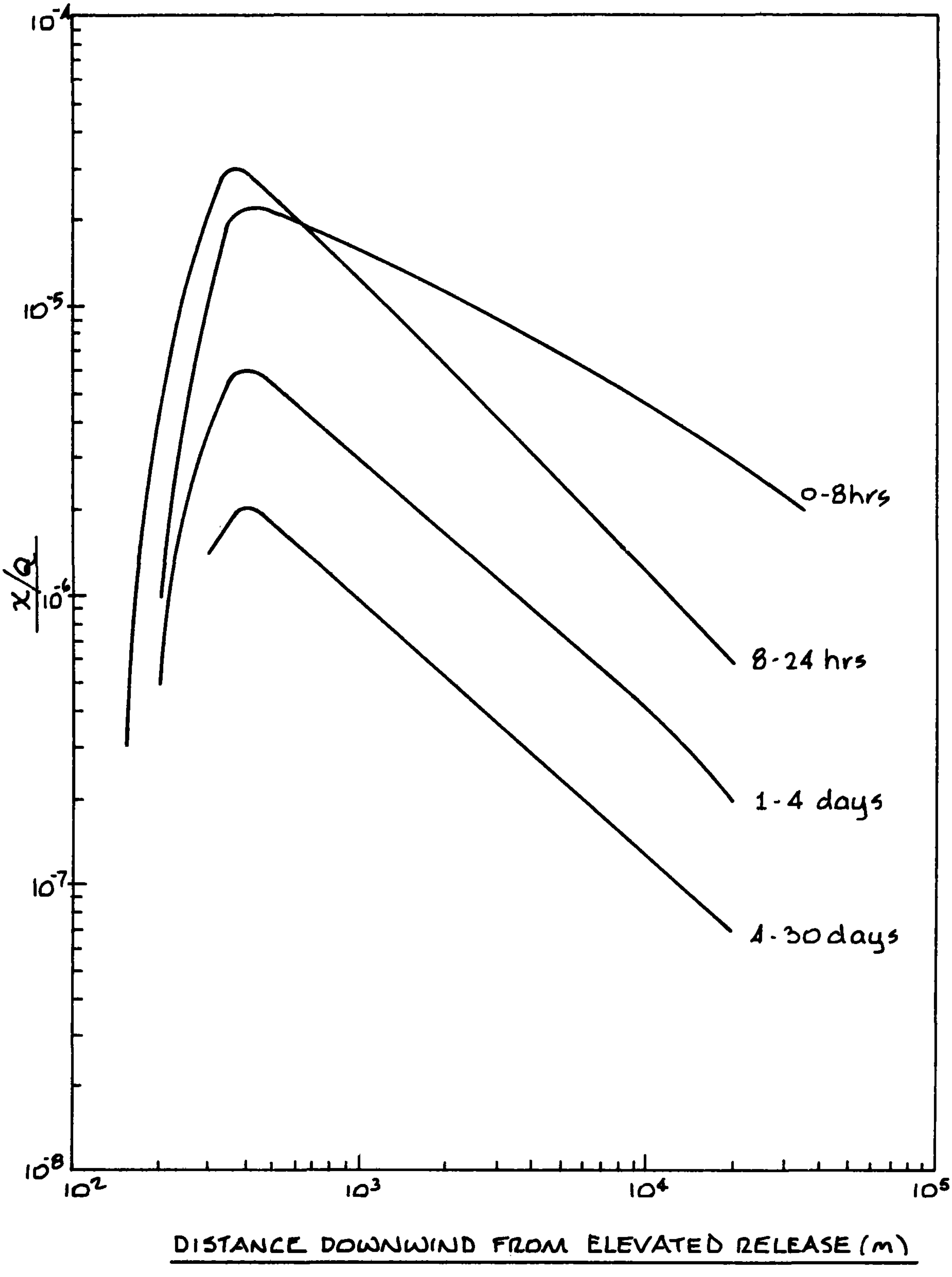


FIG. 2.2
ELEVATED RELEASE (100M)
ATMOSPHERIC DIFFUSION FACTORS
PWR

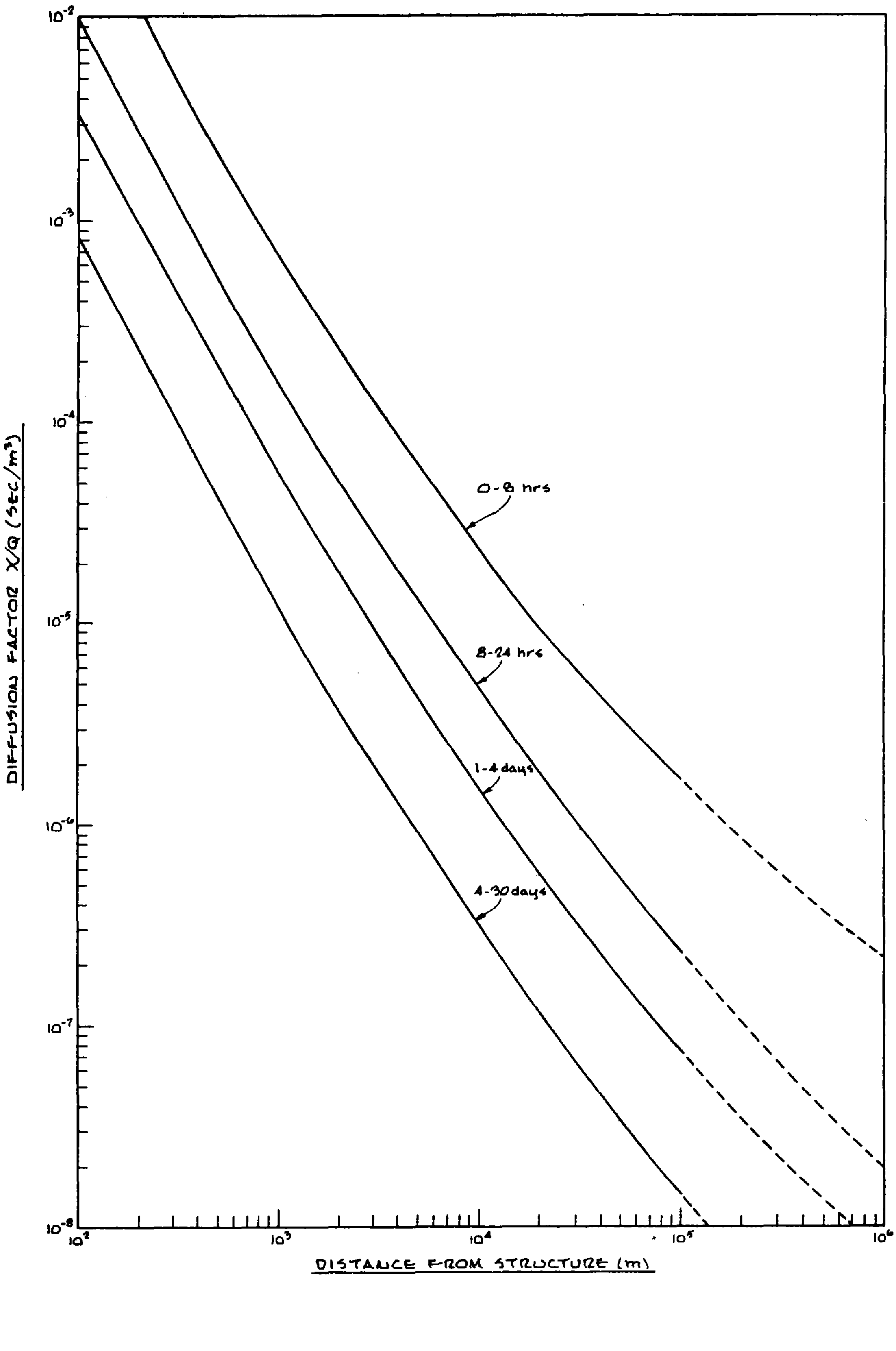


FIG. 2.3
GROUND RELEASE
ATMOSPHERIC DISPERSION FACTORS
PWR

SECTION 3

REACTOR

The reactor vessel and internals are shown in Figure 3.1. The core, consisting of the fuel assemblies, control rods, source rods, burnable poison rods, and guide thimble plugging devices, provides and controls the heat source for the reactor operation. The internals, consisting of the upper and lower core support structure, are designed to support, align, and guide the core components, direct the coolant flow to and from the core components, and support and guide the in-core instrumentation. A listing of the core mechanical design parameters is given in Table 3.1.

The fuel assemblies are arranged in a roughly circular cross-sectional pattern. The assemblies are all identical in configuration, but contain fuel of different enrichments depending on the location of the assembly within the core.

The fuel is in the form of slightly enriched uranium dioxide ceramic pellets. The pellets are stacked to an active height of 144 inches within Zircaloy-4 tubular cladding which is plugged and seal welded at the ends to encapsulate the fuel. The fuel rods are internally pressurized with helium during fabrication. Heat generated by the fuel is removed by demineralized light water which flows upward through the fuel assemblies and acts as both moderator and coolant.

The core is divided into regions of three different enrichments. Refueling takes place generally in accordance with an inward loading schedule.

The control rods, designated as Rod Cluster Control Assemblies (RCCA), consist of groups of individual absorber rods which are held together by a spider at the top end and actuated as a group. In the inserted position, the absorber rods fit within hollow guide thimbles in the fuel assemblies. The guide thimbles are an integral part of the fuel assemblies and occupy locations within the regular fuel rod pattern where fuel rods have been deleted. In the withdrawn position, the absorber rods are guided and supported laterally by guide tubes which form an integral part of the upper core support structure.

The fuel assemblies are positioned and supported vertically in the core between the upper and lower core plates. The core plates are provided with pins which index into closely fitting mating holes in the fuel assembly top and bottom nozzles. The pins maintain the fuel assembly alignment which permits free movement of the control rods from the fuel assembly into the guide tubes in the upper support structure without binding or restriction between the rods and their guide surfaces.

Operational or seismic loads imposed on the fuel assemblies are transmitted through the core plates to the upper and lower support structures and ultimately to the internals support ledge at the pressure vessel flange in the case of vertical loads or to the lower radial support and internals support ledge in the case of horizontal loads. The internals also provide a form fitting baffle surrounding the fuel assemblies which confines the upward flow of coolant in the core area to the fuel bearing region.

TABLE 3.1

CORE MECHANICAL DESIGN PARAMETERS[1]

Active Portion of the Core	
Equivalent Diameter, in.	132.7
Active Fuel Height, in.	144.0
Length-to-Diameter Ratio	1.09
Total Cross-Section Area, Ft^2	96.06
Fuel Assemblies	
Number	193
Rod Array	15 x 15
Rods per Assembly	204[2]
Rod Pitch, in.	0.563
Overall Dimensions	8.426 x 8.426
Fuel Weight, (as UO_2), pounds	215,800
Total Weight, pounds	276,000
Number of Grids per Assembly	7
Number of Guide Thimbles	20
Diameter of Guide Thimbles (upper part), in.	0.545 O.D. x 0.515 I.D.
Diameter of Guide Thimbles (lower part), in.	0.484 O.D. x 0.454 I.D.
Fuel Rods	
Number	39,372
Outside Gap, in.	0.422
Diametral Gap, in.	0.0065
Clad Thickness, in.	0.0243
Clad Material	Zircaloy
Overall Length	149.7
Length of End Cap, overall, in.	0.688
Length of End Cap, inserted in rod, in.	0.250

TABLE 3.1 (Cont'd)

Fuel Pellets	
Material	UO_2 sintered
Density (% of Theoretical)	
Region 1	94 (10.3 g/cc)
Region 2	93 (10.19 g/cc)
Region 3	92 (10.08 g/cc)
Feed Enrichments w/o	
Region 1	2.25
Region 2	2.80
Region 3	3.30
Diameter, in.	0.3659
Length, in.	0.600
Rod Cluster Control Assemblies	
Neutron Absorber	5% Cd, 15% In, 80% Ag
Cladding Material	Type 304 SS-Cold Worked
Clad Thickness, in.	0.019
Number of Clusters	
Full Length	53
Part Length	8
Number of Control Rods per Cluster	20
Length of Control Rod, in.	156.436 (overall)
	149.136 (insertion length)
Length of Absorber Section, in.	142.00 (full length)
	36.00 (part length)
Core Structure	
Core Barrel, in.	
I.D.	148.0
O.D.	152.5
Thermal Shield, in.	
I.D.	158.5
O.D.	164.0

TABLE 3.1 (Cont'd)

Burnable Poison Rods

Number	1436
Material	Borosilicate Glass
Outside Diameter, in.	0.4395
Inner Tube, O.D. in.	0.2365
Clad Material	S.S.
Inner Tube Material	S.S.
Boron Loading (natural) gm/cm of glass rod	.0603

(1) All dimensions are for cold conditions.

(2) Twenty-one rods are omitted: Twenty provide passage for control rods and one to contain in-core instrumentation.

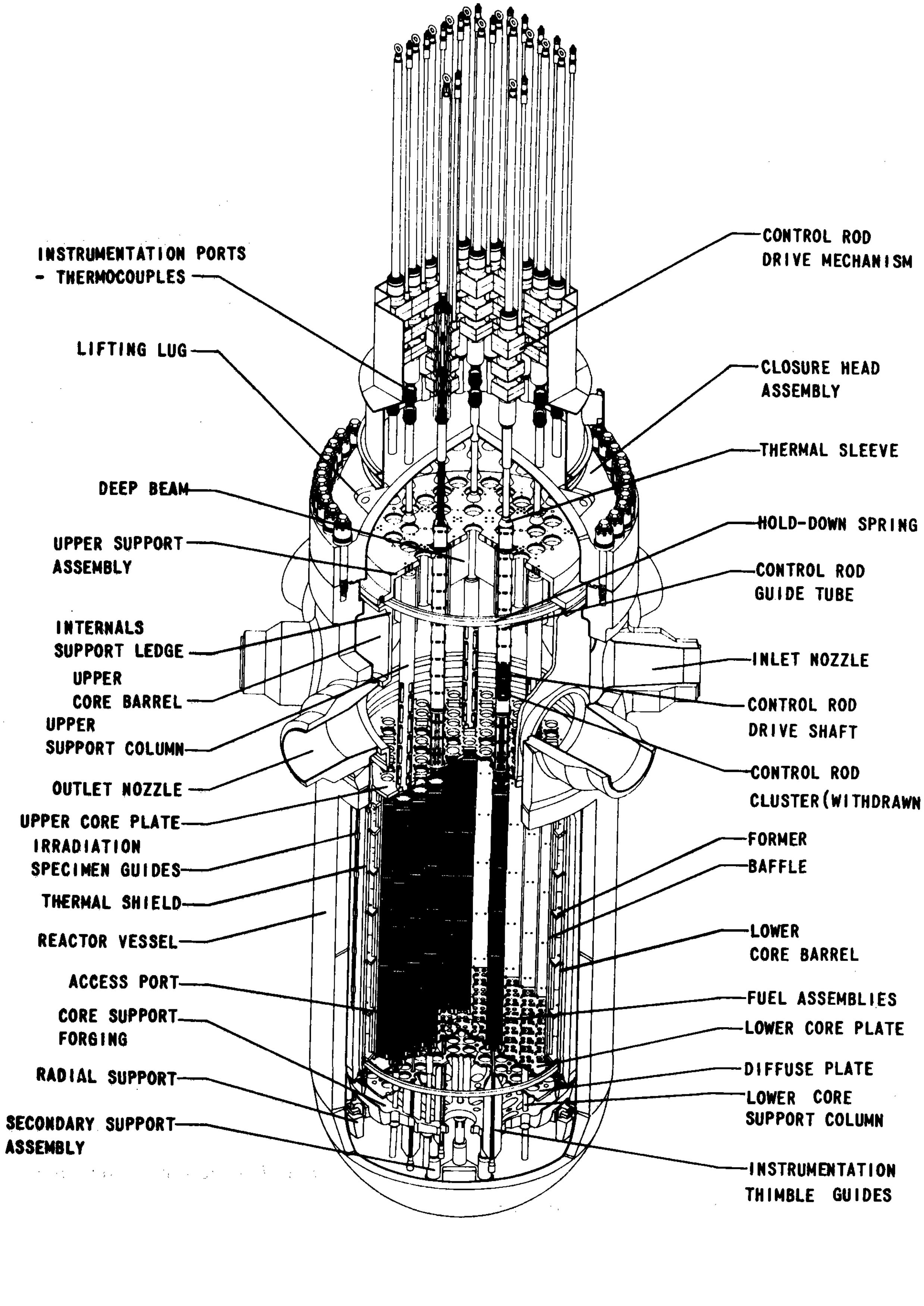


FIG. 3-1 REACTOR VESSEL AND INTERNALS
PWR

SECTION 4

REACTOR COOLANT SYSTEM

The Reactor Coolant System transfers the heat generated in the core to the steam generators where steam is produced to drive the turbine generator. This system consists of four similar heat transfer loops connected in parallel to the reactor vessel. Each loop contains a steam generator, a pump, loop piping, and instrumentation. The pressurizer surge line is connected to one of the loops. Auxiliary system piping connections into the reactor coolant piping are provided as necessary. A flow diagram of the system is shown on Figure 4.1. Reactor Coolant System design data are listed in the equipment list section of the report. A power level of 100% rated output for 80% of the time is considered an estimate of ideal operation over the service life of the system.

Pressure in the system is controlled in the pressurizer, where water and steam pressure is maintained through the use of electrical heaters and sprays. Steam can either be formed by the heaters, or condensed by a pressurizer spray to minimize pressure variations due to contraction and expansion of the coolant. Spring-loaded steam safety valves and power-operated relief valves are connected to the pressurizer and discharge to the pressurizer relief tank, where the discharged steam is condensed and cooled by mixing with water.

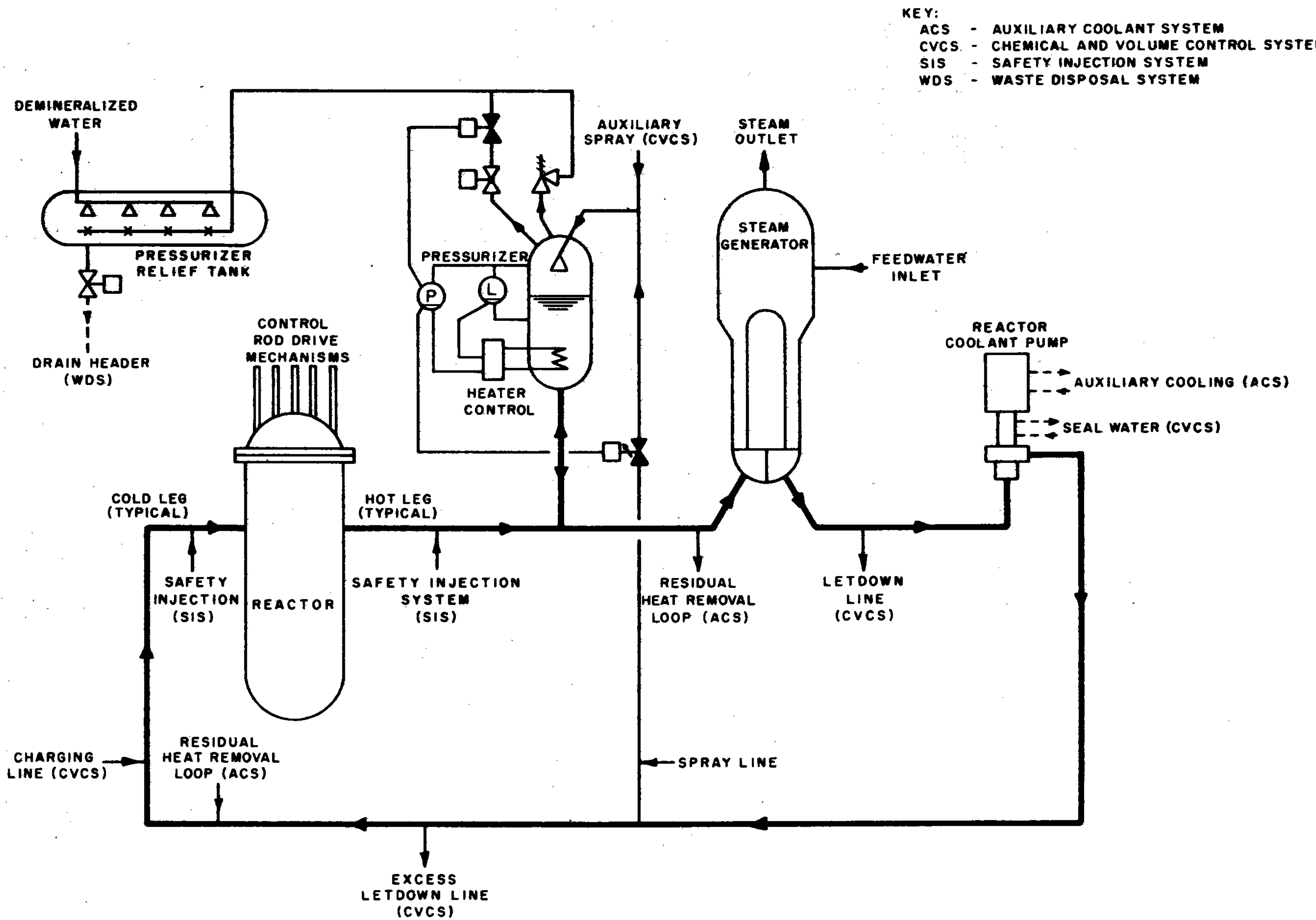


FIG. 4.1 REACTOR COOLANT SYSTEM

SECTION 5

CONTAINMENT SYSTEM

The containment structure completely encloses the entire reactor and reactor coolant system and ensures that essentially no leakage of radioactive materials to the environment would result even if gross failure of the reactor coolant system were to occur. The structure will provide biological shielding for normal and accident situations.

The containment structure is designed to safely withstand several conditions of loading and their credible combinations, which are site dependent.

The design pressure and temperature of the containment are, as a minimum, equal to the peak pressure and temperature occurring as the result of the complete blowdown of the reactor coolant through any rupture of the reactor coolant system up to and including the hypothetical double ended rupture of a reactor coolant pipe. Energy contribution from the steam system is included in the calculation of the containment pressure transient due to reverse heat transfer through the steam generator tubes. The supports for the reactor coolant system are designed to withstand the blowdown forces associated with the sudden severance of the reactor coolant piping coincident with the design basis earthquake but not with the coincidental rupture of the steam system. In addition, the design pressure will not be exceeded during any subsequent long term pressure transient determined by the combined effects of heat sources such as residual heat and limited metal-water reactions, structural heat sinks and the operation of the engineered safe-guards; the latter utilizing only the emergency electric power supply.

The design pressure and temperature on the containment structure are those created by the hypothetical loss-of-coolant accident. In the hypothetical accident, this coolant is released through a double-ended break in the largest reactor coolant pipe, causing a rapid pressure rise in the containment to approximately 42 psi.

The reactor containment structure is a reinforced concrete vertical right cylinder with a flat base and hemispherical dome. A welded steel liner with a minimum thickness of 3/8 inch is attached to the inside face of the concrete to insure a high degree of leak-tightness. The design objective of the containment structure is to contain all radioactive material which might be released from the core following a loss-of-coolant accident. The structure serves as both a biological shield and a pressure container.

The structure consists of side walls measuring 148-feet from the liner on the base to the springline of the dome, and has an inside diameter of 135-feet. The side walls of the cylinder and the dome are 4-ft. 6-in. and 3-ft. 6in., thick, respectively. The inside radius of the dome is equal to the inside radius of the cylinder so that the discontinuity at the springline due to the change in thickness is on the outer surface. The flat concrete base mat is 9-ft. thick with the bottom liner plate located on top of this mat. The bottom liner plate is covered with 3-ft. of concrete, the top of which forms the floor of the containment.

The basic structural elements considered in the design of the containment structure are the base slab, side walls and dome acting as one structure under all possible loading conditions. The liner is anchored to the concrete shell by means of stud anchors. The reinforcing in the structure will have a total elastic response to all primary loads. The lower portion of the cylindrical liner is insulated to avoid thermal deformation of the liner under accident conditions.

The containment structure is inherently safe with regard to common hazards such as fire, flood and electrical storm. The thick concrete walls are invulnerable to fire and only an insignificant amount of combustible material, such as lubricating oil in pump and motor bearings, is present in the containment.

Internal structures consist of equipment supports, shielding, reactor cavity and canal for fuel transfer, and miscellaneous concrete and steel for floors and stairs. All internal structures are supported on the 3-foot thick floor slab.

A 3-foot thick concrete ring wall serving as a missile and partial radiation shield surrounds the reactor coolant system components and supports the 175 ton polar-gantry crane. A 2-foot thick reinforced concrete floor covers the reactor coolant system with removable gratings in the floor provided for crane access to the reactor coolant pumps. The four steam generators and the pressurizer penetrate the floor. Spiral and regular stairs provide access to the areas below the floor. A reinforced concrete missile shield surrounds completely the portion of the pressurizer which protrudes above the operating floor thereby protecting the containment liner from postulated relief valve or instrument missiles connected to the pressurizer.

The refueling canal connects the reactor cavity with the fuel transport tube to the spent fuel pool. The floor and walls of the canal are concrete, with wall and shielding water providing the equivalent of 6-feet of concrete. The floor is 4-foot thick. The concrete walls and floor are lined with 1/4-inch thick stainless steel plate. The linings provide a leakproof membrane that is resistant to abrasion and damage during fuel handling operation.

SECTION 6

ENGINEERED SAFETY FEATURES

6.1 General

The safety objective in the reactor design and operation is control of reactor fission products. The methods used to assure this objective are:

a) Core design to preclude release of fission products from the fuel.

b) Retention of fission products in the reactor coolant for whatever leakage occurs.

c) Retention of fission products by the containment for operational and accidental releases beyond the reactor coolant boundary.

d) Optimizing fission product dispersal to minimize population exposure.

The Engineered Safety Features are the provisions in the plant which embody the forementioned methods to prevent the occurrence or to ameliorate the effects of serious accidents.

The Engineered Safety Features systems in this plant are the Containment System, the Safety Injection System, the Containment Spray System, the Containment Air Recirculation Cooling and Filtration System, the Isolation Valve Seal Water System and the Containment Penetration and Weld Channel Pressurization System.

The Containment System is described in Section 5.

6.2 Safety Injection System

The Safety Injection System provides adequate emergency core cooling following a loss-of-coolant accident. The Safety Injection System is shown in Figure 6.1. The system components operate in the following possible modes:

a) Injection of borated water by the passive accumulators.

b) Injection of borated water from the boron injection tank and the refueling water storage tank with the safety injection pumps.

c) Injection by the residual heat removal pumps also drawing borated water from the refueling water storage tank.

d) Recirculation of spilled reactor coolant, injected water and Containment Spray System drainage back to the reactor from the recirculation sump by the recirculation pumps. (The residual heat removal pumps provide backup recirculation capability.)

The principal components of the Safety Injection System which provide emergency core cooling immediately following a loss-of-coolant are the accumulators (one for each loop), the three safety injection (high head) pumps and the two residual heat removal (low head) pumps. The safety injection and residual heat removal pumps are located in the auxiliary building.

The accumulators, which are passive components, discharge into the cold legs of the reactor coolant piping when pressure decreases to 650 psig, thus assuring core cooling for large breaks. They are located inside the containment, but outside the crane wall, therefore each is protected against possible missiles.

The safety injection signal opens the Safety Injection System isolation valves and starts the safety injection pumps which deliver borated water to two separate discharge headers. The flow from one header is injected into two hot legs of the reactor coolant system, and the flow from the other header is injected into four cold legs via the boron injection tank.

One high head injection header contains a boron injection tank (discharge side of pump) for addition of negative reactivity to the reactor cold legs in the minimum time delay. The refueling water flowing into the tank from the discharge of the high head pumps forces the high boron concentration solution out of the tank and into the Reactor Coolant System.

For large breaks, the Reactor Coolant System would be depressurized and voided of coolant rapidly (about 10 seconds for the largest break) and a high flow rate is required to maintain a water cover over the fuel rods and prevent core damage.

To achieve this objective the residual heat removal pumps (high flow, low head) deliver borated water from the refueling water storage tank to the cold legs of the reactor coolant loops. Two pumps are available in order to provide for an active component failure. Delivery from these pumps supplements the accumulator discharge.

After the injection operation, coolant spilled from the break and water collected from the containment spray is cooled and returned to the Reactor Coolant System by the recirculation system. The system is arranged so that the recirculation pumps take suction from the recirculation sump in the containment floor and deliver spilled reactor coolant and borated refueling water back to the core through the residual heat exchangers. The system is also arranged to allow either of the residual heat removal pumps to take over the recirculation function. Water is delivered from the containment to the residual heat removal pumps from a separate sump inside the containment.

For small breaks in the Reactor Coolant System, where recirculated water must be injected against higher pressures for long term core cooling, the system is arranged to deliver the water from the residual heat exchangers to the high-head safety injection pump suction and, by this external recirculation route, to the reactor coolant loops.

The recirculation pumps, piping and valves vital to the function of the recirculation loop are located in a missile-shielded space inside the polar crane support wall on the west side of the reactor primary shield.

The Service Water System provides cooling water to the Closed Cooling Water System. The Closed Cooling Water System (Section 9) provides cooling water to the component cooling loops which in turn cool the residual heat exchangers, both of which are part of the Auxiliary Coolant System (Section 9). Three service water pumps are available to take suction from the river and discharge to the closed cooling water heat exchangers. Three component cooling pumps are available to discharge through their heat exchangers and deliver to the two residual heat exchangers. Only one pump and one heat exchanger of each type are required to meet the core cooling function. All of this equipment, is located outside containment.

6.3 Containment Spray System

The Containment Spray System provides adequate containment cooling and iodine removal capability. The Containment Spray System is shown in Figure 6.1.

The principal components of the Containment Spray System are two pumps, one spray additive tank, spray ring headers and nozzles, and the necessary piping and valves. The containment spray pumps and the spray additive tank are located in the primary auxiliary building with the spray pumps taking suction directly from the refueling water storage tank.

The Containment Spray System also utilizes the two 100% capacity recirculation pumps, two residual heat exchangers and associated valves and piping of the Safety Injection System for the long term recirculation phase of containment cooling and iodine removal after the refueling water storage tank has been exhausted.

The spray water is injected into the containment through spray nozzles connected to four 360^{o} ring headers located in the containment dome area. Each of the spray pumps supplies two of the ring headers.

The Containment Spray System also provides water to a dousing system provided for the carbon filter bank of each fan cooler unit of the Containment Air Recirculation Cooling and Filtration System.

6.4 Containment Air Recirculation Cooling and Filtration System

The Containment Ventilation System, which all of the components of the Containment Air Recirculation Cooling and Filtration System (with the exception of the moisture separators, HEPA filters and charcoal filters) are a part of, is designed to remove the normal heat loss from equipment and piping in the reactor containment during plant operation and to remove sufficient heat from the reactor containment, following the initial loss-of-coolant accident containment pressure transient, to keep the containment pressure from exceeding the design pressure. The fans and cooling units continue to remove heat after the loss-of-coolant accident and reduce the containment pressure close to atmospheric within the first 24 hours.

A second function of the Containment Air Recirculation Cooling and Filtration System is to remove fission products from the containment atmosphere should they be released in the event of an accident.

The filtration capacity of the system is sufficient to reduce the concentration of fission products in the containment atmosphere following a loss of reactor coolant to levels ensuring that the 2 hour and 30 day thyroid doses will be limited to within the guidelines of 10CFR100 limits.

The air recirculation system consists of five 20% capacity air handling units, each including motor, fan, cooling coils, moisture separators, HEPA filters, carbon filters with spray and fire detection, roughing filters, dampers, duct distribution system, instrumentation and controls. The units are located on the intermediate floor between the containment wall and the secondary shield wall. The activated carbon filter assembly is normally isolated from the main air recirculation stream. Part of the air flow (air-stream mixture) is bypassed through the carbon filter assembly to remove volatile iodine following an accident.

The cooled air is ducted to the various containment compartments and areas. During normal operation, the flow sequence through each air handling unit is as follows: Moisture separators, cooling coils, fan, discharge header. Roughing filters are installed up-stream of the moisture separators during plant clean-up and any time the reactor is down.

In an event of an accident, the flow is split into two parts: a minimum of 8000 CFM passes through the filtration section consisting of moisture separation, HEPA Filters, and carbon filter assembly, and the remainder of the flow by-passes the filtration section of the units and passes through the cooling coils with the filtration flow. The by-pass flow control is accomplished via a damper that fails closed to a pre-set position for accident operation.

6.5 Isolation Valve Seal Water System

The Isolation Valve Seal Water System assures the effectiveness of the containment isolation valves, which are located in lines connected to the Reactor Coolant System, or that could be exposed to the containment atmosphere during any condition which requires containment isolation, by providing a water seal (and in a few cases a gas seal) at the valves. The system provides for injecting seal water between the seats and stem packing of the globe and double disc types of isolation valves, and into the piping between closed diaphragm type isolation valves thereby limiting the fission product release from the containment.

The system includes one seal water tank capable of supplying the total requirements of the system. The tank is pressurized from the system's own supply of high pressure nitrogen cylinders through pressure control valves. Relief valves are provided to prevent overpressurization of the system if a pressure control valve fails, or if a seal water injection line communicates with a high pressure line due to a valve failure in the seal water line.

6.6 Containment Penetration and Weld Channel Pressurization System

The Containment Penetration and Weld Channel Pressurization System provides means for continuously pressurizing the positive pressure zones incorporated into the containment penetrations and the channels over the welds in the steel inner liner in the event of a loss-of-coolant accident.

The system is designed to provide a means for determining the leak-tightness of the containment during power operation, thereby reducing the frequency for performing postoperational integrated leakage rate tests.

A regulated supply of clean and dry compressed air from either of the plant's 100 psig compressed air systems located outside the containment is supplied to all containment penetrations and inner liner weld channels. The system maintains a pressure in excess of containment design pressure continuously during all reactor operations thereby ensuring that there will be no out-leakage of the containment atmosphere through the penetrations and liner welds during an accident.

The primary source of air for this system is the instrument air system (Section 9). Two instrument and control air compressors are used, although only one is required to maintain pressurization at the maximum allowable leakage rate of the pressurization system.

The plant air compressors act as a backup to the instrument and control air compressors (Section 9) for added reliability. One plant air compressor is available.

A standby source of gas pressure for the system is provided by a bank of nitrogen cylinders. The associated nitrogen system will automatically deliver nitrogen at a slightly lower pressure (approximately 50 psi) than the normal regulated air supply pressure of approximately 52 psig, for a minimum period of 24 hours.

Means for assuring that all the weld channels and penetrations are pressurized is provided by flow-through test lines, connected to the pressurized weld channel zones and penetrations at points as far away from the supply points as possible. Pressurization of the zone is verified by closing off the air supply line and opening the flow-through test line valve to observe the escape of the pressurizing medium.

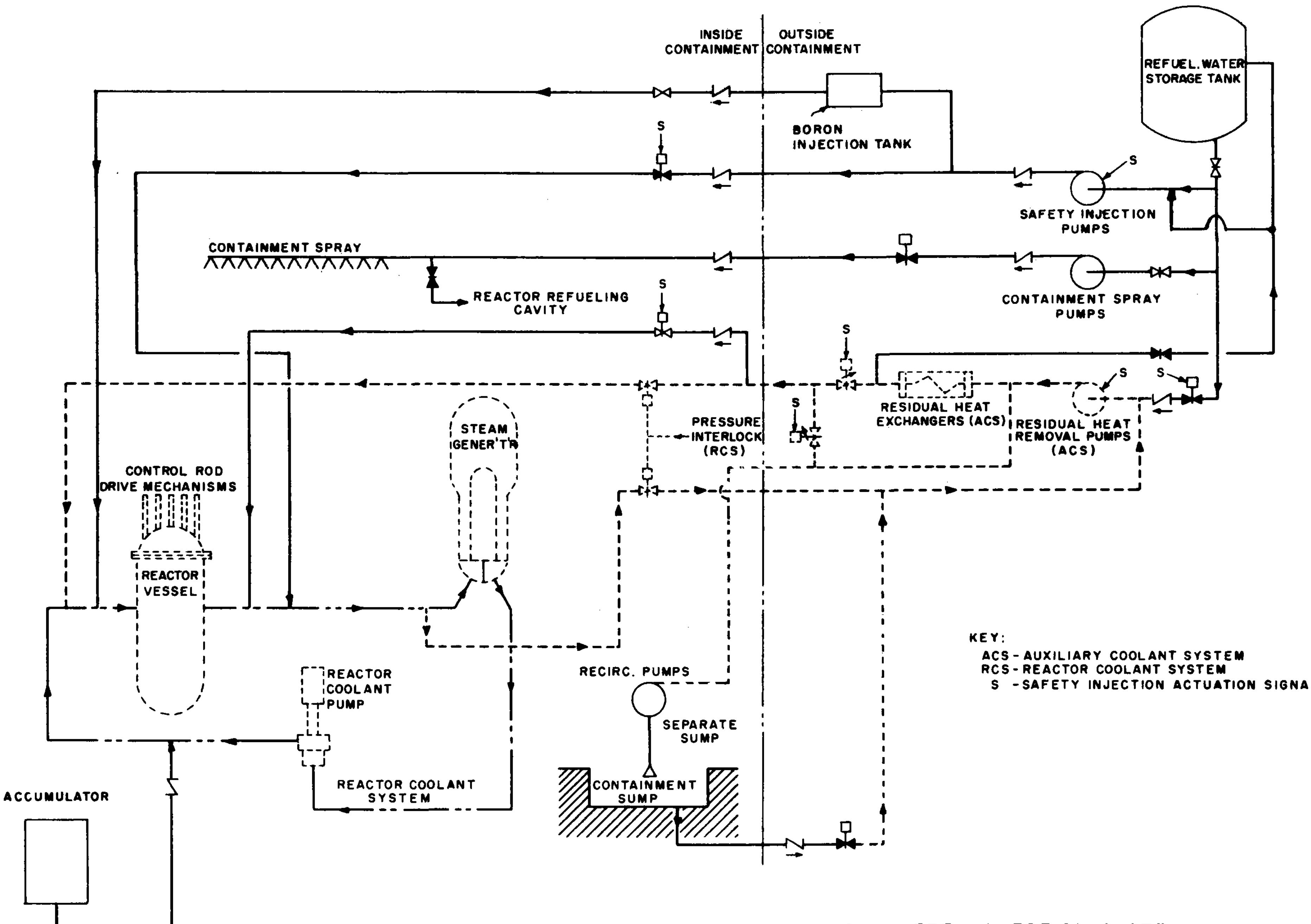


FIG. 6.1 SAFETY INJECTION SYSTEM

PWR

SECTION 7

INSTRUMENTATION AND CONTROL

Complete supervision of both the nuclear and turbine-generator sections of the plant is accomplished by the instrumentation and control systems from the control room. The instrumentation and control systems are designed to permit periodic on-line test to demonstrate the operability of the reactor protection system, and are composed of the following:

1. Protective Systems
2. Control Systems
3. Nuclear Instrumentation
4. Process Instrumentation
5. In-Core Instrumentation

7.1 Protective Systems

The protective systems consist of both the reactor protection system and the engineered safety features. Equipment supplying signals to any of these protective systems is considered a part of that protective systems.

The Protective systems are redundant and independent for all vital inputs and functions. Each channel is functionally independent of other redundant channels and are supplied from an independent power source.

The system is designed to permit any one channel to be maintained and, when required, tested or calibrated during power operation without system trip.

The protective systems are designed to provide the operator with accurate, complete, and timely information pertinent to their own status and to plant safety.

Indication is provided in the control room if some part of the system has been administratively bypassed or taken out of service.

The Reactor Protective System monitors parameters related to safe operation and trips the reactor to protect the reactor core against fuel rod cladding damage caused by departure from nucleate boiling (DNB), and to protect against reactor coolant system damage caused by high system pressure.

The core protective systems in conjunction with inherent plant characteristics are designed to prevent anticipated abnormal conditions from causing fuel damage exceeding established limits, or reactor coolant system damage exceeding established effects.

Figure 7.1 is a block diagram of the Reactor Protective System.

The maximum and minimum pressure shown (2400 psia and 1700 psia) represent the set points for the high pressure and low pressure reactor trips.

All transmitted signals (flow, pressure, temperature, etc.) which can cause a reactor trip are either indicated or recorded for every channel.

The reactor protection system is designed on a channelized basis to achieve separation between redundant protection channels. The channelized design is applied to the analog as well as the logic portions of the protection system.

The physical arrangement of all elements associated with the protective system reduces the probability of a single physical event impairing the vital functions of the system.

System equipment is distributed between instrument cabinets so as to reduce the probability of damage to the total systems by some single event.

7.2 Control Systems

The reactor control system is designed to limit nuclear plant transients for prescribed design load perturbations, under automatic control, within prescribed limits to preclude the possibility of a reactor trip in the course of these transients.

Overall reactivity control is achieved by the combination of chemical shim and 53 control rod clusters of which 29 are in 4 control banks and 24 are in 4 shut-down banks. Long-term regulation of core reactivity is accomplished by adjusting the concentration of boric acid in the reactor coolant. Short-term reactivity control for power changes or reactor trip is accomplished by movement of control rod clusters.

The rod control system equipment is assembled in enclosed steel cabinets. Three phase power is distributed to the equipment through a steel enclosed bus duct, bolted to the cabinets. DC power connections to the individual mechanisms are routed to the reactor head area from the solid state cabinets through insulated cables, enclosed junction boxes, enclosed reactor containment penetrations, and sealed connectors. In view of this type of construction, any accidental connection of either an AC or DC power source, either internal or external to the cabinets, is not considered credible.

Turbine By-Pass

A turbine by-pass system is provided to accommodate a reactor trip with turbine trip and 50% loss of load without reactor and turbine trip. The turbine by-pass system removes steam to reduce the transient imposed upon the reactor coolant system so that the control rods can reduce the reactor power to a new equilibrium value without allowing overtemperature, overpressure conditions in the reactor coolant system.

The turbine by-pass steam capacity is 45 percent of full load steam flow at full load steam pressure. The bypass flows to the main condenser.

7.3 Nuclear Instrumentation

The Nuclear Instrumentation System is provided to monitor the reactor power from source range through the intermediate range and power range up to 120 percent full power. The system provides indication, control, and alarm signals for reactor operation and protection.

The three instrumentation ranges are provided with overlap between adjacent ranges so that continuous readings will be available during transition from one range to another.

Detectors

The system consists of a total of six detector assemblies located in instrument wells around the reactor. The six assemblies provide the following instrumentation:

a) Power Range

This range consists of four independent long uncompensated ionization chamber assemblies which sense thermal neutrons in the range from 2.5×10^3 to 2.5×10^{10} neutrons per sq cm per sec.

b) Start-Up Range (Intermediate and Source)

There are two separate startup range assemblies. Each assembly contains one compensated ionization detector (intermediate range) and one proportional counter (source range).

The detectors sense thermal neutrons in the range from 10^{-1} to 5×10^4 neutrons per sq cm per sec. The range of the source range channel is 10^0 to 10^6 counts per second.

7.4 Process Instrumentation

The non-nuclear process instrumentation measures temperatures, pressures, flows, and levels in the reactor coolant system, steam system, reactor containment and auxiliary systems. Process variables required on a continuous basis for the startup, operation, and shutdown of the unit are indicated, recorded and controlled from the control room. The quantity and types of process instrumentation provided ensures safe and orderly operation of all systems and processes over the full operating range of the plant.

The following instrumentation ensures coverage of the effective operation of the engineered safety features:

Containment Pressure
Containment Sump Level
Refueling Water Storage Tank Level
Safety Injection Pumps Discharge Pressure
Safety Injection System Flows
Pump Energization
Valve Position
Residual Heat Exchangers Flow and Temperatures
Air Coolers Flow and Temperatures
Alarms

In addition to the above, the following local instrumentation is available.

a) Containment spray test lines total flow
b) Safety injection test line pressure and flow

7.5 In-Core Instrumentation

The in-core instrumentation is designed to yield information on the neutron flux distribution and fuel assembly outlet temperatures at selected core locations. Using the information obtained from the in-core instrumentation system, it is possible to confirm the reactor core design parameters and calculated hot channel factors. The system provides means for acquiring data and performs no operational plant control.

The in-core instrumentation system consists of thermocouples, positioned to measure fuel assembly coolant outlet temperature at preselected locations; and flux thimbles, which run the length of selected fuel assemblies to measure the neutron flux distribution within the reactor core.

The in-core instrumentation provides information which may be used to calculate the coolant enthalpy distribution, the fuel burnup distribution, and an estimate of the coolant flow distribution.

7.6 Operating Control Stations

The principal criteria of control station design and layout is that all controls, instrumentation displays and alarms required for the safe operation and shutdown of the plant are readily available to the operators in the control room.

Alarms and annunciators in the control room provide the operators warning of abnormal plant conditions which might lead to damage of components, fuel or other unsafe conditions. Other displays and recorders are provided for indication of routine plant operating conditions and for the maintenance of records.

Consideration is given to the fact that certain systems normally require more attention from the operator. The control system therefore is centrally located on the three section board.

Audible Reactor Building alarms are initiated from the radiation monitoring system and from the source range nuclear instrumentation. Audible alarms will be sounded in appropriate areas throughout the station if high radiation conditions are present.

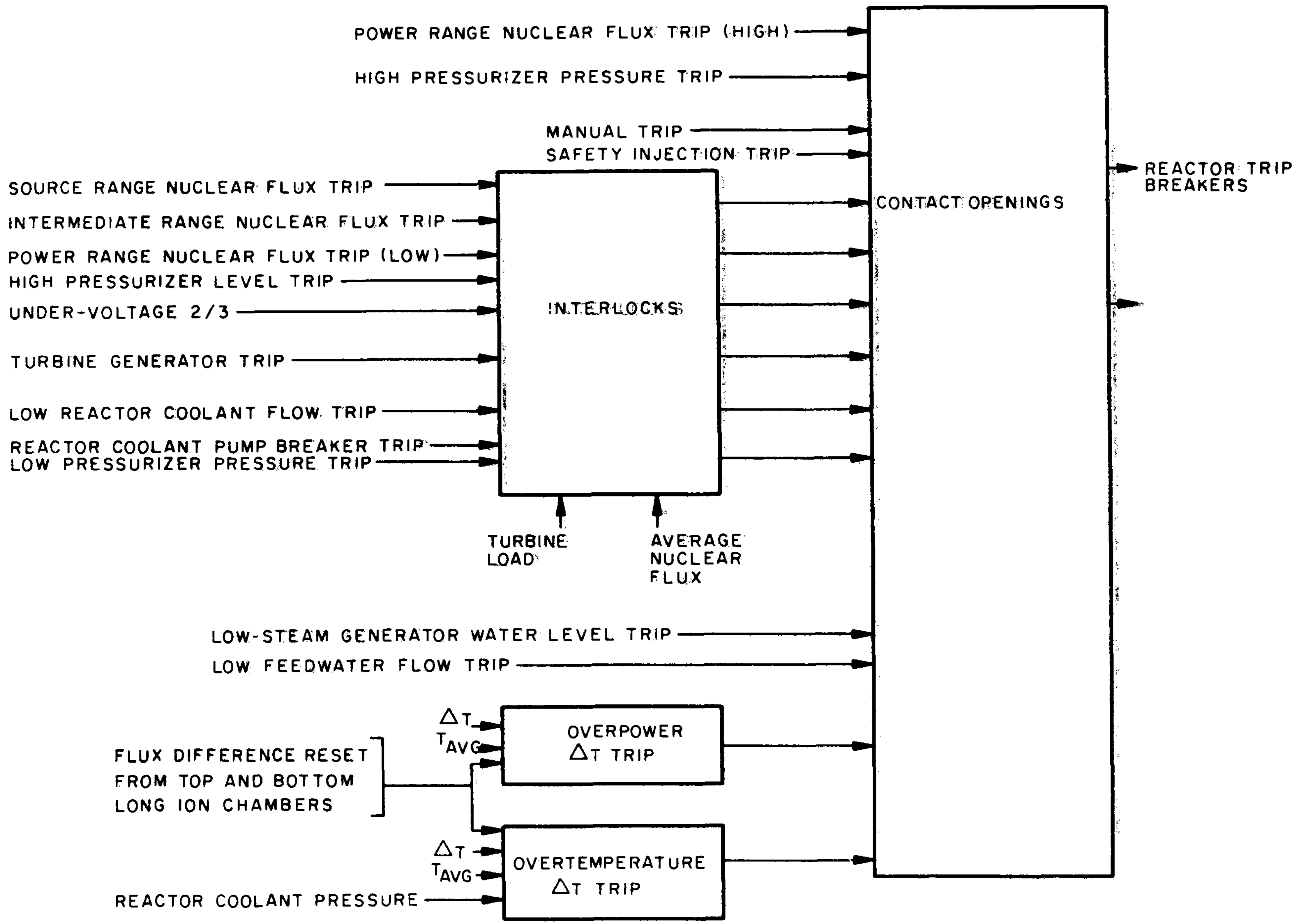


FIG. 7.1 REACTOR PROTECTION SYSTEMS

SECTION 8

ELECTRICAL SYSTEMS

The Electrical Systems are shown on Plate No. 8, Electrical Single Line Diagram. The main generator feeds electrical power at 22 kv through an isolated phase bus to two half-sized main power transformers. The bulk of the power required for station auxiliaries during normal operation is supplied by an auxiliary transformer connected to the isolated phase bus. Provisions for stand-by or emergency power have been included to further ensure the continuity of electrical power for critical loads.

The function of the Auxiliary Electrical System is to provide reliable power to those auxiliaries required during any normal or emergency mode of plant operation.

The design of the system is such that sufficient independence or isolation between the various sources of electrical power is provided in order to guard against concurrent loss of all auxiliary power.

Emergency Power

Independent alternate power systems are provided with adequate capacity and testability to supply the required engineered safety features and protection systems.

The plant is supplied with normal, standby and emergency power sources as follows:

1. The normal source of auxiliary power during plant operation is the generator, and the 138 kv offsite source. Power is supplied via the unit auxiliary transformer which is connected to the main leads of the generator, and via the station auxiliary transformer, which is connected to the incoming 138 kv line.

2. Standby power required during plant startup, shutdown and after turbine trip is furnished by the 138 kv feeder. In addition, an on-site 23.4 MVA gas turbine-generator is provided for black startup capability.

3. Three diesel generators are each connected to their respective engineered safety features buses to supply emergency shutdown power in the event of loss of all other a.c. auxiliary power. There are no automatic ties between the buses associated with the diesel generators.

4. Emergency power supply for vital instruments, control, and emergency lighting is from two 125 volt dc station batteries.

The diesel-generators are connected to three (3) separate 480 volt auxiliary system buses. Each diesel starts automatically on a safety injection signal or upon the occurrence of undervoltage on the 480 volt buses. Any two diesels have adequate capacity to supply the engineered safety features for the hypothetical accident concurrent with loss of outside power. This capacity is adequate to provide a safe and orderly plant shutdown in the event of loss of outside electrical power.

SECTION 9

AUXILIARY AND EMERGENCY SYSTEMS

The Auxiliary and Emergency Systems are supporting systems required to insure the safe operation or servicing of the Reactor Coolant System.

The systems considered under this category are:

Chemical and Volume Control System This system provides for nuclear poison fluid injection, chemical additions for corrosion control, reactor coolant clean-up and degasification, reactor coolant make-up, reprocessing of water letdown from the Reactor Coolant System, and reactor coolant pump seal water injection.

Auxiliary Coolant System This system provides for transferring heat from reactor plant waters to the service water system and consists of the following three loops:

The residual heat removal loop removes residual and sensible heat from the core and reduces the temperature of the Reactor Coolant System during the second phase of plant cooldown.

The spent fuel pit loop removes from the spent fuel pit the heat generated by stored spent fuel elements.

The component cooling loop removes residual and sensible heat from the Reactor Coolant System, via the residual heat removal loop, during plant shutdown, cools the spent fuel pit water and the letdown flow to the Chemical and Volume Control System during power operation and provides cooling to dissipate waste heat from various primary plant components.

Sampling System This system provides the equipment necessary to obtain liquid and gaseous samples from the reactor plant systems.

Fuel Handling System The system provides for the safe handling of new and spent fuel.

Facility Service Systems These systems include fire protection, service water systems and auxiliary building ventilation systems.

Reactor Components Handling System This system provides for handling fuel assemblies, control rod assemblies, core structural components and material irradiation specimens.

Equipment and Decontamination Processes These procedures provide for the removal of radioactive deposits from primary system surfaces.

Primary Auxiliary Building Ventilation System This system maintains safe ambient operation temperatures and provides purging of the auxiliary building to the plant vent.

Control Room Ventilation System This system maintains a comfortable environment in the control room and provides for particulate radioactive cleanup.

9.1 Chemical and Volume Control System

The Chemical and Volume Control System shown on Figure 9.1 adjusts the concentration of chemical neutron absorber for chemical reactivity control, maintains the proper water inventory in the Reactor Coolant System, provides the required seal water flow for the reactor coolant pump shaft seals, processes reactor coolant effluent for reuse of boric acid and reactor makeup water, maintains the proper concentration of corrosion inhibiting chemicals in the reactor coolant and maintains the reactor coolant and corrosion activities to within design levels. The system is also used to fill and hydrostatically test the Reactor Coolant System.

During normal operation, this system also has provisions for supplying the following chemicals:

i) Regenerant chemicals to the deborating and evaporator condensate demineralizers

ii) Hydrogen to the volume control tank

iii) Nitrogen as required for purging the volume control tank

iv) Hydrazine and lithium hydroxide, as required, via the chemical mixing tank to the charging pumps suction.

During plant operation, reactor coolant flows through the letdown line from the reactor coolant loop cold leg on the suction side of the pump and is returned to the same cold leg on the discharge side of the pump via a charging line. An alternate charging connection is provided to the hot leg of another loop. An excess letdown line is also provided.

Reactor coolant entering the Chemical and Volume Control System flows through the shell side of the regenerative heat exchanger where its temperature is reduced. The coolant then flows through a letdown orifice which reduces the coolant pressure. The cooled, low pressure water leaves the reactor containment and enters the auxiliary building where it undergoes a second temperature reduction in the tube side of the nonregenerative heat exchanger followed by a second pressure reduction by the low pressure letdown valve. After passing through one of the mixed bed demineralizers, where ionic impurities are removed, coolant flows through the reactor coolant filters and enters the volume control tank through a spray nozzle.

Fission gases are periodically removed from the system by venting the volume control tank to the Waste Disposal System prior to a cold or refueling shutdown.

Next, the coolant flows to the charging pumps which raise the pressure above that in the Reactor Coolant System. The coolant then enters the containment, passes through the tube side of the regenerative heat exchanger, and is returned to the Reactor Coolant System.

The cation bed demineralizer, located downstream of the mixed bed demineralizers, is used intermittently to control cesium activity in the coolant and also to remove excess lithium which is formed.

During plant startup, normal operation, load reductions and shutdowns, liquid effluents containing boric acid flow from the Reactor Coolant System through the letdown line and are collected in the holdup tanks. As liquid enters the holdup tanks, the nitrogen cover gas is displaced to the gas decay tanks in the Waste Disposal System through the waste vent header. The concentration of boric acid in the holdup tanks varies throughout core life from the refueling concentration to essentially zero at the end of the core cycle. A recirculation pump is provided to transfer liquid from one holdup tank to another.

Liquid effluent in the holdup tanks is processed as a batch operation. This liquid is pumped through the evaporator feed ion exchangers which primarily remove lithium hydroxide and fission-products such as cesium. It then flows through the ion exchanger filter and into the gas stripper where dissolved gases are removed from the liquid. The gases are vented to the Waste Disposal System. The liquid effluent from the gas stripper enters the boric acid evaporator.

The vapor produced in the boric acid evaporator leaves the evaporator condenser and is pumped through a condensate cooler where the distillate is cooled to the operating temperature of the evaporator condensate demineralizers. After nonvolatile evaporator carry over is removed by one of the two evaporator condensate demineralizers it then flows through the condensate filter and accumulates in one of two monitor tanks. The dilute boric acid solution originally in the boric acid evaporator remains as the bottoms of the distillation process and is concentrated to approximately twelve per cent boric acid which is returned to the boric acid tank by the concentrates transfer pump.

Subsequent handling of the condensate is dependent on the results of sample analysis. Discharge from the monitor tanks may be pumped to the primary water storage tank, recycled through the evaporator condensate demineralizers, returned to the holdup tanks for reprocessing in the evaporator train or discharged to the environment with the condenser circulating water.

The deborating demineralizers can be used intermittently to remove boron from the reactor coolant near the end of the core life. When the deborating demineralizers are in operation, the letdown stream passes from the mixed bed demineralizers and then through the deborating demineralizers and into the volume control tank after passing through the reactor coolant filter.

During plant cooldown when the residual heat removal loop is operating and the letdown orifices are not in service, a flow path is provided to remove corrosion impurities and fission products. A portion of the flow leaving the residual heat exchangers passes through the nonregenerative heat exchanger, mixed bed demineralizers, reactor coolant filter and volume control tank. The fluid is then pumped, via the charging pump, through the tube side of the regenerative heat exchanger into the Reactor Coolant System.

Three positive displacement variable speed drive charging pumps are used to supply charging flow to the Reactor Coolant System. The speed of each pump can be controlled manually or automatically. During normal operation, only one of the three pumps is automatically controlled; only one charging pump is operating and the speed is modulated in accordance with pressurizer level. Corrosion inhibiting chemicals are added to the Chemical and Volume Control System by batch mixing in the chemical mixing tank which discharges into the suction lines of the charging pumps.

Boric acid is prepared in the boric acid batching tank. Boric acid transfer pumps transfer the concentrated boric acid solution to the boric acid tanks. The boric acid transfer pumps also take suction from the boric acid tanks and inject the concentrated solution into the suction of the charging pumps by way of the boric acid filter and boric acid blender.

The boric acid transfer pumps are also used to fill and recirculate the boron injection tank of the Safety Injection System.

The boric acid batching tank is provided with a steam jacket and the boric acid tanks and boron injection tank are provided with electric heaters to prevent crystallization of the concentrated boric acid solution. All piping carrying concentrated boric acid solution is electric heat traced.

9.2 Auxiliary Coolant System

The Auxiliary Coolant System consists of three loops as shown in Figure 9.2; the component cooling loop, the residual heat removal loop, and the spent fuel pit cooling loop.

Component-cooling Loop

The Component-cooling Loop serves as an intermediate system between the reactor coolant and the service water cooling system. This loop ensures that leakage of radioactive fluid from the components being cooled is contained within the plant.

The Component-cooling Loop consists of component cooling pumps, two component-cooling heat exchangers, two component-cooling surge tanks, cooling lines to the various components being cooled, and associated piping, valves, and instrumentation. The component coolant flows from the component-cooling pumps, through the shell side of the component-cooling heat exchangers, through the components being cooled, and is then returned to the pumps. The surge tank, which is connected to the suction side of the component-cooling pumps, accommodates surges resulting from component coolant thermal expansion and contraction and accommodates water which may leak into the system from components which are being cooled. The surge tank also contains sufficient water to ensure continuous component cooling-water supply until a leaking cooling line can be isolated. Water chemistry control of the component-cooling system is accomplished by chemical additions to the surge tank. Makeup water is normally taken from the flash evaporator via the primary water makeup cooler as required, and delivered to the surge tank. All units are in parallel flow circuits with circulation through the shell side on all heat exchangers.

At the reactor coolant pump, component-cooling water removes heat from the bearing oil and the thermal barrier. Component-cooling water cools the bearings and seals on the high-head safety injection pumps. The internal recirculation pump motors of the Safety Injection System are cooled by means of a closed air system. The air is in turn cooled by means of a heat exchanger served by the Component-cooling Water Loop.

During normal full-power operation, one or two component-cooling pumps and one component-cooling heat exchanger accommodate the heat removal loads. The standby pump and the standby heat exchanger provide backup during normal operations. Operation of all component-cooling pumps and both component-cooling heat exchangers is required for removing residual and sensible heat during a normal plant cooldown. Failure of one of these components increases the time required for cooldown but does not affect the safe operation of the plant.

In addition to the main plant duties, the system also provides makeup water to the waste evaporator expansion tank and the waste-gas compressor seal water systems. Makeup to the expansion tank requires manual operation while the makeup to the waste-gas compressors is controlled automatically.

Residual Heat Removal Loop

The Residual Heat Removal Loop and its subsystems provide a number of basic services to the plant:

a) It removes residual heat from the reactor core at cold shutdown.

b) It removes residual heat from the reactor core and reduces the temperature of the Reactor Coolant System during the second phase of plant cooldown. During the first phase of plant cooldown, the temperature of the Reactor Coolant System is reduced by transferring heat from the Reactor Coolant System to the steam generators. Heat is then released from the secondary system by steam dump to the condensers. The residual heat removal loop is designed to begin operation at the point at which the steam dump system becomes a less efficient means of removing residual heat.

c) During refueling operations, the residual heat removal pumps fill the refueling cavity with borated water from the refueling water storage tank and return the water to the tank following refueling operations.

d) In the event of a loss-of-coolant accident, the residual heat removal pumps are used to deliver water to the Reactor Coolant System from the refueling water storage tank. Following the injection phase, the loop is used in part to remove residual heat from the reactor core and containment vessel by recirculation of the containment sump water through the residual heat removal heat exchangers.

The Residual Heat Removal Loop consists of two residual heat exchangers, two residual heat removal pumps and the associated piping, valves, and instrumentation necessary for operational control. During plant cooldown, reactor coolant flows from the Reactor Coolant System to the residual heat removal pumps, through the tube side of the residual heat exchangers and back to the Reactor Coolant System. The inlet line to the Residual Heat Removal Loop is connected to one of the reactor coolant loop hot legs and the return line can deliver coolant to all four reactor coolant loop cold legs via the safety injection manifold. The heat loads are transferred by the residual heat exchangers to the component-cooling loop.

Spent Fuel Pit Cooling Loop

The Spent Fuel Pit Cooling Loop removes residual heat from spent fuel placed in the fuel pit for storage until it is shipped to a reprocessing facility.

The cooling loop consists of a fuel pit pump, heat exchanger, piping, valves, and instrumentation necessary for operational control. The pump draws water from the pit, circulates it through the heat exchanger tubes and returns it to the pit. Component-cooling water cools the spent fuel pit heat exchanger.

To maintain water purity, 100 gpm of the loop recirculation flow is passed through a demineralizer and filter. Instrumentation is provided to enable the flow to be monitored and sample points are provided both before and after the demineralizer and filter. The refueling water storage tank water can also be cleaned up, if necessary, by recirculation through the spent fuel pit cleanup system. To further assist the maintenance of clarity in the spent fuel pit water a skimmer pump, strainer, filter, and skimmers are provided for surface cleaning of the pit. Water is removed from the surface, pumped through a strainer and filter, and returned to the pit.

Sampling System

This system provides samples for laboratory analysis to evaluate reactor coolant, feedwater, steam systems, and other reactor auxiliary systems chemistry during normal operation. It has no active emergency function. This system is normally isolated at the containment boundary.

Sampling system discharge flows are limited under normal and anticipated fault conditions (malfunctions or failure) to preclude any fission product releases beyond the limits of 10CFR20.

The system is capable of obtaining reactor coolant samples during reactor operation and during cooldown when the system pressure is low and the residual heat removal loop is in operation. Access is not required to the containment.

Sampling of other process coolants, such as from tanks in the Waste Disposal System, is accomplished locally. Equipment for sampling secondary and non-radioactive fluids is separated from the equipment provided for reactor coolant samples. Leakage and drainage resulting from the sampling operations are collected and drained to tanks located in the Waste Disposal System.

Two types of samples are obtained by the system: high temperature - high pressure Reactor Coolant System and steam generators blowdown samples which originate inside the reactor containment, and low temperature - low pressure samples from the Chemical and Volume Control and Auxiliary Coolant Systems.

High Pressure - High Temperature Samples

A sample connection is provided from each of the following:

a) The pressurizer steam space
b) The pressurizer liquid space
c) Hot legs of loops 1 and 3
d) Blowdown from each steam generator

Low Pressure - Low Temperature Samples

A sample connection is provided from each of the following:

a) The mixed bed demineralizer inlet header
b) The mixed bed demineralizer outlet header
c) The residual heat removal loop, just downstream of the heat exchangers
d) The volume control tank gas space
e) The accumulators
f) The recirculation pump discharge

The high pressure, high temperature samples and the residual heat removal loop samples leaving the sample heat exchangers are held to a temperature of 130°F to minimize the generation of radioactive aerosols.

Fuel Handling System

The Fuel Handling System provides a safe effective means of transporting and handling fuel from the time it reaches the plant in an unirradiated condition until it leaves the plant after post-irradiation cooling.

The system is designed to minimize the possibility of mishandling or mal-operations that cause fuel damage and potential fission product release.

The Fuel Handling System consists basically of:

a) The reactor cavity, which is flooded only during plant shutdown for refueling.

b) The spent fuel pit, which is kept full of water and is always accessible to operating personnel.

c) The Fuel Transfer System, consisting of an underwater conveyor that carries the fuel.

During reactor vessel head removal and while loading and unloading fuel from the reactor, boron concentration is maintained at not less than that required to shutdown the core to a $k_{eff} = 0.90$. This shutdown margin maintains the core at $k_{eff} < 0.99$, even if all control rods are withdrawn from the core. Weekly checks of refueling water boron concentration ensure the proper shutdown margin.

The new and spent fuel storage racks are designed so that it is impossible to insert assemblies in other than the prescribed locations. Borated water is used to fill the spent fuel storage pit at a concentration to match that used in the reactor cavity and refueling canal during refueling operations. The fuel is stored vertically in an array with sufficient center-to-center distance between assemblies to assure $k_{eff} \leq 0.90$ even if unborated water was used to fill the pit.

The refueling water provides a reliable and adequate cooling medium for spent fuel transfer and heat removal from the spent fuel pit is provided by an auxiliary cooling system.

Adequate shielding for radiation protection is provided during reactor refueling by conducting all spent fuel transfer and storage operations under water. This permits visual control of the operation at all times while maintaining low radiation levels, less than 2.0 mr/hr, for periodic occupancy of the area by operating personnel. Pit water level is indicated, and water removed from the pit must be pumped out since there are no gravity drains. Shielding is provided for waste handling and storage facilities to permit operation within requirements of 10CFR20.

All fuel and waste storage facilities are contained and equipment designed so that accidental releases of radioactivity directly to the atmosphere are monitored and do not exceed the guidelines of 10CFR100.

The reactor cavity, refueling canal and spent fuel storage pit are reinforced concrete structures with a seam-welded stainless steel plate liner. These structures are designed to withstand the anticipated earthquake loadings as Class I structures so that the liner prevents leakage even in the event the reinforced concrete develops cracks.

9.5 Facility Service System

Service Water Systems

The service water system is designed to supply cooling water from the North River to various heat loads in both the primary and secondary portions of the plant. Provision is made to ensure a continuous flow of cooling water to those systems and components necessary for plant safety either during normal operation or under abnormal and accident conditions. Sufficient redundancy of active and passive components is provided to insure that cooling is maintained to vital loads for short and long periods. The system also provides water required for cleaning the traveling screens and raw water make-up to the flash evaporator.

Six identical vertical, centrifugal sump-type pumps, each having a capacity of 6500 gpm, at 115 ft. TDH, located in the Intake Structure, supply service water to two independent discharge headers, each header being supplied by three of the pumps. An automatic, continuous, rotary-type strainer is in the discharge of each pump, and is capable of removing solids down to 1/8 inch diameter. Each header is connected to an independent supply line. Either of the two supply lines can be used to supply the essential loads, with the other line feeding the non-essential loads. The essential loads are the containment ventilation cooling coils; the containment ventilation fan motor coolers; instrument air compressors; turbine oil, boiler feed pump turbine oil and the seal oil coolers; and the diesel generator coolers.

Water is drawn from the river and passes under a debris wall, through a coarse screen and finally a fine traveling bank screen. To keep the intake free of ice, warm water is circulated from the condenser discharge canal to a point ahead of the coarse screens. Electric heaters are provided in the driving head of the traveling screens to prevent icing of the screen panels. Each main circulating water pump is installed in an individual chamber while the service water pumps are in a common chamber with one intake normally operating. A second full flow service water intake is constructed and provided with a temporary screen. This intake is brought into operation when required. An additional opening is provided between the southern most circulating water pump chamber and the adjacent service water pump chamber. This opening can be closed by a gate, but is normally open.

The intake structure is designed as Seismic Class I, and is therefore not subject to failure under earthquake loading.

The non-essential loads are the component cooling heat exchangers and the remaining turbine-generator plant services. By manual valve operation, the essential loads can be transferred to the supply line carrying the non-essential loads and vice versa.

The essential loads are those which must be supplied with cooling water immediately in the event of a blackout and/or loss-of-coolant accident. The cooling water for these loads is supplied by the nuclear service water header.

During normal operation, the essential loads are supplied by one of the three pumps available. The non-essential loads are supplied by two of the three pumps provided.

Following a simultaneous incident and blackout, the cooling water requirements for all five fan cooling units and the other essential loads can be supplied by any two of the three service water pumps on the header designated to supply the nuclear and essential secondary load supply lines. Any two of these three pumps can be powered by the emergency diesels. These emergency powered pumps are those necessary and sufficient to meet blackout and emergency conditions. Either one of the two sets of three pumps can be placed on the diesel starting logic.

Fire Protection

Fire prevention in all areas of the nuclear-electric plant is provided by structure and component design which optimizes the containment of combustible materials and maintains exposed combustible materials below their ignition temperature in the design atmosphere.

The fire protection system is designed to achieve the following objectives:

1) Provide automatic fire detection in those areas where the fire danger is greatest.

2) Provide fire extinguishment by fixed systems of water and foam, actuated automatically or manually in those areas where the fire danger is greatest.

3) Provide manually operated fire extinguishing equipment, including fire hose reels and CO_2 hand extinguishers.

4) The fire protection system is designed to conform to the guide lines set up by NEPIA.

The fire line headers are designed as a loop system to permit water flow in either direction. Sectionalizing valves throughout the system are located to permit isolating damaged sections of header.

There is no Class III Portion of the fire protection system whose failure could damage any Class I structure or component. The fire pumps, though not Class I, are redundant.

The water supply for the plant fire protection systems (yard fire hydrants, building hose cabinets, fixed spray automatic deluge and sprinkler systems) will be provided by three (3) 2,000 gpm, 150 psig fire pumps. Two of the pumps will be motor driven and will take suction from a ground based treated water storage tank. Piping at the tank will be arranged so that a minimum of 200,000 gallons of water will be available for fire protection at all times. Pressurization of the fire system is maintained by a 100 gpm "jockey" pump. This pump will start when the pressure drops to 135 psig.

The motor driven fire pumps start automatically on a drop in line pressure. One pump starts automatically when the pressure drops to 130 psi and the other starts automatically when the pressure drops to 120 psi. Both are activated by pressure switches to start and stop as required. Starting of each pump will be annunciated by an alarm. If the pressure drops to 100 psi, an emergency alarm sounds.

The motor driven treated water transfer pump, pumps water from the treated water tank to the fire water tank.

The two motor driven fire pumps are backed up by a 2,000 gpm, 150 psig diesel engine driven fire pump. This pump takes suction from the river. This pump is started and stopped manually from the control room or locally mounted switches.

Portable CO_2 fire extinguishers are distributed throughout the plant, including turbine hall, control building, fan house, primary auxiliary building, electrical tunnel, fuel storage building, diesel generator building, waste holdup tank pit, auxiliary feed pump building, containment building and electrical penetration tunnel.

Compressed Air Systems

Instrument Air System

The instrument air system is designed such that the instrument air shall be available under all operating conditions; all essential systems requiring air during or after an accident shall be self supporting, and after an accident, the air system shall be re-established.

Two compressors are installed each with dryer and filter throughout. In addition, a back-up supply is taken from the service air system. Those items essential for safe operation and safe down are provided with air reservoirs or gas bottles. These supplies will enable the equipment to function in a safe manner until the air supply is re-established. The controls are specified to fail to a safe position on loss of air or electrical power. The compressors and essential sections of the air supply system have been designed to operate after seismic shock. The compressors are located in a seismic Class I building. The non-essential header has a flow restrictor in it to limit flow in a break to the capacity of one compressor.

Service Air System

The service air system is supplied by a two-stage 625 scfm compressor located in the turbine room. The air is discharged through an aftercooler and moisture separator at 100 psig and 110^{o}F. The maximum discharge pressure will be 125 psig. The cooling water for the intercooler, aftercooler and compressor jacket is supplied from a closed cooling water system.

The service air system furnishes compressed air for pneumatic tools, and miscellaneous cleaning and maintenance purposes throughout the secondary and primary plants.

The system also provides for an automatic emergency supply to the instrument air system through an oil vapor filtering arrangement. In addition, an automatic emergency supply is supplied to the containment building weld channel and penetration pressurization system. The air is first filtered and then dried to -40^{o}F dewpoint.

9.6 Equipment and System Decontamination

Decontamination facilities on site consist of an equipment pit and a cask pit located adjacent to the spent fuel storage pit. In the stainless steel lined equipment pit, fuel handling tools and other tools can be cleaned and decontaminated.

In the cask decontamination pit, the outside surfaces of the shipping casks are decontaminated, if required, by using steam, water detergent solutions, and manual scrubbing to the extent required. When the outside of the casks are decontaminated, the casks are removed by the auxiliary building crane and hauled away.

For the personnel, a decontamination shower and washroom is located adjacent to the Radiation Control Area (RCA) locker room. Personnel decontamination kits with instructions for their use are in the RCA locker room.

9.7 Primary Auxiliary Building Ventilation System

The Primary Auxiliary Building Ventilation System is designed to accomplish the following:

1) Provide sufficient circulation of filtered air through the various rooms and compartments of the building to remove equipment heat and maintain safe ambient operating temperatures.

2) Control flow direction of airborne radioactivity from low activity areas toward higher activity areas.

3) Provide purging of the building to the plant vent for dispersion to the environment.

The air exhausted by the system is filtered, monitored and diluted so that off-site dose during normal operation will not exceed a small fraction of that permitted by 10CFR20.

The Primary Auxiliary Building Ventilation System is composed of the following systems:

1) Make-up air handling system complete with fan, bypass dampers, filters, heating coils and supply ductwork.

2) Exhaust system complete with fans, ductwork, roughing filters and HEPA filters.

3) Make-up air tempering unit for the waste hold up tank pit.

9.8 Control Room Air Conditioning, Heating and Ventilation System

The Control Room Air Conditioning, Heating and Ventilation System is designed to accomplish the following:

1) Maintain 75^{o}F D.B. and approximately 50% R.H. in the control room under operating conditions.

2) Permit cleanup of airborne particulate radioactivity entering the control room through either makeup outside air or by infiltration as follows:

   a) With makeup outside air (O.A.) for pressurization of control room. Approximately 10% O.A. (about 1,000 cfm) and approximately 10% (about 1,000 cfm) room air will be circulated through a charcoal filter.

   b) With 100% recirculation. Approximately 20% (about 2,000 cfm) room air will be circulated through a charcoal filter.

The Control Room Air Conditioning, Heating and Ventilation System consist of the following equipment:

1) Two direct expansion, water-cooled air conditioning units complete with fans, steam heating coils and roughing filters. Each unit sized to provide 60% of the refrigeration capacity required.

2) A filter unit consisting of casing, roughing filters, HEPA filters and charcoal filters.

3) Two charcoal filter booster fans each with a capacity of 2,000 cfm for 100% redundancy.

4) Duct system complete with dampers, controls and associated accessories to provide for three (3) different systems of air flow.

5) One locker room exhaust fan and miscellaneous electric sill-line heaters.

All equipment, except the locker room exhaust fan, is located in the Control Building.

The air conditioning system has been designed so that the functional capacity of the Control Room will be maintained at all times, including the period during a blackout or DBA. The design condition for maintaining "functional capacity" of the Control Room dictates that the ambient temperature for safety equipment located in this room shall not exceed 120°F for short term operation associated with a loss of one air conditioning unit.

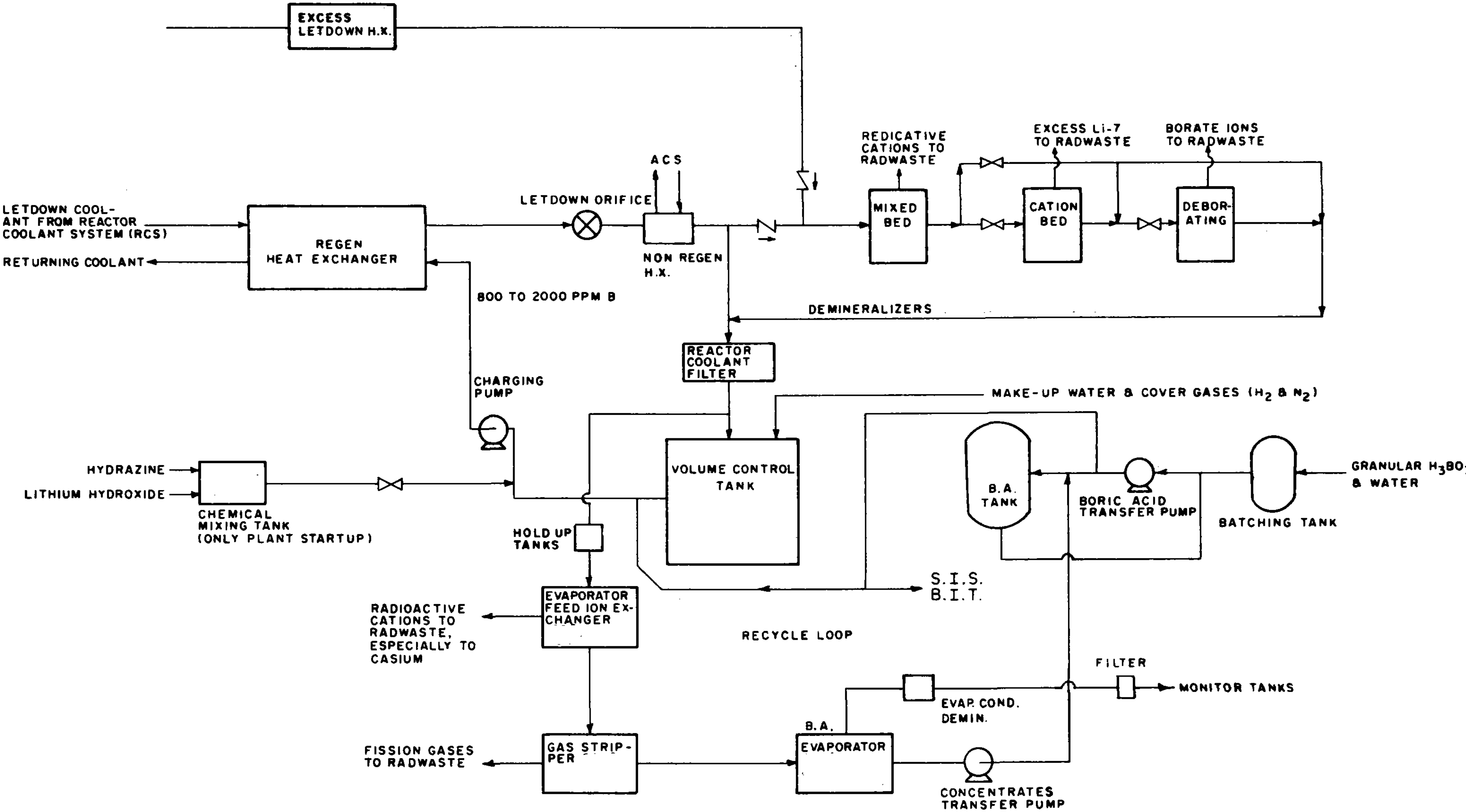


FIG. 9.1 CHEMICAL AND VOLUME CONTROL SYSTEM (CVCS)

PWR

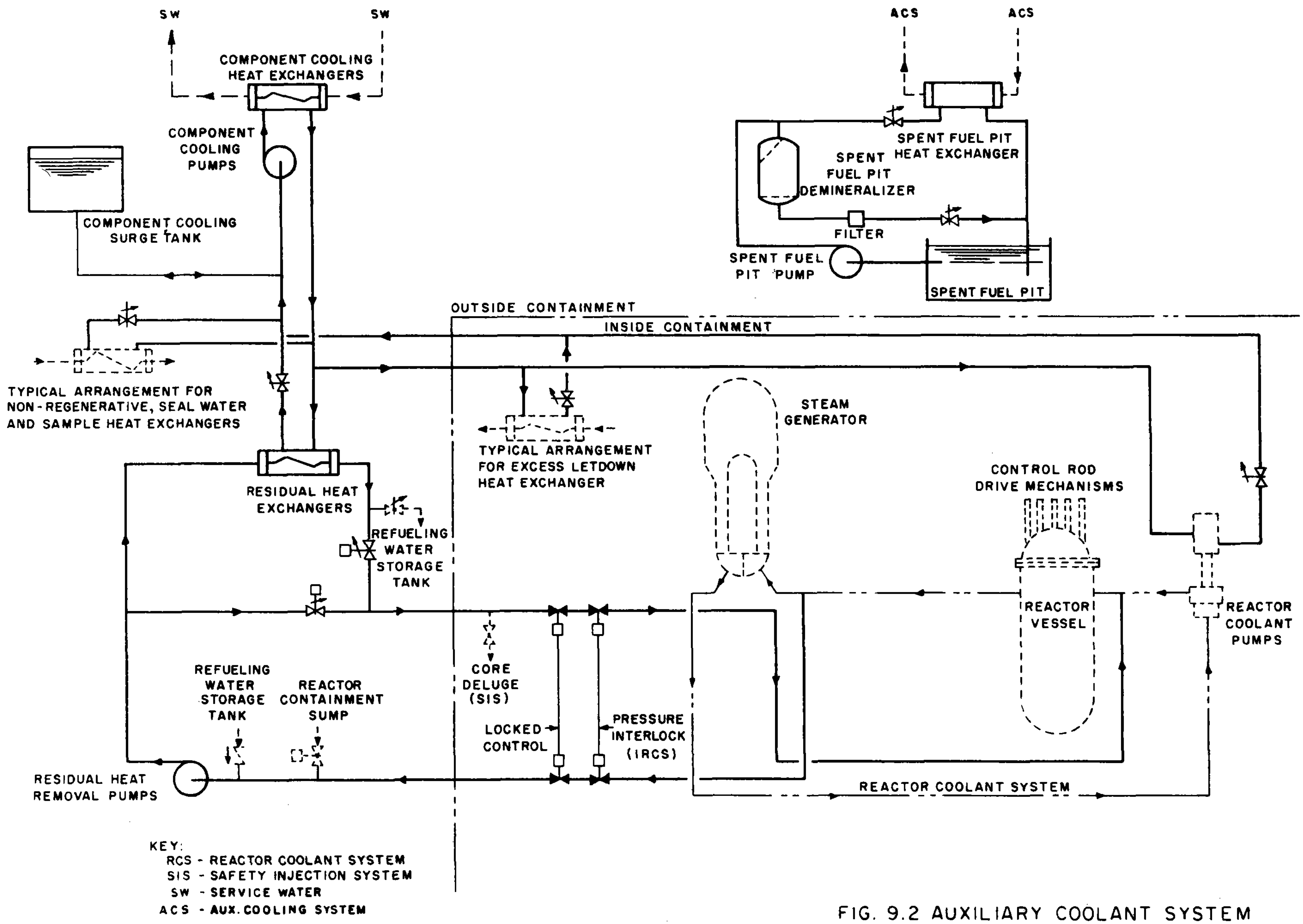


FIG. 9.2 AUXILIARY COOLANT SYSTEM

PWR

SECTION 10

STEAM AND POWER CONVERSION SYSTEM

The Steam and Feedwater System is designed to remove heat from the reactor coolant in the four steam generators, producing steam for the turbine generator. The steam condensate and feedwater systems are shown on Plate 7. The Steam and Feedwater System can receive and dispose of, in its cooling systems and through power operated relief valves, the total heat existent or produced in the Reactor Coolant System following an emergency shutdown of the turbine generator from a full load condition.

The system design provides means to monitor and restrict radioactivity discharge to normal heat sinks or the environment such that the limits of 10CFR20 are not exceeded under normal operating conditions nor in the event of anticipated system malfunctions.

One turbine driven and two motor driven auxiliary feed pumps supply feedwater to the steam generators for reactor decay heat removal under all circumstances, including loss of power and normal heat sink. Feedwater flow can be maintained until either, power is restored, or reactor decay heat removal can be accomplished by other systems. Auxiliary feedwater pumps and piping are designed as Class I components.

10.1 Main Steam System

The main steam system conducts steam in a main steam line from each of the four steam generators within the reactor containment through a swing disc type isolation valve and a swing disc type non-return valve to the turbine stop and control valves. The isolation and non-return valves are located outside of the containment. The four lines are interconnected local to the turbine. A steam flow-meter (flow venturi) is provided in the line from each steam generator, upstream of the isolation and non-return valves, to meter steam flow from each steam generator. Steam flow signals are used by the automatic feedwater flow control system. The flow venturi also serves to limit steam flow rate in the event of a steam line break downstream of the venturi.

The isolation valves contain free swinging discs which are normally held up out of the main steam flow path by an air piston. These valves are automatically closed upon receipt of a signal from the steam line break protection system. The isolation valves are designed to close in less than five seconds.

The non-return valves are activated upon reverse flow of steam in case of accidental pressure reduction in any steam generator or its piping.

Excess steam generated by the reactor coolant system is bypassed, from the four main steam lines ahead of the turbine stop valves directly to the condensers by means of two main steam bypass lines. The bypass capacity is 25% of steam generator flow.

When the condenser heat sink is not available during a turbine trip, excess steam, generated as a result of reactor coolant system sensible heat and core decay heat, is discharged to the atmosphere.

Steam For Auxiliaries

The steam for the auxiliary turbine driven feedwater pump is obtained from two of the steam generator outlet mains, and is reduced for the turbine by a pressure reducing station.

Auxiliary steam for the turbine gland steam supply control valve, the three steam-jet air ejectors, the reheater section of the six moisture separator-reheaters, the three priming ejectors and supplementary steam for the main feed pump turbines is obtained from branches on the steam lines ahead of the turbine stop valves. Pressure reducing stations are used for the priming and main air ejectors. Temperature control valves are located in the auxiliary steam line to the reheaters.

Six stages of extraction steam are piped to the shells of the three parallel strings of feedwater heaters.

To prevent turbine overspeed from backflow of flashed condensate from the heaters after a turbine trip, non-return valves are provided in all but the two lowest pressure extraction steam lines. The non-return valves are equipped with balancing counterweight and are air cylinder operated valves which are closed automatically upon a signal from the turbine trip circuit.

Steam Generator Blowdown

Each steam generator is provided with two bottom blowdown connections for shell-side solids concentration control. The bottom of each steam generator is also provided with a drain connection which discharges into the blowdown line. An integrated flow measurement is provided for each line and a flow indicator is provided for each blowdown sampling line.

Blowdown from all four steam generators passes to the blowdown flash tank. The flashed vapor is discharged to atmosphere while the condensate drains by gravity through a service water discharge line into the circulating water discharge canal. Two automatic isolation valves on each blowdown line close on radioactivity increase above a low set valve.

If drains from the blowdown tank become contaminated, the blowdown tank drains are diverted to the waste disposal system for processing.

10.2 Turbine-Generator

The turbine has a capability of 1066 MWe, allowing for 66 MWe of auxiliary power requirements, at 1.5 in. Hg absolute exhaust pressure with zero per cent makeup and six stages of feedwater heating. The unit operates at 1800 rpm with steam supplied ahead of the main stop valves at 960 psia, 540^{o}F and 0.47 per cent moisture. Steam is admitted to the turbine through four stop valves and four control valves. The expected throttle flow is approximately 13,780,000 lb. of steam per hour.

The turbine is a four casing, tandem compound, six flow exhaust unit with 44 inch last row blades. The turbine consists of one double flow HP element in tandem with three double flow LP elements. Steam after passing through the stop and control valves, passes through the high pressure turbine, and then through the moisture separator reheaters.

There are six, horizontal-axis, cylindrical shell, combined moisture separator, steam reheater assemblies. Steam from the exhaust of the HP turbine element enters each assembly at one end. Internal manifolds in the lower section distribute the wet steam. The steam then rises through a wire mesh moisture separator where the moisture is removed and drained to a drain tank. The steam leaving the wire mesh separator flows over a tube bundle where it is reheated. This reheated steam leaves through nozzles in the top of the assemblies and flows to the LP turbines. The tube bundle is supplied with main steam from ahead of the turbine throttle valves which condenses in tubes and leaves as condensate. Condensate from the reheater assemblies flows through drain tanks to the high pressure heaters.

The turbine oil system consists of a high pressure hydraulic control system and a low pressure lubrication system. Oil is also used to seal the generator shaft seals to prevent hydrogen leakage from the generator into the turbine room. The oil pump mounted on the main turbine shaft normally supplies all oil requirements. A motor driven auxiliary oil pump supplies the oil required during turbine start-up and whenever there is low pressure in the bearing oil header.

The auxiliary oil unit is a centrifugal pump driven by a 150 HP motor. Oil is supplied at 300 psig to the hydraulic control mechanisms. A motor driven bearing oil pump is also provided which supplies oil whenever there is a low pressure in the bearing oil header. This pump is a centrifugal type with a 75 HP motor. An AC motor driven oil pump is provided for turning gear and emergency operation. A DC motor driven oil pump operated from the station battery is included for additional backup to assure lubricating oil to the machine. An AC motor driven generator seal oil pump is furnished for normal operation with a DC motor driven backup pump to assure confinement of the hydrogen within the generator.

The turbine is coupled to a single, hydrogen inner cooled generator and rotating rectifier exciter. The generator is rated at 1,184,207 kva, 3 phase, 60 cycles, 22 kv at 90 percent power factor, and is cooled by 75 psig hydrogen pressure. It has sufficient capability to accept gross kilowatt output of the steam turbine with its control valves wide open at 960 psia saturated 0.47% moisture rated steam conditions.

10.3 Circulating Water System

The circulating water system supplies screened North River water, pumped by six circulating water pumps each with a design rating of 125,000 gpm. The circulating water piping is precast reinforced concrete pressure pipe laid with steel and rubber-gasketed joints.

Six traveling screens are provided to remove debris from the river water to prevent restriction of flow of water in the condenser tubes.

When the screens become sufficiently dirty to require cleaning, a pressure differential signal is dispatched to the control room and cleaning is automatically initiated. Each screen well is provided with stop logs to allow dewatering of any individual screen well for maintenance purposes. The circulating water is piped to the condensers and is discharged back into the river through a thermal discharge dispersion arrangement designed to minimize recirculation and thermal effects. To protect the traveling screens against ice during freezing water conditions, warm discharge water from the condenser may be recirculated ahead of the screens to raise the inlet water temperature. The chlorination system is provided to inject sodium hypochloride solution into the river water as it leaves the traveling screens to prevent the formulation of algae and slime in circulating water system. It includes storage tanks, pumps, control devices and diffusers.

10.4 Condenser and Auxiliaries

Three surface type, single pass, radial flow condensers are provided with bolted divided water boxes at both ends. Fabricated steel water box and shell construction is used.

In the event of high conductivity in a hotwell, that hotwell will be manually isolated and the condensate dumped overboard. The deaerating hotwells are provided to reduce the residual oxygen in the condensate to less than 0.01 cc per liter.

Three motor driven, one-third capacity, vertical, pit type, centrifugal condensate pumps are provided, each taking suction from the condenser hotwells. The condensate pumps discharge into three separate parallel streams of feedwater heaters and provide the suction supply to the feedwater pumps.

One steam jet air ejector with separate inter- and common after-condensers is provided for each condenser. The air ejector exhaust is monitored for radiation. In the event of a steam generator leak and subsequent presence of radioactive contaminated steam in the secondary system, the radioactive non-condensable gases which concentrate in the air ejector effluent will be detected by this radiation monitor. A high activity level signal automatically diverts the exhaust gases from the vent stack to the containment building.

For initial condenser shell side air removal and during plant shutdown, three non-condensing priming ejectors are provided, each having a capacity of 900 cf.

10.5 Condensate and Feedwater System

The condensate system comprises the feedwater cycle between the condenser hotwell and the feedwater pump and consists of condensate pumps, heater drain pumps, low pressure feedwater heaters, and condensate transfer pumps. The arrangement of the condensate system components provides for recirculation at low flows, hot well level control, make-up, spillover and storage.

Three, one third capacity condensate pumps take suction from the condenser hot wells and discharge into a common header which carries a portion of the condensate through three steam jet air ejector condensers, arranged in parallel, and through one gland steam condenser. The remaining portion flows in parallel with the first flow-path, bypassing the steam jet air ejectors and the gland steam condenser. The second flow-path rejoins the first in the condensate header downstream of the gland steam condenser and upstream of the low pressure feedwater heaters.

To maintain condenser vacuum and turbine steam seals during start-up, shutdown, and at very low loads, a condensate recirculation line is provided to maintain minimum flow through the air ejector condensers and gland steam condenser. The recirculation line originates at the condensate header downstream of the gland steam condenser and terminates at the condenser hot well. A diaphragm operated recirculation valve is automatically controlled by the minimum flow required by the air ejector condensers.

The condensate header is divided into three lines downstream of the gland steam condenser. These lines carry the condensate through the tube sides of three parallel strings of two LP feedwater heaters. The flow to the remaining three strings of three LP heaters is through a common pipe. The condensate is returned to the common stream before the remaining LP heaters. After the No. 5 feedwater heaters, the three condensate lines join into a common header. The heater drain pump discharge enters this header and then continues on to the suction of the steam generator feed pumps.

Each parallel string of feedwater heaters may be taken out of service by closing a manual gate valve at the inlet to the string of heaters, and at the outlet to the string of heaters.

The makeup system connects the 500,000 gal. capacity condensate storage tank to a diffusing pipe in the condenser shell. This line contains a diaphragm operated valve which automatically opens on low level in the condenser hot well to pass makeup water from the condensate storage tank to the condenser. An isolating valve will close the condenser makeup when the storage tank level reaches 360,000 gal. This will ensure a reserve of condensate for the auxiliary feedwater pumps to hold the plant at hot shutdown for 24 hours following a trip at full power.

The surge or condensate draw-off system connects the condensate pump discharge header to the condensate storage tank. This line contains a diaphragm operated valve which automatically opens on high level in the condenser hot well to pass excess condensate from the condensate pump discharge header to the condensate storage tank.

The drains from the No. 6 feedwater heater flow to the heater drain tank. Normal condensate level is maintained in the No. 6 heater by diaphragm operated level control valves.

The drains from the No. 5 feedwater heaters flow by gravity directly to the heater drain tank. The heater drain tank also receives drains from the shells of moisture separators through separate gravity flow drain lines. Air cylinder operated swing check type non-return valves in these drain lines close on turbine trip.

Two half size heater drain pumps pump the drains from the drain tank into the condensate header ahead of the steam generator feed pumps.

Feedwater System

Main Feedwater System

Two half size steam turbine driven main feedwater pumps increase the pressure of the condensate for delivery through one stage of three string feedwater heaters and feedwater regulating valves to the steam generators. The turbine drives normally operate with steam from the outlet of the three reheater moisture separators.

Auxiliary Feedwater System

The Auxiliary Feedwater System supplies high pressure feedwater to the steam generators in order to maintain a water inventory for removal of heat energy from the reactor coolant system by secondary side steam release in the event of inoperability of the main feedwater system. The head generated by the pumps is sufficient to deliver feedwater into the steam generators at the highest safety valve setting. Redundant supplies are provided by using two pumping systems, using different sources of power for the pumps.

The capacity of each system is set so that the four steam generators will not boil dry nor will the primary side relieve fluid through the pressure relief valves, following a loss of main feedwater flow.

One system utilizes a steam turbine-driven pump, with the steam capable of being supplied from two of the steam generators. This system supplies 800 gpm of feedwater.

Steam to drive the turbine is supplied from two of the main steam lines upstream of the isolation valves at steam generator outlet pressure and is reduced to the 600 psig turbine design pressure by a pressure reducing control valve. Each supply is provided with a stop check valve suitable for local isolation.

The other system utilizes two motor-driven pumps each having a capacity of 400 gpm and the discharge piping is arranged so that each pump supplies two steam generators. Electrical power for three motors is automatically obtained from the diesel generators in the event of complete loss of power.

The auxiliary feed pumps are located in the area of the main steam and feedwater penetration immediately outside the reactor containment.

The water supply source for this sytem is redundant. The main source is by gravity feed from the condensate storage tank. This tank is sized to meet the normal operating and maintenance needs of the turbine cycle systems; however, a minimum water level will be maintained, equivalent to the steam generation due to 24 hours of residual heat generation at hot shutdown conditions.

Closed Cooling Water System

The closed cooling water system provides water to the sample coils, pump glands and motor bearings, various pumps, oil coolers, turbine generator oil and hydrogen coolers, feedwater pump turbine oil coolers, instrument and station air aftercoolers, air conditioners, etc. It includes three pumps @ 8000 gpm capacity with a total head of 50 psi, each driven by a 350 hp, 1800 rpm, 440 volt, 3 phase, 60 cycle motor, three horizontal single pass heat exchangers 5,000 sq. ft. each transferring 35×10^6 btu/hr., 150 psig shell and tube design pressure, piping and valves.

Water Treatment System

The plant overall water treating system shown on Figure 10.1 consists of the raw water system, and demineralizer system.

Water is supplied to the raw water treating system by the service water pumps. After raw water treatment of softening, coagulation (by reactivators) and filtration (by gravity filters) the water is pumped by the treated water pumps to the treated water storage tank. A treated water transfer pump takes suction from the treated water storage tank to the fire water tank.

A supply header from the treated water storage tank supplies the suction supply of the demineralizer feed pumps. The discharge header from the demineralizer feed pumps supplies the demineralizers and other services requiring treated water. With the pressure supplied by the demineralizer feed pumps the water flows through the demineralizers to the condensate water storage tank.

When heat cycle make-up (condensate) is required, the condensate is admitted to the condenser hotwell by gravity head through a control valve regulated from hotwell level demand.

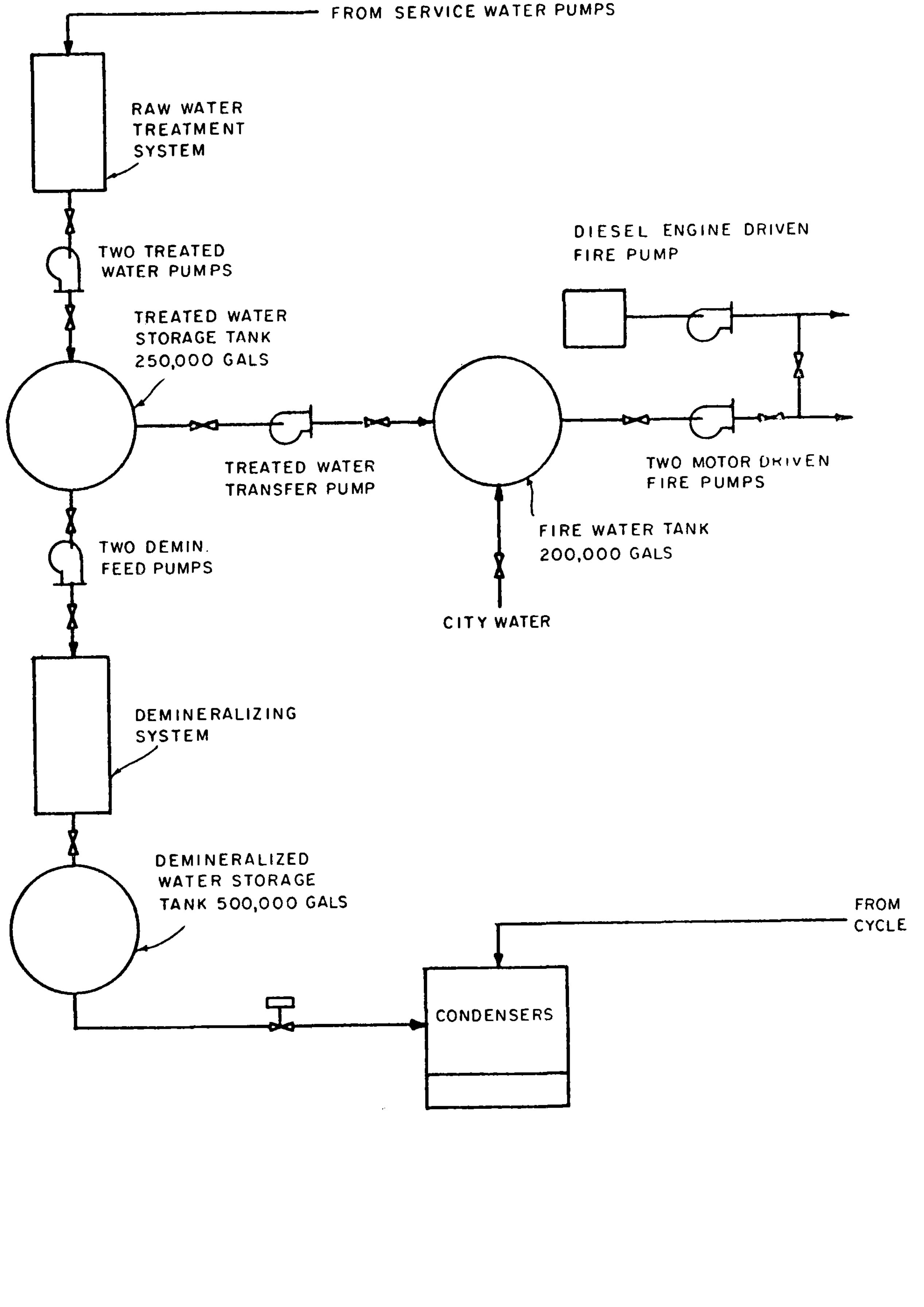


FIG. 10.1 WATER TREATMENT SYSTEM

PWR

SECTION 11

WASTE DISPOSAL AND RADIATION PROTECTION SYSTEM

11.1 Waste Disposal System

The Waste Disposal System Flow Diagrams are shown in Figure 11.1. The Waste Disposal System collects and processes all potentially radioactive primary plant wastes for removal from the plant site within limitations established by applicable governmental regulations. Fluid wastes are sampled and analyzed to determine the quantity of radioactivity, with an isotopic breakdown if necessary, before any attempt is made to discharge them and they are then released under controlled conditions. A radiation monitor is provided to maintain surveillance over the release operation, but the permanent record of activity releases is provided by radiochemical analysis of known quantities of waste. The system is capable of processing all wastes generated during continuous operation of the primary system assuming that fission products corresponding to defects in one per cent of the fuel cladding escape into the reactor coolant.

As secondary functions, system components supply hydrogen and nitrogen to primary system components as required during normal operation, and provide facilities to transfer fluids from inside the containment to other systems outside the containment.

Liquid Processing

During normal plant operation the Waste Disposal System processes liquids from the following sources:

a) Equipment drains and leaks
b) Radioactive chemical laboratory drains
c) Decontamination drains
d) Demineralizer regeneration
e) Floor drains

The system also collects and transfers liquid drained from the following sources directly to the Chemical and Volume Control System for processing:

a) Reactor coolant loops
b) Pressurizer relief tank
c) Reactor coolant pump secondary seals
d) Excess letdown during startup
e) Accumulators
f) Valve and reactor vessel flange leakoffs

The valve and reactor flange leakoff liquids flow to the reactor coolant drain tank and are discharged directly to the CVCS holdup tanks by the reactor coolant drain pumps which are operated automatically by a level controller in the tank. These pumps also return water from the refueling canal and cavity to the refueling water storage tank.

Where plant layout permits, waste liquids drain to the waste holdup tank by gravity flow. Other waste liquids, including floor drains, drain to the sump tank and are discharged to the waste holdup tank by pumps operated automatically by a level controller in the tank.

If preliminary analysis by sampling indicates that the liquid is suitable for discharge, it is pumped from the waste holdup tank to the waste condensate tanks where its activity can be determined for record by isolating, sampling and analyzing before it is discharged through the radiation monitor to the condenser circulating water.

Liquids requiring cleanup before release are processed in batches by the waste evaporator. The concentrated bottoms are discharged to the drumming room where they are packaged and stored until removal to a burial facility. The condensate is routed to one of two waste condensate tanks. When one tank is filled, it is isolated and sampled for analysis while the second tank is in service. If analysis confirms the activity level is suitable for discharge, the condensate is pumped through a flow meter and a radiation monitor to the condenser circulating water discharge. Otherwise it is returned to the waste holdup tank for reprocessing. Although the radiochemical analysis forms the basis for recording activity releases, the radiation monitor provides surveillance over the operation by preventing the discharge valve from opening if the liquid activity level exceeds that which can be safely discharged.

Gas Processing

During plant operations, gaseous wastes will originate from:

a) Degassing reactor coolant and purging the volume control tank
b) Displacement of cover gases as liquid accumulates in various tanks
c) Equipment purging
d) Sampling operations and automatic gas analysis for hydrogen and oxygen in cover gases.

Most of the gas received by the Waste Disposal System during normal operation is cover gas displaced from the Chemical and Volume Control System holdup tanks as they fill with liquid. Since this gas must be replaced when the tanks are emptied during processing, facilities are provided to return gas from the decay tanks to the holdup tanks. A backup supply from the nitrogen header is provided for makeup if return flow from the gas decay tanks is not available. Since the hydrogen concentration may exceed the combustible limit during this type of operation, components discharging to the vent header system are restricted to those containing no air or aerated liquids and the vent header itself is designed to operate at a slight positive pressure (0.5 psig minimum to 2.0 psig maximum) to prevent in-leakage. On the other hand, out-leakage from the system is minimized by using Saunders patent diaphragm valves, bellows seals, self contained pressure regulators and soft-seated packless valves throughout the radioactive portions of the system.

Gases vented to the vent header flow to the waste gas compressor suction header. One of the two compressors is in continuous operation with the second unit instrumented to act as backup for peak load conditions. From the compressors, gas flows to one of the four large gas decay tanks.

Gas held in the decay tanks can either be returned to the Chemical and Volume Control System holdup tanks, or discharged to the atmosphere if the activity concentration is suitable for release. Generally, the last tank to receive gas will be the first tank emptied back to the holdup tanks in order to permit the maximum decay time before releasing gas to the environment.

Six additional small gas decay tanks are supplied for use during degassing of the reactor coolant prior to a cold shutdown. The reactor coolant fission gas activity inventory is distributed equally among the six tanks through a common inlet header.

A radiation monitor in the sample line to the gas analyzer checks the gas decay tank activity inventory each time a sample is taken for hydrogen-oxygen analysis. An alarm warns the operator when the inventory limit is approached so that he may place another tank in service.

Before a tank can be emptied to the environment, its contents must be sampled and analyzed. Samples are taken manually by opening the isolation valve to the gas analyzer sample line and permitting gas to flow to the gas analyzer where it can be collected in one of the Sampling System gas sample vessels.

Solids Processing

The Waste Disposal System is designed to package all solid wastes in standard 55 gallon drums for removal to burial facilities. Concentrates from the waste evaporator will be pumped into a battery of 6 drums previously filled with a mixture of vermiculite and cement. After filling, the drums are moved to a shielded storage area by a bridge and trolley crane until a sufficient number have accumulated for shipment. Spent resins are packaged in a similar manner.

Miscellaneous solid wastes, such as paper, rags, and glassware, are compressed into 55 gallon drums by a hydraulically operated baler located in the drumming room. Filled drums are stored in a shielded area in the drumming room.

11.2 Radiation Protection

11.2.1 Monitoring Radioactivity Releases

The containment atmosphere, the plant vent, the containment fan-cooler's service water discharge, the Waste Disposal System gas and liquid effluent, the condenser air ejectors, the component cooling loop liquid, and the steam generator blowdown are monitored for radioactivity released during normal operations, from anticipated transients, and from accident conditions.

All gaseous effluent from possible sources of accidental releases of radioactivity external to the reactor containment (e.g., the spent fuel pit and waste handling equipment) will be exhausted from the plant vent which is monitored. All accidental spills of liquids are maintained within the auxiliary building and collected in a drain tank. Any Waste Disposal System liquid effluent discharged to the condenser circulating water canal is monitored. For the case of leakage from the reactor containment under accident conditions, the plant area radiation monitoring system supplemented by portable survey equipment to be kept in the Health Physics office area will provide adequate monitoring of accident releases.

Monitoring Fuel and Waste Storage

Monitoring and alarm instrumentation are provided for fuel and waste storage and handling areas to detect inadequate cooling and to detect excessive radiation levels.

Radiation monitors are provided to maintain surveillance over the waste release operation. The permanent record of activity releases is provided by radiochemical analysis of known quantities of waste.

There is a controlled ventilation system for the fuel storage and waste treating areas of the auxiliary building which discharges to the atmosphere via the plant vent. Radiation monitors are in continuous service in these areas to actuate a high-activity alarm on the control board annunciator.

Fuel and Waste Storage Radiation Shielding

Auxiliary shielding for the Waste Disposal System and its storage components is designed to limit the dose rate to levels not exceeding .75 mr/hr in normally occupied areas, to levels not exceeding 2.0 mr/hr in intermittently occupied areas and to levels not exceeding 15 mr/hr in limited occupancy areas.

Gamma radiation is continuously monitored in the auxiliary building. A high level signal is alarmed locally and annunciated in the control room.

Protection Against Radioactivity Release from Spent Fuel and Waste Storage
All waste handling and storage facilities are contained and equipment designed so that accidental releases directly to the atmosphere are monitored and will not exceed the limits of 10CFR100. The components of the Waste Disposal System are not subjected to any high pressures or stresses and those components whose failure could result in the release of radioactivity are Class I design. In addition, the tanks, which have a design pressure greater than atmospheric pressure, piping and valves of the system are designed to the codes given in Table 11.2-1. Hence the probability of a rupture or failure of the system is exceedingly low.

11.2.2 Shielding

Radiation shielding is designed for operation at maximum calculated thermal power and to limit the normal operation radiation levels at the site boundary below those levels allowed for continuous non-occupational exposure. The plant is capable of continued safe operation with 1% fuel element defects.

In addition, the shielding provided ensures that in the event of a hypothetical accident, the integrated off-site exposure due to the contained activity does not result in any off-site radiation exposures in excess of those permitted in current regulations.

Operating personnel at the plant are protected by adequate shielding, monitoring, and operating procedures. Each area in the plant is classed according to the dose rate allowable in the area. The allowable dose rate is based on the expected frequency and duration of occupancy.

The shielding is divided into five categories according to function. These functions include the primary shielding, the secondary shielding, the accident shielding, the fuel transfer shielding, and the auxiliary shielding.

Primary Shield

The primary shield is designed to:

1. Reduce the neutron fluxes incident on the reactor vessel to limit the radiation induced increase in transition temperature.

2. Attentuate the neutron flux sufficiently to prevent excessive activation of plant components.

3. Limit the gamma fluxes in the reactor vessel and the primary concrete shield to avoid excessive temperature gradients or dehydration of the primary shield.

4. Reduce the residual radiation from the core, reactor internals and reactor vessel to levels which will permit access to the region between the primary and secondary shields after plant shutdown.

5. Reduce the contribution of radiation leaking to obtain optimium division of the shielding between the primary and secondary shields.

Secondary Shield

The main function of the secondary shielding is to attentuate the radiation originating in the reactor and the reactor coolant. The major source in the reactor coolant is the Nitrogen -16 activity, which is produced by neutron activation of oxygen during passage of the coolant through the core. The secondary shield will limit the full power dose rate outside the containment building to less than 0.75 mr/hr.

Accident Shield

The main purpose of the accident shield is to ensure safe radiation levels outside the containment building following a maximum credible accident.

Fuel Handling Shield

The fuel handling shield is designed to facilitate the removal and transfer of spent fuel assemblies and control rod clusters from the reactor vessel to the spent fuel pit. It is designed to attentuate radiation from spent fuel, control clusters, and reactor vessel internals to less than 2.0 mr/hr at the refueling cavity water surface and less than 0.75 mr/hr in areas adjacent to the spent fuel pit.

Auxiliary Shielding

The function of the shielding is to protect personnel working near various system components in the Chemical and Volume Control System, the Residual Heat Removal System, the Waste Disposal System and the Sampling System. The shielding provided for the auxiliary building is designed to limit the dose rate to less than 0.75 mr/hr in normally occupied areas, and at or below 2.0 mr/hr in intermittently occupied areas.

Shielding Design

Primary Shield

The primary shield consists of the core baffle, water annuli, barrel-thermal shield (all of which are within the reactor vessel), the reactor vessel wall, and a concrete structure surrounding the reactor vessel.

The primary shield immediately surrounding the reactor vessel consists of an annular reinforced concrete structure extending from the base of the containment to an elevation of 60 feet. The lower portion of the shield is a minimum thickness of 6 feet of concrete and is an integral part of the main structural concrete support for the reactor vessel. It extends upward to join the concrete cavity over the reactor. The reactor cavity, which is approximately rectangular in shape, extends upward to the operating floor with vertical walls 4 ft. thick, except in the area adjacent to fuel handling, where the thickness is increased to 6 ft.

Secondary Shield

The secondary shield surrounds the reactor coolant loops and the primary shield. It consists of the annular crane support wall, the operating floor, and the reactor containment structure. The containment structure also serves as the accident shield.

The lower portion of the secondary shield above grade consists of the 4 ft. -6 in. cylindrical portion of the reactor containment and a 3 ft. concrete annular crane support wall surrounding the reactor coolant loops. The secondary shield will attenuate the radiation levels in the primary loop compartment from a value of 25 rem/hr to a level of less than 0.75 mr/hr outside the reactor containment building. Penetrations in the secondary shielding are protected by supplemental shields.

Accident Shield

The accident shield consists of the 4 ft. -6 in. reinforced concrete cylinder capped by a hemispherical reinforced concrete dome of a 3 ft. -6 in. thickness. This shielding includes supplemental shields in front of the containment penetrations.

The equipment access hatch is shielded by a 3 ft. -6 in. thick concrete shadow shield and a 1 ft. -6 in. concrete roof to reduce scattered dose levels in the event of loss of reactor coolant accident accompanied by a complete core meltdown.

Fuel Handling Shield

The refueling cavity, flooded to elevation 58 feet during refueling operations, provides a temporary water shield above the components being withdrawn from the reactor vessel. The water height during refueling is approximately 24 1/2 ft. above the reactor vessel flange. This height ensures that a minimum of 10 1/2 ft. of water will be above the active fuel of a withdrawn fuel assembly. Under these conditions, the dose rate is less than 2.0 mr/hr at the water surface.

The refueling canal is a passageway connected to the reactor cavity and extending to the inside surface of the reactor containment. The canal is formed by two concrete walls each 6 ft. thick, which extends upward to the same height as the reactor cavity. During refueling the canal is flooded with borated water to the same height as the reactor cavity.

The spent fuel assemblies and control rod clusters are remotely removed from the reactor containment through the horizontal spent fuel transfer tube and placed in the spent fuel pit. Concrete, 6 ft. thick, shields the spent fuel transfer tube. This shielding is designed to protect personnel from radiation during the time a spent fuel assembly is passing through the main concrete support of the reactor containment and the transfer tube.

Radial shielding during fuel transfer is provided by the water and concrete walls of the fuel transfer pit. An equivalent of 6 feet of regular concrete is provided to insure a maximum dose value of 0.75 mr/hr in the areas adjacent to the spent fuel pit.

Spent fuel is stored in the spent fuel pit which is located adjacent to the containment building. Shielding for the spent fuel storage pit is provided by 6 feet thick concrete walls and is flooded to a level such that the water height is greater than 13 ft. above the spent fuel assemblies.

Auxiliary Shielding

The auxiliary shield consists of concrete walls around certain components and piping which process reactor coolant. In some cases, the concrete block walls are removable to allow personnel access to equipment during maintenance periods. Periodic access to the auxiliary building is allowed during reactor operation. Each equipment compartment is individually shielded so that compartments may be entered without having to shut down and, possibly, to decontaminate the adjacent system.

11.2.3 Radiation Monitoring System

The radiation Monitoring System is designed to perform two basic functions:

a) Warn of any radiation health hazard which might develop.

b) Give early warning of a plant malfunction which might lead to a health hazard or plant damage.

Instruments are located at selected points in and around the plant to detect, compute and record the radiation levels. In the event the radiation level should rise above a desired setpoint, an alarm is initiated in the control room. The automatic Radiation Monitoring System operates in conjunction with regular and special radiation surveys and with chemical and radiochemical analyses performed by the plant staff. Adequate information and warning is thereby provided for the continued safe operation of the plant and assurance that personnel exposure does not exceed 10CFR20 limits.

The only components of this system which are located in the containment are the detectors for certain area monitoring channels. They would not be expected to operate following a major loss-of-coolant accident and are not designed for this purpose. Components of all other area and process monitoring channels are designed for post-accident operation.

The components of the Radiation Monitoring System are designed according to the following environmental conditions:

a) Temperature - an ambient temperature range of 40 to 120°F*

b) Humidity - 0 to 100% relative humidity*

*Equipment located in the control room area may be specified for smaller temperature and humidity ranges because of the controlled environment provided by the heating and ventilating system.

c) Pressure - Components in the auxiliary building and control room are designed for normal atmospheric pressure. Area monitoring system components inside the containment are designed to withstand test pressure.

d) Radiation - Process and area radiation monitors are of a nonsaturating design so that they "peg" full scale if exposed to radiation levels up to 100 times full scale indication. Process monitors are located in areas where the normal and post-accident background radiation levels will not affect their usefulness.

The Radiation Monitoring System is divided into the following subsystems:

a) The Process Radiation Monitoring System monitors various fluid streams for indication of increasing radiation levels.

b) The Area Monitoring System monitors area radiation in various parts of the plant.

c) Environmental Radiation Monitoring System monitors radiation in the area surrounding the plant.

TABLE 11.2-1

WASTE DISPOSAL COMPONENTS CODE REQUIREMENTS

Component	Code
Chemical Drain Tank	ASME VIII
Reactor Coolant Drain Tank	ASME III, Class C
Sump Tank	ASME VIII
Spent Resin Storage Tanks	ASME III, Class C
Gas Decay Tanks	ASME III, Class C
Waste Holdup Tank	ASME VIII
Water Condensate Tank	ASME VIII
Regenerant Tank	ASME VIII
Waste Evaporator	ASME III, Class C
Waste Filter	ASME VIII
Piping and Valves	ANSI-B31.7

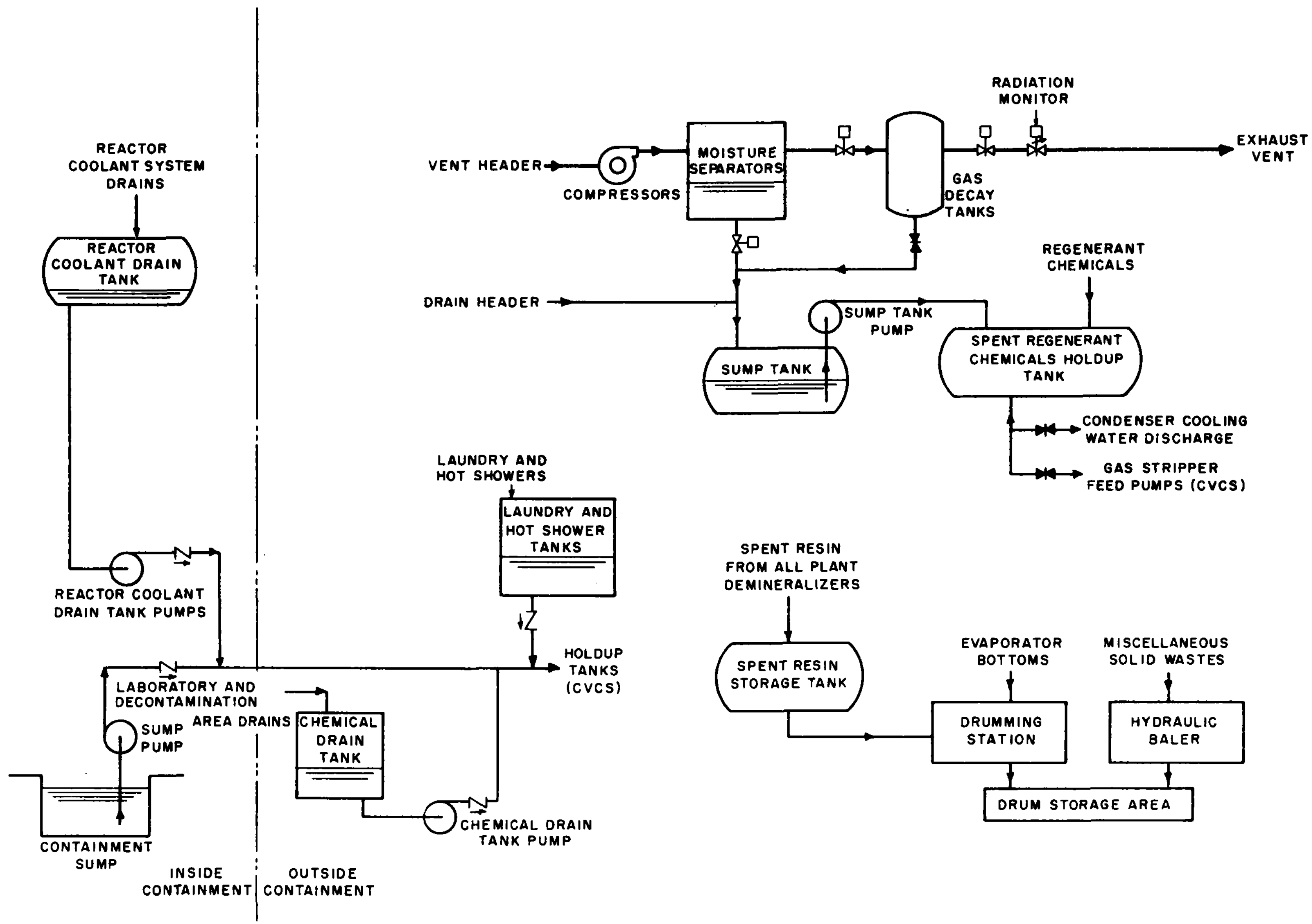


FIG. 11.1 WASTE DISPOSAL SYSTEMS

1000 MW PRESSURIZED WATER REACTOR POWER PLANT

EQUIPMENT LIST

The following Equipment List describes those major components considered during the development of this study. Each of the components is briefly described in terms of design, pressures, temperatures, flow, capacities, materials, etc. sufficiently to correlate same from the Cost Estimate for the 1000 MWe Nominally Rated Pressurized Water Reactor.

As a convenience for cross-referencing between the Cost Estimate and the Equipment List, the account number has been added at the left-hand column of the Equipment List. The account numbers are intended to correlate with equipment identified in the Cost Estimate.

III

Account No.		Description
211.15	Sewage Treatment Plant	One (1) activated sludge type (Aerobic Digestion Process) 10,000 gallons per day sewage treatment plant.
212.22	HEATING & VENTILATION SYSTEMS (Containment Building)	
	Heating	Four (4) 400,000 Btu/hr steam unit heaters and controls.
	Containment Recirculation System	Five (5) containment building air recirculating Fan-Cooler-Filter Units complete with cooling water coils, demisters, HEPA filters, centrifugal fan with 225 hp motor, carbon filters, automatic controls and air distribution ductwork. Each unit is sized to circulate 65,000 cfm of fluid and to remove approximately 76,300,000 Btu's per hour, under incident conditions.
	Containment Purge System	One (1) 40,000 cfm air tempering unit complete with steam coils, filters, controls and distribution ductwork. Fan motor approximately 40 hp.
	Containment Iodine Removal	One (1) 70,000 cfm exhaust fan complete with vortex dampers and controls, roughing and HEPA filters, plenum and exhaust ductwork. Fan motor approximately 125 hp. (NOTE: Back-up for this fan is provided by the Primary Auxiliary Building Exhaust Fan; Acct. No. 215.223.)
		Two (2), one spare, 8,000 cfm each Iodine Removal units complete with roughing, HEPA and carbon filters, exhaust ductwork and controls. Fan motors 10 hp.
	Control Rod Drive Mechanism Cooling System	Four (4) 15,000 cfm vaneaxial exhaust fans each complete with ductwork, minimum 25 hp motors and controls.
213.22	HEATING & VENTILATION SYSTEMS (Turbine Room and Heater Bay)	
	Heating	Twenty-five (25) steam unit Heaters each rated at 400,000 Btu's per hour and each complete with ½ hp motor and controls.

Account No.		Description
	Ventilation	Fifteen (15) roof ventilators, 60,000 cfm each with minimum 15 hp each.
		Fourteen (14) wall exhaust fans rated at 50,000 cfm each with minimum 7½ hp each.
		Wall louvers to suit exhaust requirements.
213.233	Fire Protection (Standpipe)	Fifteen (15) hose stations complete with hose reels or cabinets, nozzles and 100 feet of 1½ inch CRL hose.
215.22	HEATING & VENTILATION SYSTEMS (Primary Auxiliary Building)	
	Heating	Ten (10) steam unit heaters each rated at 40,000 Btu/hr.
		Eighty (80) electric strip heaters each rated at 1,000 watts.
	Ventilation	One (1) 65,000 cfm air tempering unit complete with steam coils, filters, controls and distribution ductwork. Fan motor approximately 40 hp.
		One (1) 70,000 cfm exhaust fan complete with vortex dampers and controls, roughing and HEPA filters, plenum and exhaust ductwork. Fan motor approximately 125 hp.
217.22	HEATING & VENTILATION (Fuel Handling Building)	
		Two (2) 300,000 Btu/hr steam unit heaters and controls.
		Two (2) 17,000 cfm each air tempering units complete with steam coils, filters and controls.
		One (1) 36,000 cfm exhaust fan complete with vortex dampers and controls, roughing and HEPA filters, plenum and exhaust ductwork. Fan motor approximately 75 hp.

Account No.		Description
		One (1) dilution exhaust fan 50,000 cfm capacity complete with control. (NOTE: This fan will operate as required in conjunction with the Containment Building Purge System, the Fuel Handling Building Exhaust System and the Primary Auxiliary Building Exhaust System.
218A.22	HEATING & VENTILATION (Control Building)	
	Heating	80 kw of electric Sill-Line Heaters, in varying lengths, for the first and second floors of the Control Building.
	Ventilation	Two (2) exhaust fans (one standby) each rated at 25,000 cfm with a 10 hp motor complete with make-up air louvers, exhaust ductwork and controls.
	Air Conditioning	30 tons of air conditioning for the Control Room, complete with ductwork, HEPA and carbon filters and booster fans for emergency use, and remote controls.
		Two (2) exhaust fans, same as above, each rated at 16,500 cfm with a 7½ hp motor.
218B.22	HEATING & VENTILATION (Diesel Generator Building)	
	Heating	Six (6) 7.5 kw electric unit heaters complete with controls.
	Ventilation	Six (6) wall exhaust (three (3) standby) each rated at 35,000 cfm 7½ hp. Systems are provided with motor operated makeup air louvers to suit exhaust requirements.
218C.22	HEATING, VENTILATING AND AIR CONDITIONING (Administration Building)	
		140 tons of air conditioning, including supply and return ductwork, controls, necessary exhaust systems, supplemental electric base board heat, etc.
218C.23	Fire Protection	Ten (10) hose stations complete with hose reels or cabinets, nozzles and 50 feet of 1½ inch CRL hose.

Account No.		Description
218D.22	HEATING, VENTILATING AND AIR CONDITIONING (Service Building)	
		100 tons of air conditioning including supply and return ductwork, controls, necessary exhaust systems, supplemental electric base board heat, etc.
218D.23	Fire Protection	Ten (10) hose stations complete with hose reels or cabinets, nozzles and 50 feet of CRL hose.
218E.22	HEATING & VENTILATION (Fan Room Building)	
		Two (2) 200,000 Btu/hr steam unit heaters and controls.
		One 6,000 cfm roof ventilator with minimum 3/4 hp motor and associated air intake louvers and controls.

Account No.		Description
221.12	Reactor	3025 MWt Pressurized Water Reactor. Light water is used as moderator and coolant. Slightly enriched uranium dioxide fuel. Silver-indium-cadmium full length and part-length control rods. Design pressure 2485 psig D.T. 650°F. Pressure losses through vessel 50 psi. Carbon steel vessel completely clad with stainless steel. Overall height 44 ft.
222.111	Reactor Coolant Pumps	Four vertical, single stage centrifugal pumps with bottom inlet and side outlet. Controlled seal leakage type. 88,500 gpm at 277 ft. head. Design pressure 2500 psia, design temperature 650°F. 6000 HP single speed AC induction motor.
222.131	Steam Generator	Four vertical shell and U-tube with integral primary and secondary steam separators to obtain maximum moisture at outlet of 0.47%. Steam flow 3.445×10^6 lb/hr. at 960 psia, 540°F. Primary side design pressure 2500 psia, design temperature 650°F. Secondary side design pressure 1100 psia, design temperature 556°F. Carbon steel shell with Inconal U-tubes and stainless steel cladding on all parts on the primary side.
222.141	Pressurizer	One vertical cylindrical 1800 cu. ft. carbon steel pressurizer vessel with all internal surfaces clad with stainless steel. Overall height 53 ft. Direct immersion electric heaters in bottom head. Spray system in top head. Design pressure 2500 psia, design temperature 680°F. Two power operated relief valves and three code safety valves are provided.
222.143	Pressurizer Relief Tank	One horizontal cylindrical 1800 cu. ft. relief tank with underwater discharge header, water spray header and rupture disc. Design pressure 100 psig, design temperature 340°F.
223.111	Residual Heat Removal Pumps	Two vertical, single stage centrifugal pumps with side inlet and outlet. 3000 gpm at 350 ft. head. Design pressure 600 psig, design temperature 400°F.

Account No.		Description
223.121	Residual Heat Removal Heat Exchangers	Two vertical shell and U-tube heat exchangers. Tube side design pressure 600 psig, design temperature 400°F. Shell side design pressure 150 psig, design temperature 200°F.
223.311	Safety Injection Pumps	Three horizontal centrifugal pumps. 400 gpm at 2500 ft. head. Design pressure 1750 psig, design temperature 300°F.
223.312	Recirculation Pumps	Two vertical centrifugal pumps. 3000 gpm at 350 ft. head. Design pressure 300 psig, design temperature 300°F. Stainless steel construction.
223.331	Accumulators	Four vertical cylindrical 1100 cu. ft. tanks. Design pressure 700 psig, design temperature 300°F. Carbon steel construction, stainless steel lined.
223.332	Boron Injection Tank	One vertical cylindrical 360 cu. ft. tank with two electric immersion heaters. Design pressure 100 psig, design temperature 250°F. Stainless steel construction.
223.471	Containment Spray Pumps	Two horizontal centrifugal pumps. 2600 gpm at 450 ft. head. Design pressure 300 psig, design temperature 200°F. Stainless steel construction.
223.473	Spray Additive Tank	One horizontal cylindrical 5100 gal. tank Design pressure 300 psig, design temperature 300°F. Sodium hydrozide solution. Carbon steel construction stainless steel lined.
224.111	Waste Holdup Tank	One 24,500 gal. Austenitic SS Waste Holdup Tank. Design pressure - Atmospheric; design temperature - 180°F.
224.112	Spent Resin Storage Tank	One 300 cu. ft. Austenitic SS Spent Resin Storage Tank design pressure - 100 psig design temperature 150°F.
224.113	Reactor Coolant Drain Tank	One 350 gal. Austenitic SS Reactor Coolant Drain Tank. Design pressure internal 25 psig, external 60 psig - design temperature 267°F.
224.114	Chemical Drain Tank	One 375 gal. Austenitic SS Chemical Drain Tank. Design pressure, Atmospheric; design temperature 180°F.

Account No.		Description
224.115	Sump Tank	One 375 gal. Austenitic SS Sump Tank. Design pressure - atmospheric; design temperature 150°F.
224.116	Regenerant Tank	One 400 gal. Austenitic SS Regenerant Tank. Design pressure - Atmospheric; design temperature 180°F.
224.117	Waste Condensate Tank	Two 1000 gal. Austenitic SS Waste Condensate Tanks. Design pressure - Atmospheric Design temperature 180°F.
224.121	Waste Condensate Pumps	Two horizontal centrifugal Austenitic SS 20 gpm design flow rate at 20 ft. design head. Design pressure - 150 psig; design temperature - 180°F with NPSH at 4 ft. design flow.
224.122	Reactor Coolant Drain Pumps	Two canned Austenitic SS Reactor Coolant Drain Pumps. 50 gpm and 150 gpm, 175 ft. head. Design pressure 150 psig, design temperature 267°F. NPSH at design flow is 7 ft. and 4 ft.
224.123	Containment Sump Pumps	Two vertical stainless steel Containment Sump Pumps. 50 gpm - 34 ft. suction head and 119 ft. discharge head. NPSH is 23 ft. fluid at 50° - 150°F pumping temperature.
224.124	Sump Tank Pumps	Two horizontal centrifugal Austenitic SS Sump Tank Pumps. 20 gpm design flow rate at 100 ft. design head. Design pressure - 150 psig; design temperature 180°F. NPSH at 4 ft. design flow.
224.125	Chemical Drain Pump	One horizontal centrifugal Austenitic SS Chemical Drain Pump. 20 gpm design flow rate, 100 ft. design head. Design pressure 150° psig, design temperature 180°F at NPSH 4 ft. design flow.
224.127	Regenerant Pump	One horizontal centrifugal Austenitic SS Regenerant Pump. 20 gpm design flow rate at 100 ft. design head. Design pressure - 150 psig, design temperature 180°F. NPSH at 4 ft. design flow.

Account No.		Description
224.129	Primary Make-up Pumps	Two horizontal centrifugal pumps. 150 gpm at 240 ft. head. Design pressure 150 psig. Design temperature 100°F. Stainless steel construction.
224.141	Waste Evaporator	One Vacuum Austenitic SS 2 gpm design capacity Waste Evaporator. Feed composition dissolved solids and activity - Variable bottoms composition, dissolved solids - Variable activity, uCi/cc (Max.) - 40. Condensate composition dissolved solids, 10 ppm activity, uCi/cc (Max.) 4×10^{-5} with a decontamination factor of 10^6 and steam supply flow rate pressure (saturated) of 15 psig.
	Waste Evaporator Feed Pump	One horizontal centrifugal Austenitic SS Waste Feed Pump. 20 gpm design flow rate at 100 design head. Design pressure - 150 psig; design temperature - 180°F. NPSH at 4 ft. design flow.
	Waste Filter	One disposable synthetic cartridge Austenitic SS Waste Filter. 20 gpm flow rate - Pressure drop at 20 gpm, clean fliter, 5 psi. Maximum differential pressure 100% fouled, 20 psi with retention for 25 micron particles - 98%.
	Reagent Tank	One 6 gal. Austenitic SS Reagent Tank. Design pressure 150 psig; design temperature 250°F.
224.21	Large Gas Decay Tanks	Four 525 cu. ft. carbon steel Lg. Gas Decay Tanks. Design pressure - 150 psig; design temperature 150°F.
224.21	Small Gas Decay Tanks	Six 40 cu. ft. carbon steel Sm. Gas Decay Tanks Design pressure - 150 psig; design temperature - 150°F.
224.25	Waste Gas Compressors	Two horizontal centrifugal water-sealed Waste Gas Compressors N_2 (at 140°F, 2 psig) 20 cfm design flow rate with a design pressure of 150 psig - design temperature 180°F.
224.37	Drumming Station Crane	One (1) 5 ton overhead traveling crane for drum handling in the PAB. 14 foot lift. Hoist speed 10 FPM, bridge speed 37.5 FPM, trolley speed 20 FPM.

Account No.		Description
225.11	Fuel Cask Handling Crane	One (1) 40 ton overhead bridge crane for handling 40 ton spent fuel cask.
225.31	Reactor Cavity Manipulator Crane	One (1) fuel manipulator crane
225.32	Spent Fuel Manipulator Crane	One (1) travelling platform with monorail hoist for fuel handling
225.4311	Spent Fuel Pit Pump	One horizontal, centrifugal stainless steel Spent Fuel Pit Pump with a design pressure of 150 psig and a design temperature of 200^{o}F with a flow rate of 2300 gpm. The total developed head is 150 ft. with the temperature of pump fluid at 80-180^{o}F.
225.4312	Spent Fuel Pit Skimmer Pump	One horizontal centrifugal stainless steel spent fuel pit skimmer pump with a design pressure of 50 psig and design temperature of 200^{o}F. Design flow rate is 100 gpm with a total developed head of 50 ft. at 75-150^{o}F pump fluid.
225.432	Spent Fuel Pit Heat Exchanger	One horizontal shell and U-tube heat exchanger. Tube side design pressure 150 psig, design temperature 200^{o}F. Shell side design pressure 150 psig, design temperature 200^{o}F. Carbon steel shell and stainless steel tubes.
225.433	Spent Fuel Pit Demineralizer	One flushable IRN-150 30 cu. ft. spent fuel Pit demineralizer with a design pressure of 200 psig and design temperature of 250^{o}F and a flow rate of 100 gpm.
	Spent Fuel Pit Strainer	One 2300 gpm 0.2 in. Spent Fuel Pit Strainer with a maximum differential pressure across the strainer element at rated flow of 1 psi.
225.434	Spent Fuel Pit Filter	One 100 gpm spent fuel pit filter with internal design pressure housing of 200 psig and design temperature of 250^{o}F. Maximum differential pressure across filter element at rated flow is 5 psi and maximum differential pressure across the filter element before replacement filtration requirement is 20 psi.

Account No.		Description
225.434	Spent Fuel Pit Skimmer Filter	One replaceable 100 gpm spent fuel pit skimmer filter with an internal design pressure of 200 psig and design temperature of 250°F. Maximum differential pressure across filter at 5 psi and maximum differential pressure across filter prior to replacement at 20 psi.
225.434	Spent Fuel Pit Skimmer Strainer	One basket 1/8 in. 100 gpm spent fuel pit skimmer strainer with a design pressure of 50 psig and design temperature of 200°F. Maximum differential pressure across strainer is 1 psi.
225.434	Spent Fuel Pit Skimmer	Two 50 gpm spent fuel pit skimmers with a vertical fluctuation range for floating of 4 in. and manual adjustment of 2 ft.
225.4371	Refueling Water Storage Tank	One 350,000 gal. capacity stainless steel refueling water storage tank with an atmospheric design pressure and ambient design temperature.
225.4372	Refueling Water Purification Pump	One horizontal centrifugal stainless steel refueling water purification pump with a design pressure of 150 psig and design temperature of 200°F. Design flow rate is 100 gpm with a total developed head of 150 ft. at 150°F maximum pump fluid.
225.45	Spent Fuel Pit Underwater Lighting System	Eighteen (18) underwater flood light assemblies for lighting the Nuclear Reactor Refueling Canal and spent fuel storage pit.
226.112	Pressurization Emergency Nitrogen Storage System	Three 7333 cu. ft. carbon steel Pressurization Emergency Nitrogen Storage System. Design pressure 2450 psig, design temperature 200°F.
226.421	Volume Control Tank	One 400 cu. ft. Austenitic SS Volume Control Tank with an internal design pressure of 75 psig, an external design pressure of 15 psig and a design temperature of 250°F. Spray nozzle flow is at 120 gpm with a pressure drop of 4.0 psi.

Account No.		Description
226.422	Charging Pumps	Three Austenitic SS positive displacement with variable speed charging pumps having a speed reduction ratio of 8:1 and a design flow rate of 98 gpm. Design pressure - 3000 psig with a design temperature of 250°F, and a normal head at 130°F of 2385 psi. Three Austenitic SS 100 cu. in. Charging Pump Accumulators. Design pressure - 3000 psig with a design temperature of 250°F.
226.5211	Gas Stripper Feed Pumps	Two canned Austenitic SS Gas Stripper Feed Pumps. Design pressure - 150 psig, design temperature - 200°F. Design flow is 12.5 gpm at 200 ft. design head.
226.5212	Monitor Tank Pumps	Three centrifugal Austenitic SS 60 gpm monitor tank pumps. Design pressure - 150 psig; design temperature - 250°F with a design heat of 235 ft.
226.5213	Hold Up Tank Recirculation Pump	One centrifugal Austenitic SS Recirculation Pump. Design pressure - 75 psig; design temperature - 200°F. Design flow is 500 gpm at 100 ft. design head.
226.5214	Concentrates Holding Tank Transfer Pumps	Two canned motor pumps. 20 gpm at 150 ft. head. Design pressure 100 psig. Design temperature 250°F. Stainless steel construction.
226.5215	Boric Acid Pumps	Two horizontal centrifugal pumps. 75 gpm at 235 ft. head. Stainless steel construction.
226.5221	Boric Acid Tanks	Two vertical cylindrical 7000 gal. tanks with electric immersion heaters. Design pressure, atmospheric. Design temperature 250°F. Stainless steel construction. Two 7.5 kw heaters in each tank.
226.5222	Boric Acid Batch Tank	One vertical, cylindrical 400 gal. jacketed bottom tank. Design pressure, atmospheric. Design temperature 250°F. Stainless steel construction. One top-mounted agitator.
226.5223	Chemical Mixing Tank	One vertical cylindrical 5 gal. tank. Design pressure 150 psig. Design temperature 200°F. Stainless steel construction.

Account No.		Description
226.5224	Resin Fill Tank	One conical 8 cu. ft. tank. Design pressure, atmospheric. Design temperature 200°F. Stainless steel construction.
226.5225	Holdup Tanks	Three Austenitic SS 8500 cu. ft. Holdup Tanks. Design pressure - 15 psig; design temperature - 200°F.
226.5226	Monitor Tanks	Two Diaphragm Stainless Steel 7500 gal. monitor tanks. Design pressure - atmospheric; design temperature - 125°F.
226.5227	Concentrates Holding Tank	One 700 gal. vertical cylindrical tank with one 3 kw electric heater. Design pressure, atmospheric. Design temperature 250°F. Stainless steel construction.
226.5228	Primary Water Storage Tank	One 165,000 gal. vertical cylindrical tank with diaphragm seal and steam heating coil.
226.5231	Regenerative Heat Exchanger	One shell and tube heat exchanger. Tube side design pressure 2735 psig, design temperature 650°F. Shell side design pressure 2485 psig, design temperature 650°F. Stainless steel construction.
226.5232	Non-Regenerative Heat Exchanger	One shell and tube heat exchanger. Tube side design pressure 600 psig, design temperature 400°F. Shell side design pressure 150 psig, design temperature 250°F. Carbon steel shell and stainless steel tubes.
226.5233	Excess Letdown Heat Exchanger	One shell and tube heat exchanger. Tube side design pressure 2485 psig, design temperature 650°F. Shell side design pressure 150 psig, design temperature 250°F. Carbon steel shell and stainless steel tubes.
226.5241	Mixed Bed Demineralizers	Two flushable mixed bed demineralizers. Design pressure 200 psig, design temperature 250°F. Rohm and Haas Amberlite IRN-217 or equivalent resin. Stainless steel construction.
226.5242	Deborating Demineralizers	Two fixed bed demineralizers. Design pressure 200 psig. Design temperature 250°F. Rohm and Haas Amberlite IRN-78 or equivalent resin. Stainless steel construction.

Account No.		Description
226.5243	Base Removal Ion Exchanger	One flushable ion exchanger. Design pressure 200 psig. Design temperature 250°F. Stainless steel construction.
226.5244	Cation Removal Ion Exchangers	Two flushable ion exchangers. Design pressure 200 psig. Design temperature 250°F. Stainless steel construction.
226.5245	Evaporator Condensate Demineralizer	Two Fixed Austenitic SS evaporator condensate demineralizers. Design pressure 200 psig; design temperature 250°F. with a flow rate of 12.5 gpm. with a volume of 12 cu. ft. and vessel drop of 5.0 psi. Bed depth is 5.5 ft. and bed diameter is 19.5 in.
226.525	Condensate Filters	Two Austenitic SS disposable synthetic cartridge condensate filters. Design pressure - 200 psig; design temperature 250°F with a flow rate of 12.5 gpm and pressure drop of 5 psi. Retention of 25 micron particles is 98% with maximum differential pressure of 20 psi.
226.525	Reactor Coolant Filter	One Austenitic SS disposable synthetic cartridge reactor coolant filter with a design pressure of 200 psig and a design temperature of 250°F. Flow rate is 120 gpm with a pressure drop of 7.5 psi. Retention for 25 micron particles is 98% with a maximum differential pressure 100% fouled of 20 psi.
226.525	Concentrates Filter	One disposable synthetic cartridge Austenitic SS concentrates filter with a design pressure of 200 psig and design temperature of 250°F. Flow rate is 20 gpm at a pressure drop of 5 psi. Retention for 25 micron particles is 98% with a maximum differential pressure of 20 psi.
226.525	Seal Water Filter	One disposable synthetic cartridge filter. Design pressure 220 psig. Design temperature 250°F. Stainless steel construction.
226.525	Boric Acid Filter	One disposable synthetic cartridge filter. Design pressure 200 psig. Design temperature 250°F. Stainless steel construction.

Account No.		Description
226.527	Boric Acid Evaporator Packages	Two Austenitic SS vacuum, single stage boric acid evaporator packages with a flow rate of 12.5 gpm and 10 to 2500 ppm feed composition for boric acid 12 wt% H_3BO_3; overhead composition is 10 ppm with 0.1 ppm oxygen and 2.0 uMhos/cm. The decontamination factor for bottom/distillate activity is 10^6 to 10^7.
226.5291	Blowdown Tank	7.5 ft. diameter x 12 ft. O.A.
226.711	Component Cooling Pumps	Three horizontal centrifugal pumps. 3600 gpm at 220 ft. head. Design pressure 150 psig. Design temperature 200°F. Carbon steel construction.
226.712	Auxiliary Component Cooling Pump	Two vertical centrifugal pumps. 80 gpm at 100 ft. head. Design pressure 150 psig. Design temperature 200°F.
226.721	Component Cooling Surge Tanks	Two 2000 gal. vertical cylindrical tanks. Carbon steel construction. Design pressure vacuum to 100 psig internal. Provided with vacuum breaker.
226.761	Component Cooling Heat Exchanger	Two vertical shell and tube heat exchangers. Tube side design pressure 150 psig, design temperature 200°F. Shell side design pressure 150 psig, design temperature 200°F. Carbon steel construction.
226.762	Main Coolant Pumps Seal Water Heat Exchanger	One shell and tube heat exchanger. Tube side design pressure 150 psig, design temperature 250°F. Shell side design pressure 150 psig, design temperature 250°F. Carbon steel shell and stainless steel tubes.
227.1	Main Control Room Nuclear Instrumentation Cabinets	There are four (4) NIS cabinets, one for each channel, which provides indication, control, and alarm signals for reactor operation and protection.
227.23	Main Control Room Computer	One Westinghouse PRODAC 250 process computer system.

Account No.		Description
231.1	TURBINE GENERATOR	
	Turbine	1066 MWe Turbine; tandem compound, four cylinder, 6 flow exhaust; 44 inch last stage blades, rating at 1½ inch Hg absolute; 1800 RPM. Turbine throttle steam conditons are 960 psia at 540°FTT and 158 psia at 512.2 FRT.
	Generator	1184 MVA at 0.90 PF, 1800 RPM, 3 phase, 60 cycle, 22 kv, and hydrogen cooled at 75 psig.
	Exciter	Direct connected rotating rectifier brushless exciter; 4000 kw, 500V.
	Moisture Separator-Reheaters	Six 18,300 sq. ft. Tubular Heat Exchangers reheat the high pressure cylinder exhaust steam. Wire mesh demisters included for moisture separation.
	Hydrogen & Carbon Dioxide System	Hydrogen at 75 psig is provided to cool the generator. Included are storage tubes, piping manifold, storage control cabinet and supply control station. Carbon dioxide is provided for purging the generator.
	Lubricating Oil Conditioning Equipment	One continuous bypass Lube Oil Conditioner; 3600 GPH capacity; with clean and dirty oil storage tanks, circulation pump and transfer and cleanup pump.
231.431	Fire Protection	Automatic deluge water spray system complete with supervisory control system for: 1. Lube Oil Reservoir 2. Hydrogen Seal Oil Unit 3. Clean and Dirty Oil Tanks 4. Boiler Feed Pump Oil Console
232.11	Traveling Screens	Six 12 feet wide by 43 feet high screens traveling at 10 FPM. Each screen has 49 baskets, 24 inches high and 12 feet long covered with 0.080 Dia. Type 304 stainless steel wire cloth with 3/8 inch square openings. Each screen passes 125,000 GPM at a velocity of 2.0 FPS to a circulating water pump and is cleaned by a spray system. One 6 feet wide screen with same construction that passes 39,000 GPM to Service Water Pumps.

Account No.		Description
232.15	Chlorination System	Storage tanks, pumps, control devices and diffusers provided to inject liquid sodium hypochlorite into the river water as it leaves the traveling screens to prevent the formation of algae and slime in the circulating and service water systems.
232.211	Circulating Water Pumps	Six vertical motor driven pumps each to deliver 125,000 GPM at 21 feet TDH; 86% efficiency; 292 RPM; 771 BHP. Each with 900 HP, 6600 volt vertical induction motor, 3 phase, 60 cycle, 300 RPM. Each with steel casing, chrome steel shaft and propeller, Kennametal carbide bearings and graphited asbestos packing with gland and bearing water required.
232.221	Variable Weir	A variable weir maintains a constant discharge channel water level to allow the recovery of a substantial portion of the circulating pumps discharge head by virtue of the syphon effect. This is accomplished by the automatic positioning of two nested submerged movable gates installed in the discharge channel.
233.1	Condensers	Three single pass deaerating radial flow surface condensers with divided fabricated steel water boxes and steel shell. Each with condensing surface of 204,000 square feet, 15,585 one (1) inch, 22 BWG, 50 foot long A 249 welded type 304 stainless steel tubes. 250,000 GPM cooling water required at 57°F with 90% tube cleanliness factor, 18.48°F temperature rise, 8 ft./sec. tube velocity and 1.5" Hg absolute exhaust pressure.
233.21	Condensate Pumps	Three 8-stage vertical condensate pumps, rated at 6162 GPM, 1150 feet TDH, 84% efficiency at 1185 RPM; driven by 2500 HP, 6600 volt, 3 phase, 1200 RPM vertical motor. Pumps with carbon steel casing, chrome steel shaft and inlet impeller, bronze gland and bearings.
233.221	Condensate Water Storage Tank	One stainless steel condensate water storage tank having a capacity of 500,000 gallons.

Account No.		Description
233.3	Gas Removal System	
	Priming Ejectors	Three single stage, steam jet air ejectors required for initial air removal.
	Steam Jet Air Ejectors	Three required for normal air removal, each are four element, 2 stage units with common inter and after condensers.
	Waterbox Priming Ejectors	Two single stage, steam jet air ejectors for priming waterboxes, tubes and circulating water piping.
234.11	Feedwater Heaters	
	No. 1 Low Pressure Heater	Three 15,350 sq. ft. horizontal feedwater heaters with 10°F approach and 5°F terminal difference each transferring 199.3 x 10^6 BTU/hr; 50 psig shell design, 750 psig tube design. Each with 58 inch I.D. steel shell, steel tube channel and plates, and baffles; and A-249 Tp304 Stainless Steel tubes 3/4" O.D., No. 18 BWG with effective length of 40 ft. 2 in.
	No. 2 Low Pressure Heater	Three 11,740 sq. ft. horizontal feedwater heaters with 10°F approach and 5°F terminal difference each transferring 128.8 x 10^6 BTU/hr; 100 psig shell design, 750 psig tube design. Each with 55 inch I.D. steel shell, steel tube channel and plates, and baffles; and A-249 Tp304 Stainless Steel tubes 3/4" O.D., No. 18 BWG with effective length of 38 ft.
	No. 3 Low Pressure Heater	Three 10,850 sq. ft. horizontal feedwater heaters with 10°F approach and 5°F terminal difference each transferring 172.83 x 10^6 BTU/hr; 100 psig shell design, 750 psig tube design. Each with 53 inch I.D. steel shell, steel tube channel and plates, and baffles; and A-249 Tp304 Stainless Steel tubes 3/4" O.D., No. 18 BWG with effective length of 35 ft.

Account No.		Description
	No. 4 Low Pressure Heater	Three 8,400 sq. ft. horizontal feedwater heaters with 10^oF approach and 5^oF terminal difference each transferring 94.78 x 10^6 BTU/hr; 100 psig shell design, 750 psig tube design. Each with 51 inch I.D. steel shell, steel tube channels and plates, and baffles; and A-249 Tp304 Stainless Steel tubes 3/4" O.D. No. 18 BWG with effective length of 37 ft.
	No. 5 Low Pressure Heater	Three 8,500 sq. ft. horizontal feedwater heaters with no drain cooling and 5^oF terminal difference each transferring 218.44 x 10^6 BTU/hr; 250 psig shell design, 750 psig tube design. Each with 54 inch I.D. steel shell, steel tube channels and plates, and baffles; and A-249 Tp304 Stainless Steel 3/4" O.D., No. 18 BWG tubes with effective length of 35 ft.
	No. 6 High Pressure Heater	Three 25,125 sq. ft. horizontal feedwater heaters with 10^oF approach and 5^oF terminal difference each transferring 373 x 10^6 BTU/hr; 500 psig shell design, 2000 psig tube design. Each with 60 inch I.D. steel shell, steel tube channels and plates, and baffles; and A-249 Tp304 Stainless Steel 3/4" O.D., No. 18 BWG tubes with effective length of 35 ft.
234.21	Main Feedwater Pumps and Drive Turbines	Two one-half size horizontal single stage, double suction, diffuser type centrifugal pumps each delivering 15,590 GPM at 3144 ft. TDH with a suction temperature of 367oF. Each with chrome-steel casing, case wearing rings, impeller, diffuser, and shaft. Provided with Kingsbury type thrust bearing, sleeve type radial bearing and provision for bearing thermocouples and vibration probes. Drive Turbine - Each pump directly driven by turbine rated at 12,300 HP at 5350 RPM. Turbine operates at normal loads with crossover steam and steam directly from steam generator during startup and reduced load operation.

Account No.		Description
234.22	Auxiliary Feedwater Pumps	1. Turbine Driven - one seven stage, centrifugal, horizontally split case pump delivers 800 GPM at 1350 psi total head; and is driven by a variable speed single stage non-condensing steam turbine rated 970 HP at 3570 RPM. 2. Motor Driven - two nine stage centrifugal, horizontally split case pumps each rated 400 GPM at 1350 psi total head; driven at 3550 RPM by a 400 HP, 440 volt motor.
234.23	Heater Drain Pumps	Two vertical, half sized pumps each delivering 5100 GPM at 790 ft. TDH with a suction temperature of 366°F; each driven by a 1250 HP, 6600 volt, 1200 RPM vertical solid shaft motor. Pump bowls, shaft, impellers, bearings, shaft sleeve and pump head are chrome steel and pump outer case and column are carbon steel. Each heater drain pump is supplied with a heater drains receiver.
235.31	Closed Cooling Water System Pumps	3 pumps for above (2 operating, one spare), each 8000 gpm at 50 psi total head with 350 hp, 440 volt, 3 phase, 60 cycle motor. Materials of casing - cast iron, impeller-bronze, shaft-cold rolled c.s., sleeves-bronze.
235.322	Closed Cooling Water System Heat Exchangers	3 heat exchangers to cool demineralized water in a closed cycle cooling water system for turbine building usage. Each exchanger to cool 8000 gpm of demineralized water from 108°F to 95°F using 57°F service water as the cooling media. Design pressure 150 psig, cleanliness factor 85%, effective tube length 39'-6", material-shell carbon steel, material-tubes and tube sheets 90/10 cupro-nickel. Tubes 3/4" O.D. x 18 BWG.
235.41	Raw Water Treating System	The raw water treating system is sized to handle a maximum capacity of 1000 gpm and includes the following components: 1) One reactivator flow split box. 2) Two reactivators with integral clean-wells (each 500 gpm capacity and 30,000 gallons clearwell capacity).

Account No.	Description

3) One ferric sulphate feeder and solution pump.
4) Two lime feeders and solution pumps.
5) One chemical solution flow split box.
6) Two gravity filters of 500 gpm capacity each, 15 feet dia. x 17 feet high.
7) One local control panel with annunciator, flow recorder indicator, timers, control switches, level indicator gauge, etc.
8) Two treated water pumps each of 1000 gpm capacity and a total head of 40 psi driven by a 30 hp motor, 1770 rpm, 3 phase, 60 cycle, 480 volts.
9) 250,000 gallon carbon steel treated water storage tank, 34 feet dia. x 39 feet high.

Demineralizer System

The Demineralizer System includes the following components:

1) Two demineralizer feed pumps, 1000 gpm at total 91 psi, with a 80 hp, 3550 rpm, 3 phase, 60 cycle, 480 volt motor.
2) Two Cation exchangers, 250 gpm, 62" dia. x 12'-0" high.
3) Two Anion exchangers, 250 gpm, 62" dia. x 12'-0" high.
4) Two 120 gph acid pumps with a 3/4 hp, 1750 rpm motor.
5) Two 65 gph caustic pumps with a 3/4 hp, 1750 rpm motor.
6) Two caustic heat exchangers to heat 16.4 gpm of 4% caustic solution from 40 F to 110 F utilizing 800 lbs./hr. of 20 psig steam.
7) Two recycle pumps, 200 gpm at 50 psi with a 10 hp, 3600 rpm motor.
8) Controls and instrumentation including a local panel with a service selector, power switch, "Regen. Test" pushbuttons, "Alarm Silence" pushbuttons for annunciators, and local "start-stop" motor pushbutton stations, etc.
9) One stainless steel basic demineralized water storage tank of 500,000 gallons - size: 44 ft. dia. x 46 ft. high.

Account No.		Description
236.12	Local Control Stations	Approximately 100 miscellaneous local control stations consisting of essentially of NEMA-1 enclosures mounting pushbuttons, control switches, indicating lights, motor starter switches on hinged panels and control relays, motor starter and terminal blocks on the backs of the enclosures.
	Miscellaneous Control Devices	100 miscellaneous pushbutton stations, magnetic starters, selector switch stations, and manual motor starters.
241.12	Neutral Transformer	The generator neutral is grounded through a 45 kva, single phase transformer rated at 20,000 volts on the primary and 240 volts, on the secondary. The secondary is connected to a 64 kw, 0.52 OHM resistor bank.
241.21	6900 Volt Metalclad Switchgear	The switchgear is arranged into two (2) sections each consisting of one (1) 2000 ampere bus and two (2) 1200 ampere bus. Eight (8) incoming line units. Four (4) from Unit Auxiliary Transformer, two (2) from Station Auxiliary Transformer, and two (2) from the on-site Gas Turbine. Thirty-one (31) circuit breakers: 27 - 1200 ampere rating, 4 - 2000 ampere rating.
241.22	480 Volt Motor Control Center	Eleven (11) 480 volt motor control centers (MCC) are located at various points of electrical load concentration. Each motor control center compartment is provided with a fused disconnect, motor starter, overload relay, and control power transformer as required by the individual auxiliaries. Reversing contactors are provided with electrical and mechanical interlocks. The MCC's are standard NEMA-1 construction with the exception of the outdoor MCC which is NEMA-3.
242.11	Unit Auxiliary Transformer	FOA Class, 3 phase, 60 cycle, 22 kv delta, 6.9 kv Delta-Wye with plus 10 percent, minus 5 percent LTC. The BIL is 150 kv for the high voltage windings and 110 kv for the low voltage windings. The FOA output is 43 Mva at 55^{o}F temperature rise.

Account No.		Description
242.12	Station Auxiliary Transformer	FOA Class, 3 phase, 60 cycle, 138 kv delta, 6.9 kv wye with plus 10 percent, minus 5 percent load tap changing. The BIL is 550 kv for the high voltage winding and 110 kv for the low voltage windings. The FOA output is 43 Mva at 55°C Temperature rise.
242.211	Station Service Transformer	Four (4) AA/FA Class, 3 phase, 60 cycle 6900V delta, 480V wye with plus and minus 2.5 percent TAPS. The BIL is 35 kv for the high voltage winding and 10 kv for the low voltage windings. The FA output is 2666 kva at 150°C temperature rise.
242.211	480 Volt Switchgear	The four 480V 2000 ampere buses are located in two 480 volt switchgear structures. They are rated at 600V and are each supplied thru a 3000 amp 75,000 ampere i.c. circuit breaker from each of the station service transformers. Three (3) emergency diesels are connected to three of the four buses. There are thirteen (13) feeder breakers with an interrupting capacity of 50,000 amps.
242.311	Station Batteries	Two station batteries rated 125V DC, 60 cell lead acid type, one rated 960 amp-hour at 8 hour rate, and the other rated 1320 amp-hour at 8 hour rate.
242.311	Main Battery Fuses	Two main battery fuse enclosures complete with lugs and fuses rated 800 amps, i.c. 15,000 amp. at 125V DC.
242.312	Battery Chargers	Two static rectifier type rated at 25 kw each, 200 amp DC output, 140V DC output.
242.321	Emergency Diesel Generators	Three emergency generators are installed, any two of which are capable of starting sequentially and providing the power for one set of safeguards equipment. Each electric generator is rated 2000 kw, 2500 kva at 900 RPM with 0.8 power factor, 277/480 Y, 3 phase, 60 cycle AC generator. The drive unit is a 16 cylinder, Vee configuration, 4 cycle, heavy-duty diesel engine, rated at 2800 HP and 900 RPM.

Account No.		Description
242.3211	Diesel Generators	Three diesel generators with the following characteristics: 900 rpm, 3 phase, 60 cycle, 480 volts, rated 2188 kva and 0.80 power factor, complete with control and relay switchboards.
242.3221	Gas Turbine Generator	One 23.4 MVA, 0.9 P. F. gas turbine generator installation.
	Gas Turbine-Generator Switchgear	One (1), 6900 volt, metalclad, outdoor switchgear, with one (1) 3000 amp gas-turbine generator Main Breaker.
	Gas Turbine-Generator Bus Duct	One (1) 2500 ampere, 7.5 kv Class, 3 phase Bus Duct from gas turbine generator to the 6900V switchgear buses.
242.332	Inverter	Two 7½ kva static inverters for the instrument buses and one 5 kva inverter for the rod position control rack.
243.11	Main Control Board Flight Panel	The flight panel is of duplex walk-in-construction with a benchboard. The panel is divided into four sections.
243.11	Main Control Supervisory Control Board	The supervisory panel is of walk-in construction. The panels are divided into eleven relative areas to show the location of control components and information display pertaining to the various subsystem.
243.22	DC Main Power Panels	Two 125V DC power panels 800 amp main bus, 35 branch circuit breakers i.c. 20,000 amps.
243.22	DC Distribution Panels	Four 125V DC distribution panels, 100 amp main bus, 80 branch circuit breakers i.c. 10,000 amps.
244.112	Cathodic Protection System	Cathodic protection is provided for underground piping and other vulnerable plant equipment in the vicinity of the Hudson River. The method is by use of an external source of DC voltage.

Account No.		Description
244.113	Lightning Protection Mast	Six lightning protection masts complete with air terminal and base plates.
244.211	Fire Protection	Automatic deluge water spray system complete with supervisory control system for: 1. Main Transformers 2. Station Auxiliary Transformers 3. Unit Auxiliary Transformers
246.1	Generator Main Leads	An isolated phase bus is run between the generator line terminals and the low voltage bushings of the main step-up power transformers. The leads are rated 22 kv, 32,000 amperes, 150 kv Basic Impulse Level, 65°C temperature rise with forced air cooling.
246.223	Diesel Generator Bus Duct	Diesel generator bus is run between the 2000 kw diesel generator and the 480 volt switchgear. The bus is rated 4000 amperes, 600V AC 3 phase 3 wire at 55°C rise.
246.224	Gas Turbine-Generator Bus Duct	One (1) 2500 amp, 7.5 kv Class, 3 phase Bus Duct, from the gas-turbine generator Main Breaker to the two (2) 2000 amp 6900V switchgear buses.
	CRANES	
251.11	Turbine Building Cranes	Turbine Building - one (1) 175 ton overhead traveling crane with 25 ton auxiliary hook. Main hook 89 foot lift, auxiliary hook 85 foot lift. Main hoist speed 4 FPM, auxiliary hoist speed 15 FPM, bridge speed 75 FPM, trolley speed 50 FPM.
251.12	Containment Building Polar Crane	One (1) 460/175 ton polar crane with 35 ton auxiliary hook. Main hook 84'-6" lift, auxiliary hook 115 foot lift. Main hoist speed 4 FPM, auxiliary hoist speed 15 FPM, bridge speed 75 FPM, trolley speed 50 FPM.
251.132	Primary Auxiliary Building	One (1) ton monorail system.

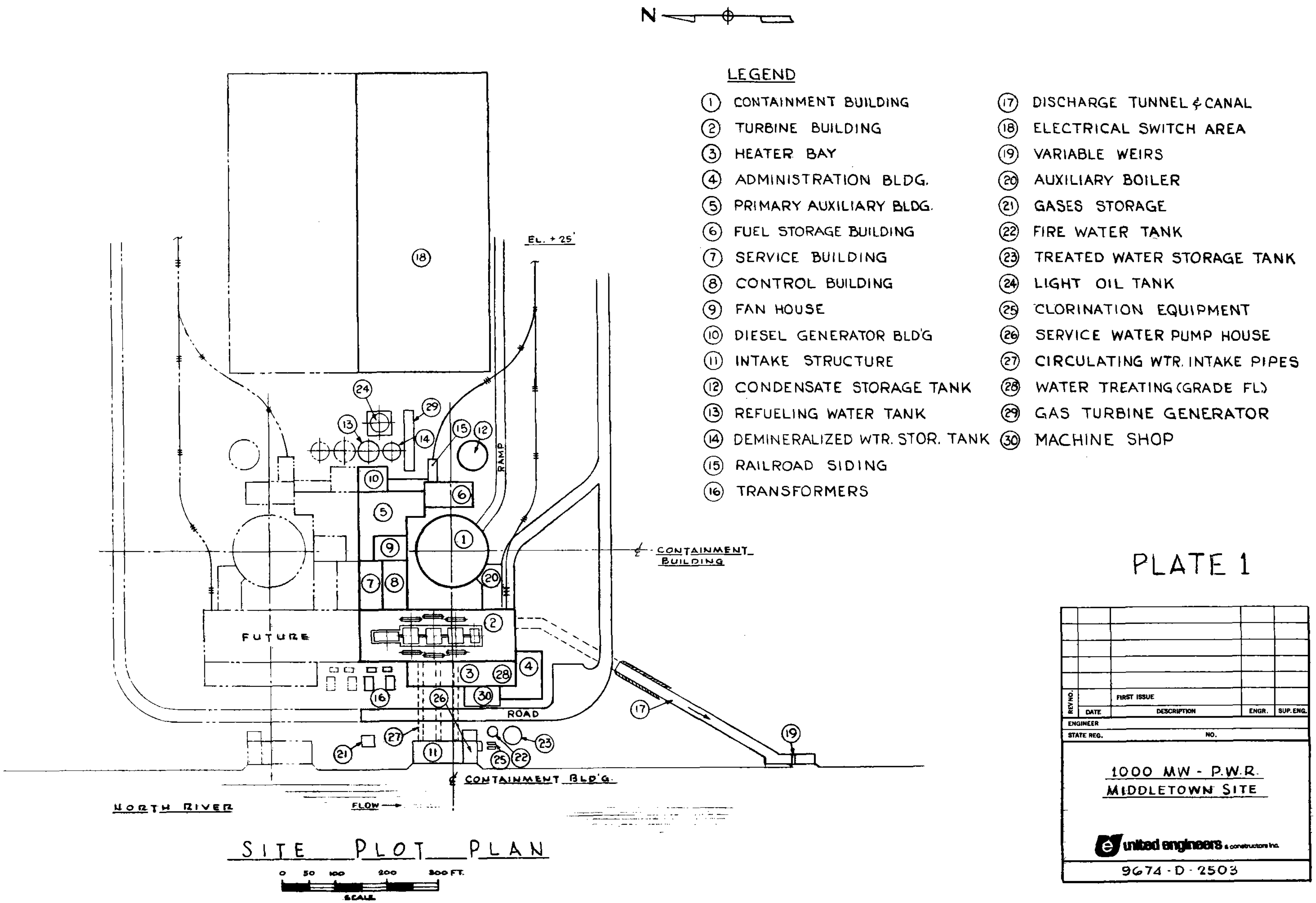
Account No.		Description
252.1111	Station Air Compressor	One angle type, motor driven, two-stage double acting, lubricated compressor including intake filter, intercooler and aftercooler, dual control and receiver; rated 625 SCFM at 100 psig discharge pressure.
252.1112	Instrument Air Compressor and Air Dryers	Two horizontal, motor driven, single-stage double acting, non-lubricated compressors including air dryers, intake filter and silencer, aftercooler, dual control, receiver and motor with V-belt drive; each rated 215 SCFM at 100 psig discharge pressure.
252.211	Service Water Pumps	Six 2 stage vertical service water pumps each to deliver 6500 GPM at 115 feet TDH; 85% efficiency, driven by a 250 HP, 60 cycle 3 phase, 440 volt VHS motor at 1770 RPM.
252.221	Fire Protection	Two (2) electric motor horizontal (300 hp) driven fire pumps each rated at 2,000 gpm at 150 psig. Pumps will be complete with extended base plate, coupling guard and accessories recommended by NFPA. One (1) diesel engine driven vertical fire pump rated at 2,000 gpm at 150 psig. Pump will be complete with all accessories as recommended by NFPA. One (1) motor driven (50 hp) treated water transfer pump rated at 1000 gpm @ 50 psi total head. One (1) electric motor (20 hp) driven horizontal jockey pump rated at 100 gpm and 140 psig.
252.31	Auxiliary Boilers	2-50,000 lbs./hr. each, 250 psig sat. steam, (300 psig design), No. 2 oil fired, package type, pressurized furnace design. Complete with F.D. fans and controls. 1-105,000 lb./hr. deaerator, 19.7 psig operation, 30 psig design with 300 cu. ft. storage capacity, to deliver 0.0005 cc/liter water.

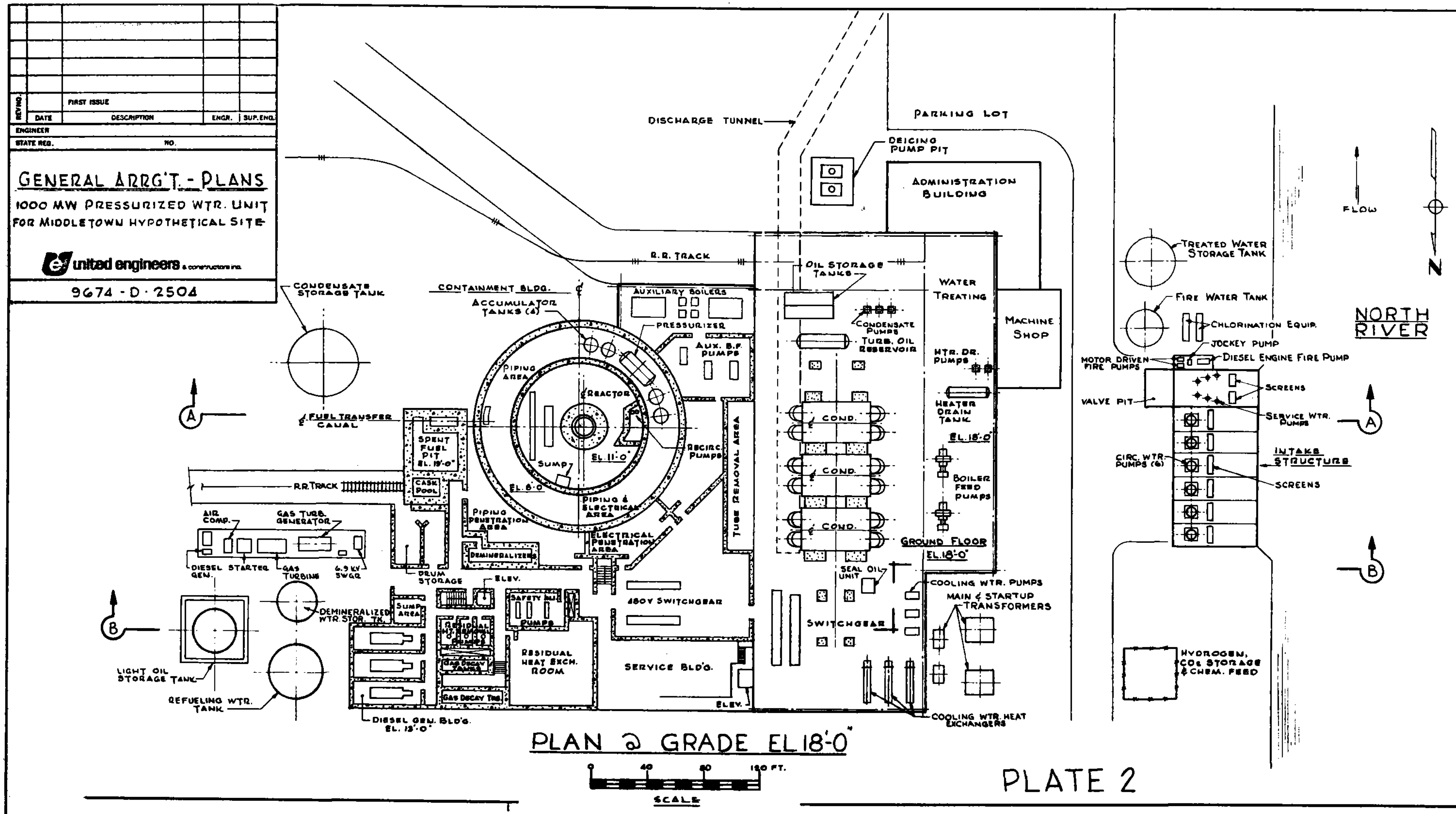
Account No.		Description
		3-115 gpm each boiler feed pumps, 724 TDH, with 30 hp, 440 volt, 3 phase, 60 cycle motors.
253.15	Plant Communication System	One plant communication system consisting of approximately 115 speakers, 130 handsets and amplifiers and 1 communications desk with associated monitoring equipment.
253.21	Fire Detection System	One fire detection system including 58 smoke detectors and one alarm indicating panel.
253.25	Noise Monitoring System	One noise monitoring system consisting of eight (8) microphone assemblies, one (1) amplifier and speaker assembly, one nine (9) position selector switch and one (1) plug-in headset and jack station.
254.12	Portable Fire Extinguishers	Approximately 100, 15 lb carbon dioxide hand extinguishers for use throughout the plant.

1000 MW PRESSURIZED WATER REACTOR

LIST OF DRAWINGS

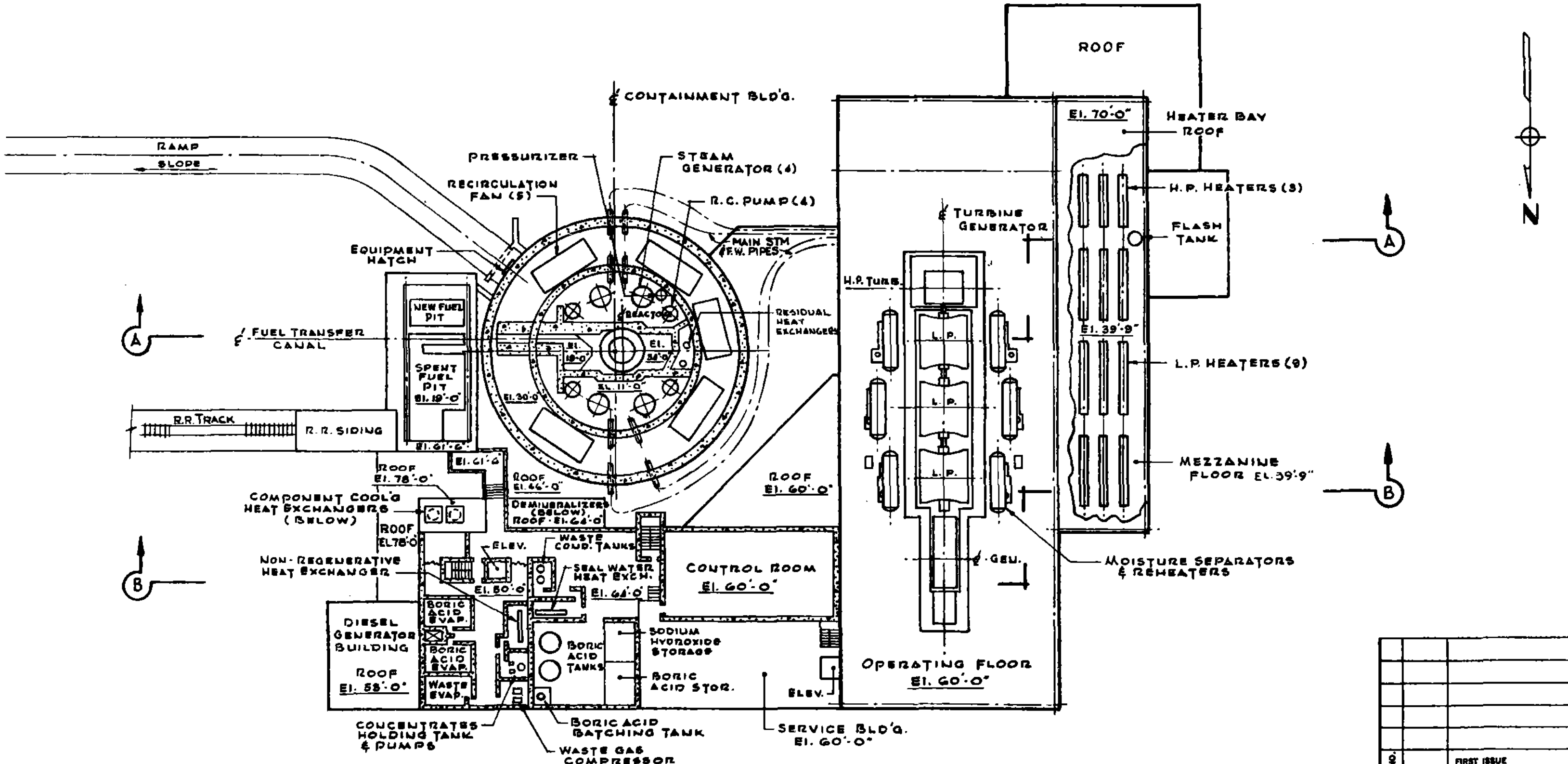
IV


N
LEGEND
① CONTAINMENT BUILDING
② TURBINE BUILDING
③ HEATER BAY
④ ADMINISTRATION BLDG.
⑤ PRIMARY AUXILIARY BLDG.
⑥ FUEL STORAGE BUILDING
⑦ SERVICE BUILDING
⑧ CONTROL BUILDING
⑨ FAN HOUSE
⑩ DIESEL GENERATOR BLD'G
⑪ INTAKE STRUCTURE
⑫ CONDENSATE STORAGE TANK
⑬ REFUELING WATER TANK
⑭ DEMINERALIZED WTR. STOR. TANK
⑮ RAILROAD SIDING
⑯ TRANSFORMERS
⑰ DISCHARGE TUNNEL & CANAL
⑱ ELECTRICAL SWITCH AREA
⑲ VARIABLE WEIRS
⑳ AUXILIARY BOILER
㉑ GASES STORAGE
㉒ FIRE WATER TANK
㉓ TREATED WATER STORAGE TANK
㉔ LIGHT OIL TANK
㉕ CLORINATION EQUIPMENT
㉖ SERVICE WATER PUMP HOUSE
㉗ CIRCULATING WTR. INTAKE PIPES
㉘ WATER TREATING (GRADE FL.)
㉙ GAS TURBINE GENERATOR
㉚ MACHINE SHOP
EL. + 25'
RAMP
℄ CONTAINMENT BUILDING
FUTURE
ROAD
℄ CONTAINMENT BLD'G.
NORTH RIVER
FLOW
SITE PLOT PLAN
0 50 100 200 300 FT.
SCALE
PLATE 1
REV. NO.
DATE
FIRST ISSUE
DESCRIPTION
ENGR.
SUP. ENG.
ENGINEER
STATE REG.
NO.
1000 MW - P.W.R.
MIDDLETOWN SITE
united engineers & constructors inc.
9674 - D - 2503



PLAN @ GRADE EL 18'-0"

PLATE 2



PLAN @ OPERATING FLOOR EL. 60'-0"

0 40 80 120 FT.
SCALE

PLATE 3

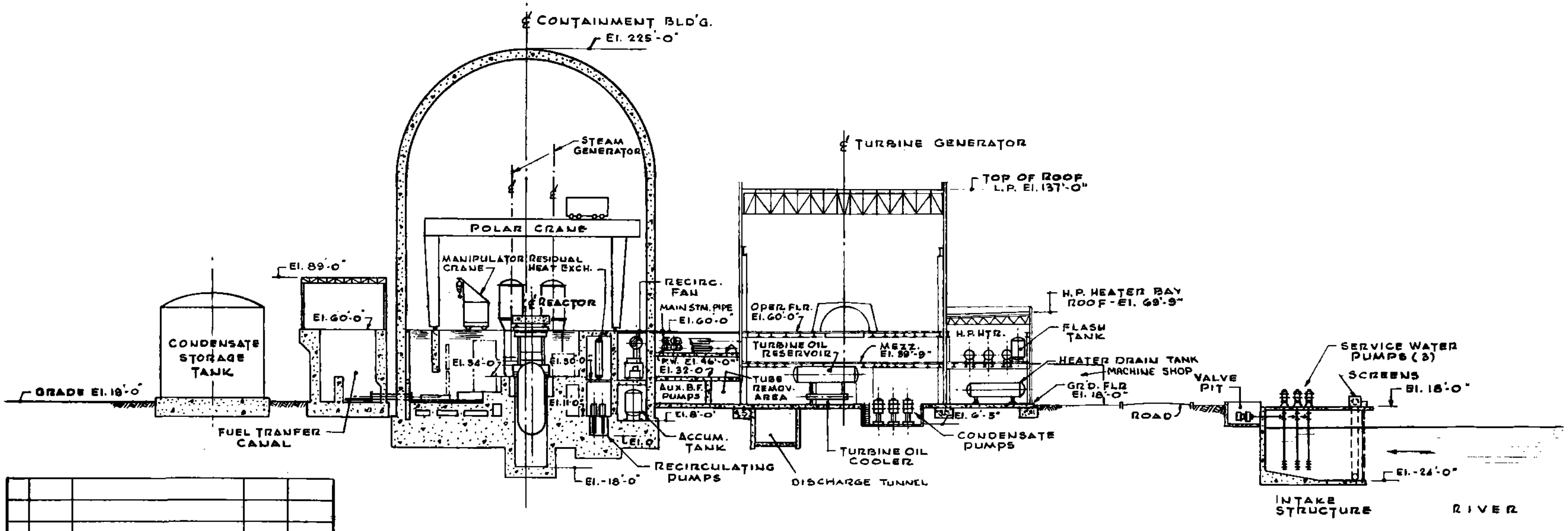
REV. NO.	DATE	DESCRIPTION	ENGR.	SUP. ENG.
		FIRST ISSUE		

ENGINEER
STATE REG. NO.

GENERAL ARRG'T. - PLANS
1000 MW PRESSURIZED WTR. UNIT
FOR MIDDLETOWN HYPOTHETICAL SITE

united engineers & constructors inc.

9674 - D - 2504



ELEVATION A-A

PLATE 4

		FIRST ISSUE		
REV.NO.	DATE	DESCRIPTION	ENGR.	SUP.ENG.

ENGINEER

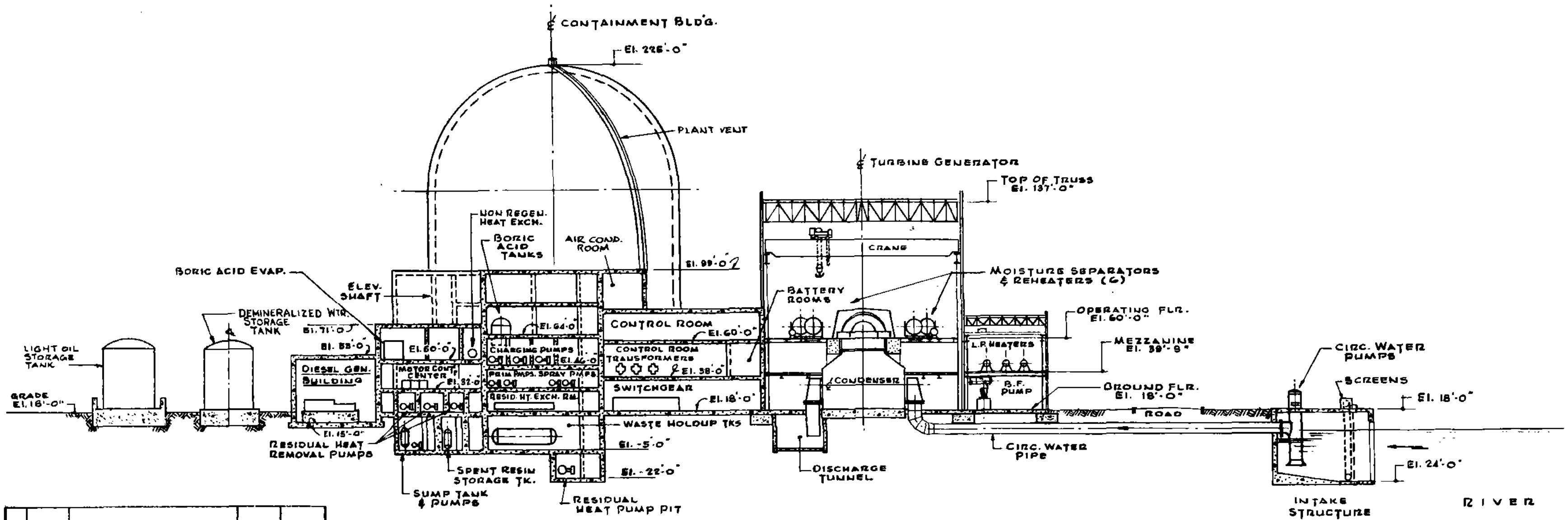
STATE REG. NO.

GENERAL ARRG'T. - ELEVATIONS

1000 MW PRESSURIZED WTR. UNIT FOR MIDDLETOWN HYPOTHETICAL SITE

united engineers & constructors inc.

9674 - D - 2505



ELEVATION "B - B"

0 40 80 120 FT.

SCALE

PLATE 5

REV. NO.	DATE	DESCRIPTION	ENGR.	SUP. ENG.
		FIRST ISSUE		

ENGINEER

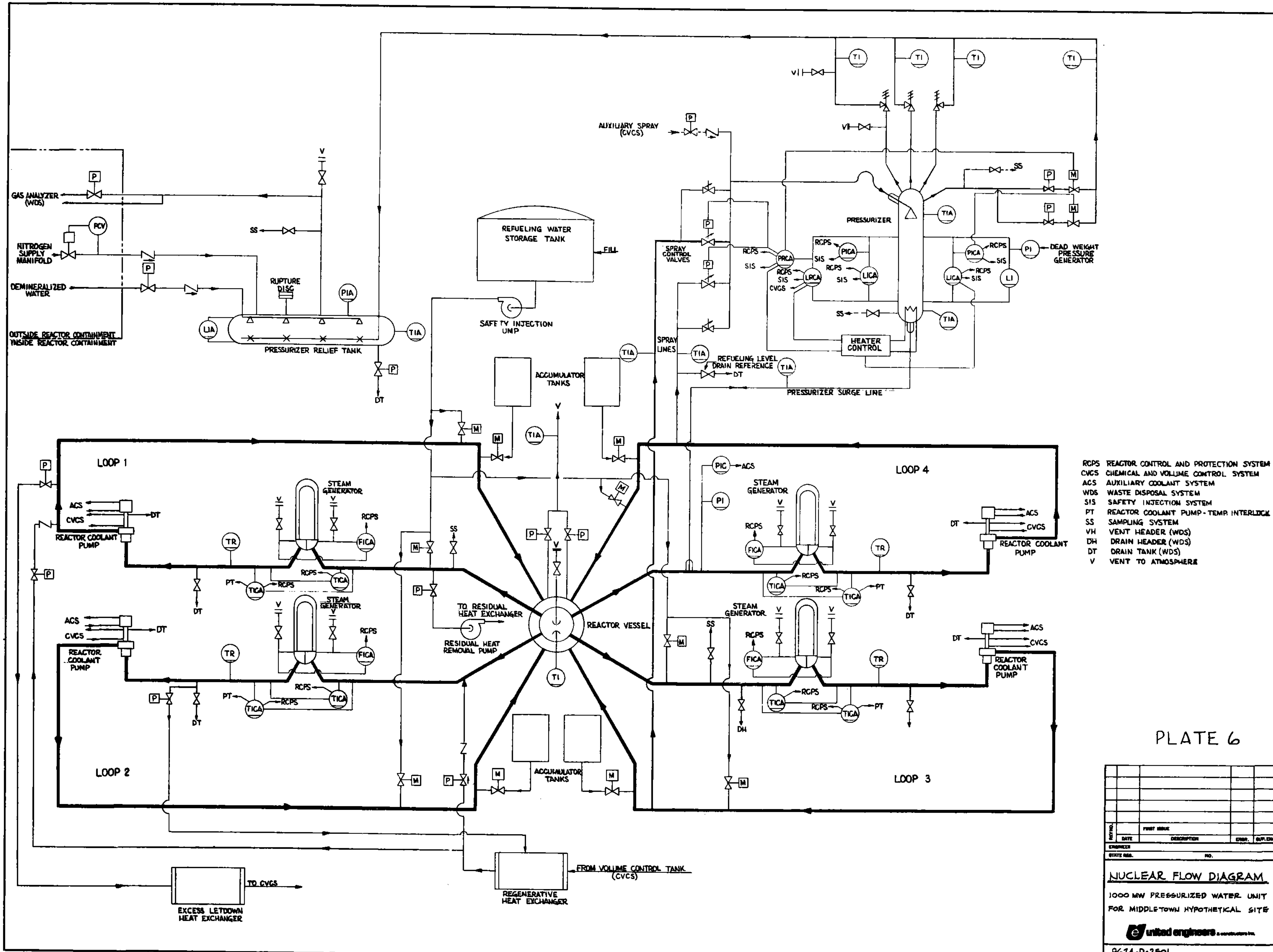
STATE REG. NO.

GENERAL ARRG'T. - ELEVATIONS

1000 MW PRESSURIZED WTR. UNIT FOR MIDDLETOWN HYPOTHETICAL SITE

united engineers & constructors inc.

9674 - D - 2505



GAS ANALYZER (WDS)
NITROGEN SUPPLY MANIFOLD
DEMINERALIZED WATER
OUTSIDE REACTOR CONTAINMENT
INSIDE REACTOR CONTAINMENT
RUPTURE DISC
PRESSURIZER RELIEF TANK
REFUELING WATER STORAGE TANK
FILL
SAFETY INJECTION PUMP
AUXILIARY SPRAY (CVCS)
SPRAY CONTROL VALVES
PRESSURIZER
HEATER CONTROL
DEAD WEIGHT PRESSURE GENERATOR
SPRAY LINES
REFUELING LEVEL DRAIN REFERENCE
PRESSURIZER SURGE LINE
ACCUMULATOR TANKS
LOOP 1
LOOP 2
LOOP 3
LOOP 4
STEAM GENERATOR
REACTOR COOLANT PUMP
REACTOR VESSEL
TO RESIDUAL HEAT EXCHANGER
RESIDUAL HEAT REMOVAL PUMP
EXCESS LETDOWN HEAT EXCHANGER
TO CVCS
REGENERATIVE HEAT EXCHANGER
FROM VOLUME CONTROL TANK (CVCS)
RCPS REACTOR CONTROL AND PROTECTION SYSTEM
CVCS CHEMICAL AND VOLUME CONTROL SYSTEM
ACS AUXILIARY COOLANT SYSTEM
WDS WASTE DISPOSAL SYSTEM
SIS SAFETY INJECTION SYSTEM
PT REACTOR COOLANT PUMP-TEMP. INTERLOCK
SS SAMPLING SYSTEM
VH VENT HEADER (WDS)
DH DRAIN HEADER (WDS)
DT DRAIN TANK (WDS)
V VENT TO ATMOSPHERE
PLATE 6
FIRST ISSUE
NUCLEAR FLOW DIAGRAM
1000 MW PRESSURIZED WATER UNIT
FOR MIDDLETOWN HYPOTHETICAL SITE
united engineers
9674-D-2501

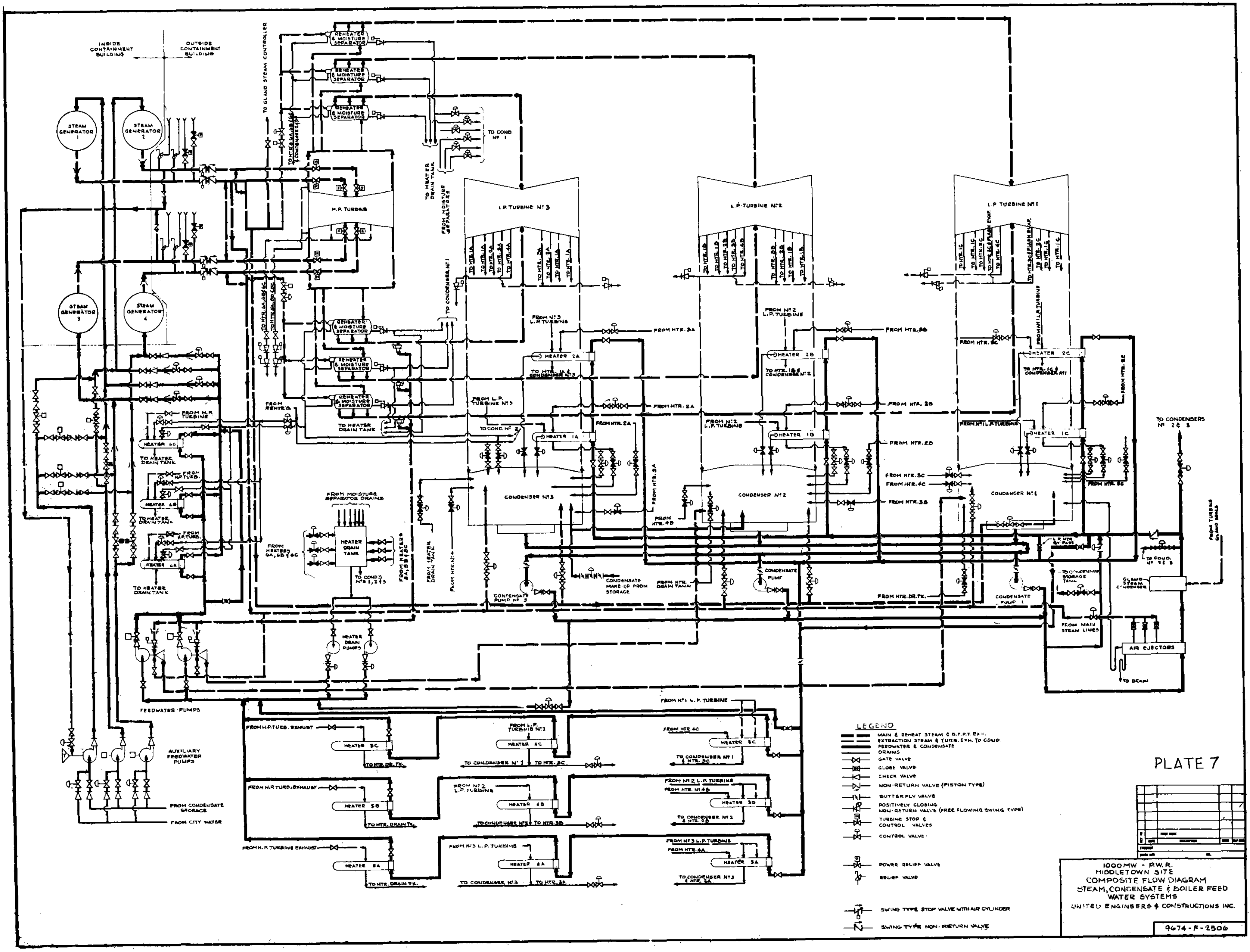
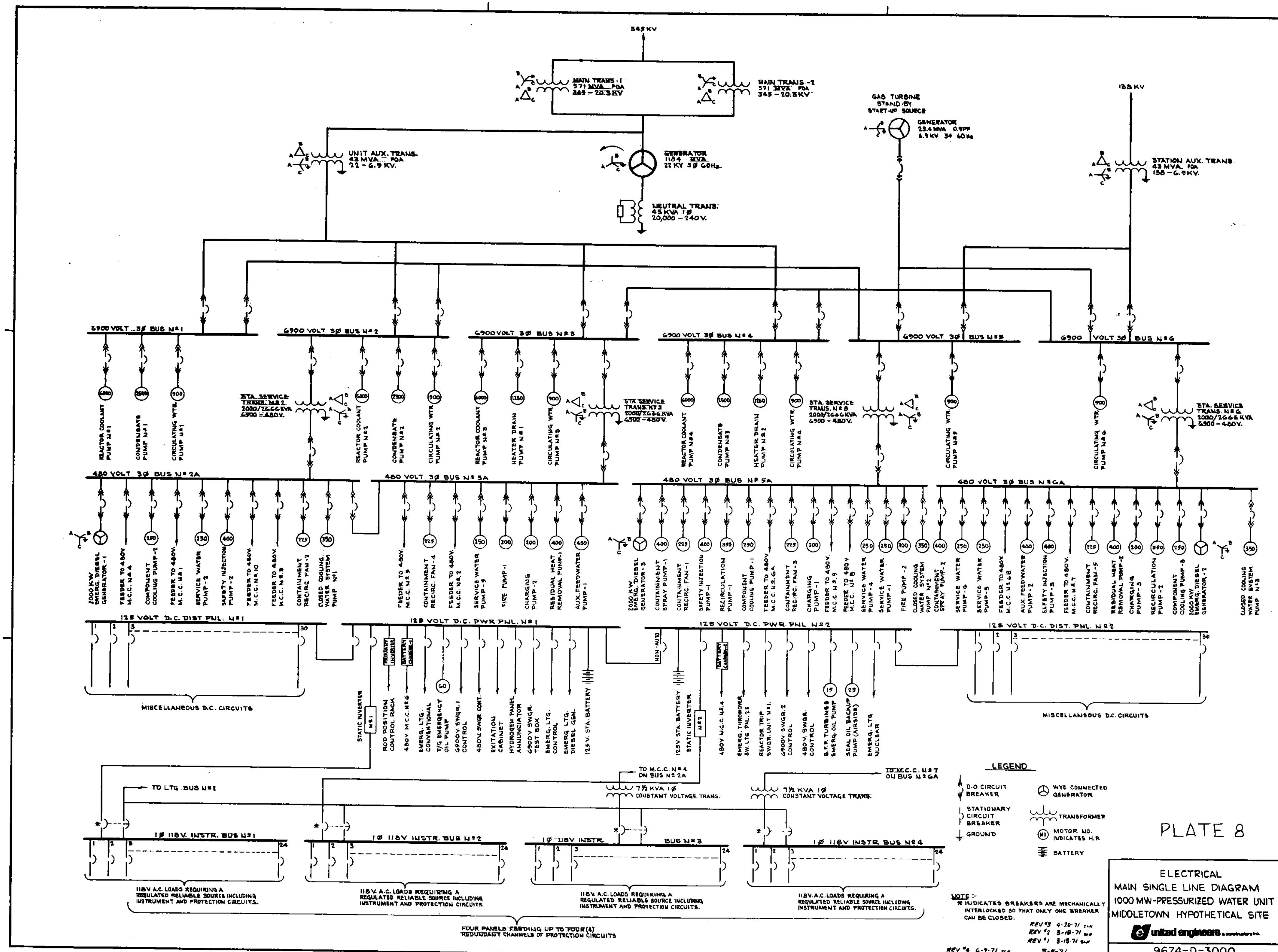
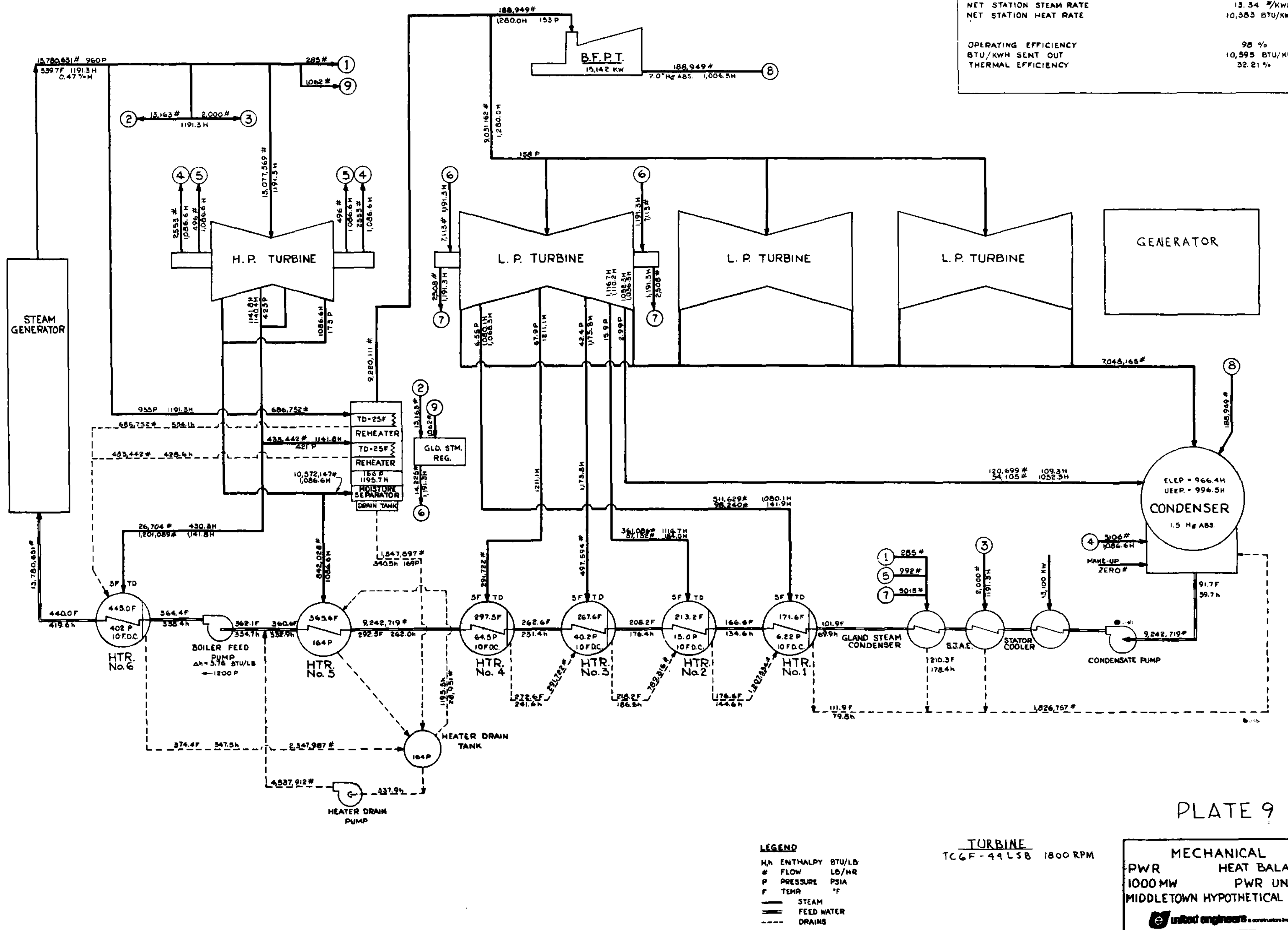

INSIDE CONTAINMENT BUILDING
OUTSIDE CONTAINMENT BUILDING
STEAM GENERATOR 1
STEAM GENERATOR 2
STEAM GENERATOR 3
STEAM GENERATOR 4
REHEATER & MOISTURE SEPARATOR
H.P. TURBINE
L.P. TURBINE Nº 3
L.P. TURBINE Nº 2
L.P. TURBINE Nº 1
CONDENSER Nº 3
CONDENSER Nº 2
CONDENSER Nº 1
HEATER 2A
HEATER 2B
HEATER 2C
HEATER 1A
HEATER 1B
HEATER 1C
HEATER 6C
HEATER 6B
HEATER 6A
HEATER DRAIN TANK
HEATER DRAIN PUMPS
CONDENSATE PUMP
FEEDWATER PUMPS
AUXILIARY FEEDWATER PUMPS
FROM CONDENSATE STORAGE
FROM CITY WATER
GLAND STEAM CONDENSER
AIR EJECTORS
TO DRAIN
HEATER 5C
HEATER 4C
HEATER 3C
HEATER 5B
HEATER 4B
HEATER 3B
HEATER 5A
HEATER 4A
HEATER 3A
LEGEND
MAIN & REHEAT STEAM & B.F.P.T. EXH.
EXTRACTION STEAM & TURB. EXH. TO COND.
FEEDWATER & CONDENSATE
DRAINS
GATE VALVE
GLOBE VALVE
CHECK VALVE
NON-RETURN VALVE (PISTON TYPE)
BUTTERFLY VALVE
POSITIVELY CLOSING NON-RETURN VALVE (FREE FLOWING SWING TYPE)
TURBINE STOP & CONTROL VALVES
CONTROL VALVE
POWER RELIEF VALVE
RELIEF VALVE
SWING TYPE STOP VALVE WITH AIR CYLINDER
SWING TYPE NON-RETURN VALVE
1000MW - P.W.R.
MIDDLETOWN SITE
COMPOSITE FLOW DIAGRAM
STEAM, CONDENSATE & BOILER FEED WATER SYSTEMS
UNITED ENGINEERS & CONSTRUCTIONS INC.
9674-F-2506

PLATE 7



345 KV
MAIN TRANS.-1 571 MVA FOA 345-20.3 KV
MAIN TRANS.-2 571 MVA FOA 345-20.3 KV
UNIT AUX. TRANS. 43 MVA FOA 22-6.9 KV.
GENERATOR 1184 MVA 22 KV 3Ø 60Hz
NEUTRAL TRANS. 45 KVA 1Ø 20,000-240V.
GAS TURBINE STAND-BY START-UP SOURCE
GENERATOR 23.4 MVA 0.9PF 6.9 KV 3Ø 60Hz
138 KV
STATION AUX. TRANS. 43 MVA FOA 138-6.9 KV.
6900 VOLT 3Ø BUS Nº1
6900 VOLT 3Ø BUS Nº2
6900 VOLT 3Ø BUS Nº3
6900 VOLT 3Ø BUS Nº4
6900 VOLT 3Ø BUS Nº5
6900 VOLT 3Ø BUS Nº6
REACTOR COOLANT PUMP Nº1
CONDENSATE PUMP Nº1
CIRCULATING WTR. PUMP Nº1
STA. SERVICE TRANS. Nº2 2000/2666 KVA 6900-480V.
REACTOR COOLANT PUMP Nº2
CONDENSATE PUMP Nº2
CIRCULATING WTR. PUMP Nº2
REACTOR COOLANT PUMP Nº3
HEATER DRAIN PUMP Nº1
CIRCULATING WTR. PUMP Nº3
STA. SERVICE TRANS. Nº3 2000/2666 KVA 6900-480V.
REACTOR COOLANT PUMP Nº4
CONDENSATE PUMP Nº3
HEATER DRAIN PUMP Nº2
CIRCULATING WTR. PUMP Nº4
STA. SERVICE TRANS. Nº5 2000/2666 KVA 6900-480V.
CIRCULATING WTR. PUMP Nº5
CIRCULATING WTR. PUMP Nº6
STA. SERVICE TRANS. Nº6 2000/2666 KVA 6900-480V.
480 VOLT 3Ø BUS Nº2A
480 VOLT 3Ø BUS Nº3A
480 VOLT 3Ø BUS Nº5A
480 VOLT 3Ø BUS Nº6A
2000 KW EMERG. DIESEL GENERATOR-1
FEEDER TO 480V M.C.C. Nº4
COMPONENT COOLING PUMP-2
FEEDER TO 480V. M.C.C. Nº1
SERVICE WATER PUMP-2
SAFETY INJECTION PUMP-2
FEEDER TO 480V. M.C.C. Nº10
FEEDER TO 480V. M.C.C. Nº3
CONTAINMENT RECIRC FAN-2
CLOSED COOLING WATER SYSTEM PUMP Nº1
FEEDER TO 480V. M.C.C. Nº3
CONTAINMENT RECIRC. FAN-4
FEEDER TO 480V. M.C.C. Nº2
SERVICE WATER PUMP-5
FIRE PUMP-1
CHARGING PUMP-2
RESIDUAL HEAT REMOVAL PUMP-1
AUX. FEEDWATER PUMP-1
2000 KW EMERG. DIESEL GENERATOR-3
CONTAINMENT SPRAY PUMP-1
CONTAINMENT RECIRC. FAN-1
SAFETY INJECTION PUMP-1
RECIRCULATION PUMP-1
COMPONENT COOLING PUMP-1
FEEDER TO 480V M.C.C. Nº6A
CONTAINMENT RECIRC. FAN-3
CHARGING PUMP-1
FEEDER TO 480V. M.C.C. Nº9
FEEDER TO 480V M.C.C. Nº8
SERVICE WATER PUMP-4
SERVICE WATER PUMP-1
FIRE PUMP-2
CLOSED COOLING WATER SYSTEM PUMP Nº2
CONTAINMENT SPRAY PUMP-2
SERVICE WATER PUMP-6
SERVICE WATER PUMP-3
FEEDER TO 480V. M.C.C. Nº6B
AUX. FEEDWATER PUMP-2
SAFETY INJECTION PUMP-3
FEEDER TO 480V. M.C.C. Nº7
CONTAINMENT RECIRC. FAN-5
RESIDUAL HEAT REMOVAL PUMP-2
CHARGING PUMP-3
RECIRCULATION PUMP-2
COMPONENT COOLING PUMP-3
2000 KW EMERG. DIESEL GENERATOR-2
CLOSED COOLING WATER SYSTEM PUMP Nº3
125 VOLT D.C. DIST. PNL. Nº1
MISCELLANEOUS D.C. CIRCUITS
125 VOLT D.C. PWR. PNL. Nº1
STATIC INVERTER Nº1
ROD POSITION CONTROL RACK
480V M.C.C. Nº6
EMERG. LTG. CONVENTIONAL
T/G EMERGENCY OIL PUMP
6900V. SWGR. 1 CONTROL
480V. SWGR. CONT.
EXCITATION CABINET
HYDROGEN PANEL ANNUNCIATOR
6900V SWGR. TEST BOX
EMERG. LTG. CONTROL
EMERG. LTG. DIESEL GEN.
125 V. STA. BATTERY
PRIMARY INVERTER
BATTERY CHARGER-1
NON-AUTO
125 VOLT D.C. PWR. PNL. Nº2
125V STA. BATTERY
STATIC INVERTER Nº2
BATTERY CHARGER-2
480V M.C.C. Nº4
EMERG. THROWOVER 5W LTG. PNL. 25
REACTOR TRIP SWGR. UNIT Nº1
6900V SWGR. 2 CONTROL
480V. SWGR. CONTROL
B.F.P. TURBINES EMERG. OIL PUMP
SEAL OIL BACKUP PUMP (AIRSIDE)
EMERG. LTG. NUCLEAR
125 VOLT D.C. DIST. PNL. Nº2
MISCELLANEOUS D.C. CIRCUITS
TO LTG. BUS Nº2
TO M.C.C. Nº4 ON BUS Nº2A
7½ KVA 1Ø CONSTANT VOLTAGE TRANS.
TO M.C.C. Nº7 ON BUS Nº6A
7½ KVA 1Ø CONSTANT VOLTAGE TRANS.
1Ø 118V. INSTR. BUS Nº1
1Ø 118V INSTR. BUS Nº2
1Ø 118V INSTR. BUS Nº3
1Ø 118V INSTR. BUS Nº4
118V A.C. LOADS REQUIRING A REGULATED RELIABLE SOURCE INCLUDING INSTRUMENT AND PROTECTION CIRCUITS.
FOUR PANELS FEEDING UP TO FOUR (4) REDUNDANT CHANNELS OF PROTECTION CIRCUITS
LEGEND
D.O. CIRCUIT BREAKER
STATIONARY CIRCUIT BREAKER
GROUND
WYE CONNECTED GENERATOR
TRANSFORMER
MOTOR NO. INDICATES H.P.
BATTERY
NOTE :- * INDICATES BREAKERS ARE MECHANICALLY INTERLOCKED SO THAT ONLY ONE BREAKER CAN BE CLOSED.
REV #3 4-20-71
REV #2 3-18-71
REV #1 3-15-71
REV #4 6-9-71
3-5-71
PLATE 8
ELECTRICAL
MAIN SINGLE LINE DIAGRAM
1000 MW-PRESSURIZED WATER UNIT
MIDDLETOWN HYPOTHETICAL SITE
united engineers & constructors inc.
9674-D-3000

TOTAL TURBINE OUTPUT	1,127,017 KW
FIXED LOSSES	3,563 KW
GENERATOR LOSSES	13,920 KW
STATOR COOLER	13,100 KW
GENERATOR OUTPUT	1,096,434 KW
AUXILIARY POWER AT 6.00%	65,786 KW
NET SENT OUT	1,030,648 KW
NET STATION STEAM RATE	13.34 #/KWH
NET STATION HEAT RATE	10,383 BTU/KWH
OPERATING EFFICIENCY	98 %
BTU/KWH SENT OUT	10,595 BTU/KWH
THERMAL EFFICIENCY	32.21 %



TURBINE
TC6F-44LSB 1800 RPM

PLATE 9

MECHANICAL
PWR HEAT BALANCE
1000 MW PWR UNIT
MIDDLETOWN HYPOTHETICAL SITE
united engineers & constructors inc.
9674-01-2502

Date: ____________

ESTIMATE OF COST
FOR
1000 MW PWR POWER PLANT

ACCT. NO.	DESCRIPTION	QUANTITY	UNIT	RATES	AMOUNTS	TOTALS
20.	LAND AND LAND RIGHTS				$	$
201.	Land and Privilege Acquisition					
201.1	Allowance for purchase of approximately 500 acres of land including all surveys, privileges, clearing costs, etc. (M				1,000,000	
	Total Land and Land Rights,- (M				1,000,000	1,000,000

ACCT. NO.	DESCRIPTION		QUANTITY	UNIT	RATES	AMOUNTS	TOTALS
21.	STRUCTURES AND IMPROVEMENTS					$	$
211.	Yard Work						
211.11	General Cut and Fill						
	Includes excavation to rough grade in area outside of building lines. (Excavation in building areas is with buildings)						
	Common excavation	(L	100,000	cu yd	1.50	150,000	
		(M			.50	50,000	
	Yard fill	(L	Allowance			10,000	
		(M				5,000	
	Clearing site	(L	Allowance			10,000	
		(M				5,000	
	Finish grading	(L	Allowance			35,000	
		(M				15,000	
		(L				205,000	
		(M				75,000	
211.12	Roads, Walks and Parking Areas						
	Access road to plant site area				(Existing)		
	Subgrade preparation- roads and parking lot	(L	32,000	sq yd	1.75	56,000	
		(M				5,000	
	Paving for roads and parking areas	(L	24,000	sq yd	2.00	48,000	
		(M			3.00	72,000	
	Walks and curbs	(L	Allowance			3,000	
		(M				4,000	
	Gutters	(L	12,000	lin ft	2.00	24,000	
		(M			2.50	30,000	
		(L				131,000	
		(M				111,000	
211.13	Retaining Walls						
	Forms	(L	20,000	sq ft	5.50	110,000	
		(M			.50	10,000	
	Reinforcing steel	(L	80	ton	270.00	21,600	
		(M			150.00	12,000	
	Concrete including finish, etc.	(L	1,200	cu yd	15.33	18,400	
		(M			23.33	28,000	
	Cribbing at Containment Building access road	(L	5,000	sq ft	5.00	25,000	
		(M			5.00	25,000	
		(L				175,000	
		(M				75,000	

Date: ____________

ESTIMATE OF COST
FOR
1000 MW PWR POWER PLANT

ACCT. NO.	DESCRIPTION		QUANTITY	UNIT	RATES	AMOUNTS	TOTALS
21.	STRUCTURES AND IMPROVEMENTS (cont'd)					$	$
211.	Yard Work (cont'd)						
211.14	Fencing and Gates						
	Permanent fence (7' high + barbed wire) including gates, etc.	(L	3,200	lin ft	2.50	8,000	
		(M			5.00	16,000	
	Gate house	(L	Allowance			10,000	
		(M				5,000	
		(L				18,000	
		(M				21,000	
211.15	Sanitary Sewage Facilities						
	Sewage treatment facilities	(L	Allowance			25,000	
		(M				25,000	
	Connections between buildings and treating plant	(L	1,000	lin ft	25.00	25,000	
		(M			10.00	10,000	
		(L				50,000	
		(M				35,000	
211.16	Yard Drainage						
	Allowance for area drains and on-site roads and railroad drains						
	Pipe and fittings	(M	3,000	lin ft	6.00	18,000	
	Area drains	(M	Allowance			5,000	
	Installation	(L	3,000	lin ft	8.00	24,000	
		(M			1.50	4,500	
	Excavation and backfill	(L	3,000	cu yd	10.00	30,000	
		(M			2.50	7,500	
	Manholes and catch basins, etc.	(L	20	@		36,000	
		(M				15,000	
		(L				90,000	
		(M				50,000	
211.17	Yard Lighting						
	Allowance for lighting yard areas, railroads and roads on-site, etc.	(L	50	fixt		75,000	
		(M				25,000	

Date: ____________

ESTIMATE OF COST
FOR
1000 MW PWR POWER PLANT

ACCT. NO.	DESCRIPTION		QUANTITY	UNIT	RATES	AMOUNTS	TOTALS
21.	STRUCTURES AND IMPROVEMENTS (cont'd)					$	$
211.	Yard Work (cont'd)						
211.34	Bridges Over Discharge Canal, etc.						
	Concrete slab on steel beam bridge spanning the extended discharge canal						
	Structural steel and	(L	40	ton	250.00	10,000	
	miscellaneous iron	(M			300.00	12,000	
	Forms	(L	6,000	sq ft	5.00	30,000	
		(M			.50	3,000	
	Reinforcing steel	(L	30	ton	250.00	7,500	
		(M			150.00	4,500	
	Concrete	(L	250	cu yd	10.00	2,500	
		(M			22.00	5,500	
		(L				50,000	
		(M				25,000	
211.43	Railroads						
	Offsite access railroad	(L	5	mi		490,000	
		(M				530,000	
	Onsite sidings, turn-outs,	(L	5,000	lin ft		55,000	
	etc.	(M				90,000	
		(L				545,000	
		(M				620,000	
	Total Yard Work,-	(L				1,339,000	
		(M				1,037,000	2,376,000

Date: ______________

ESTIMATE OF COST
FOR
1000 MW PWR POWER PLANT

ACCT. NO.	DESCRIPTION		QUANTITY	UNIT	RATES	AMOUNTS	TOTALS
21.	STRUCTURES AND IMPROVEMENTS (cont'd)					$	$
212.	Containment Building 135'-0" I.D. Cylindrical Building, 215'-6" high above foundation mat including hemispherical dome						
	Substructure						
212.31	Excavation Work						
	Earth excavation	(L	7,000	cu yd	4.00	28,000	
		(M			1.00	7,000	
	Rock excavation	(L	13,000	cu yd	20.00	260,000	
		(M			5.00	65,000	
	Concrete fill	(L	None			-	
		(M				-	
	Backfill	(L	2,000	cu yd	5.00	10,000	
		(M			5.00	10,000	
	Dewatering	(L	Allowance			50,000	
		(M				10,000	
		(L				348,000	
		(M				92,000	
	Concrete Work						
212.331	Formwork	(L	15,000	sq ft	8.00	120,000	
		(M			.50	7,500	
212.332	Reinforcing steel	(L	1,200	ton	250.00	300,000	
	(Field fabricated)	(M			150.00	180,000	
212.333	Structural concrete - including pea gravel	(L	7,000	cu yd	8.00	56,000	
	leveling concrete	(M			20.00	140,000	
		(L				476,000	
		(M				327,500	
212.334	Miscellaneous Iron						
	Leveling tees, anchors,	(L	100,000	lb	.60	60,000	
	etc.	(M			.30	30,000	
	Total Substructure,-	(L				884,000	
		(M				449,500	1,333,500

Date: ____________

ESTIMATE OF COST
FOR
1000 MW PWR POWER PLANT

ACCT. NO.	DESCRIPTION		QUANTITY	UNIT	RATES	AMOUNTS	TOTALS
21.	STRUCTURES AND IMPROVEMENTS (cont'd)					$	$
212.	Containment Building (cont'd)						
	Superstructure						
	Concrete Containment Cylinder Wall						
212.3411	Exterior wall forms	(L	68,000	sq ft	3.50	238,000	
		(M			.40	26,800	
212.3411	Interior wall bracing	(L	62,000	sq ft	2.50	155,000	
		(M			.40	25,200	
212.3412	Reinforcing steel	(L	3,500	ton	600.00	2,100,000	
		(M			220.00	770,000	
212.3413	Concrete	(L	11,000	cu yd	22.50	247,500	
		(M			22.50	247,500	
212.3415	Rubbing surface	(L	65,000	sq ft	.60	39,000	
		(M			.10	6,500	
212.3414	Embedded steel	(L	Allowance			5,000	
		(M				5,000	
		(L				2,784,500	
		(M				1,081,000	
	Concrete Dome						
212.3411	Formwork	(L	30,000	sq ft	5.00	150,000	
		(M			2.00	60,000	
212.3412	Reinforcing steel						
		(L	1,000	ton	900.00	900,000	
		(M			250.00	250,000	
212.3413	Concrete	(L	4,000	cu yd	25.00	100,000	
		(M			25.00	100,000	
212.3415	Rubbing surfaces,	(L	32,000	sq ft	.60	19,200	
	waterproofing, etc.	(M			.10	3,200	
		(L				1,169,200	
		(M				413,200	

ESTIMATE OF COST
FOR
1000 MW PWR POWER PLANT

ACCT. NO.	DESCRIPTION		QUANTITY	UNIT	RATES	AMOUNTS	TOTALS
21.	STRUCTURES AND IMPROVEMENTS (cont'd)					$	$
212.	Containment Building (cont'd)						
	Superstructure (cont'd)						
	Interior Concrete Work						
212.3411	Formwork	(L	100,000	sq ft	7.50	750,000	
		(M			.60	60,000	
212.3412	Reinforcing steel						
		(L	650	ton	450.00	292,500	
		(M			150.00	97,500	
212.3413	Concrete	(L	7,500	cu yd	15.00	112,500	
		(M			20.00	150,000	
212.3414	Embedded Steel						
	Inserts, anchor bolts,	(L	150	ton	2000.00	300,000	
	curb angles, etc.	(M			600.00	90,000	
	Reactor cavity liner	(L	10,000	sq ft	30.00	300,000	
	plates	(M			10.00	100,000	
212.3415	Rubbing surfaces	(L	80,000	sq ft	1.00	80,000	
		(M			.05	4,000	
212.3416	Concrete block shielding	(L				5,000	
		(M				5,000	
212.3419	Painting concrete	(L	Allowance			35,000	
		(M				25,000	
		(L				1,875,000	
		(M				531,500	
212.342	Structural Steel						
	Floor and platform	(L	100	ton	1000.00	100,000	
	supporting steel	(M			415.00	41,500	
	Miscellaneous frames,	(L				30,000	
	spiral stairway, etc.	(M				10,000	
	Floor grating	(L	6,000	sq ft	3.50	21,000	
		(M			2.50	15,000	
	Stair treads	(L	200	@	20.00	4,000	
		(M			8.00	1,600	
	Handrail	(L	1,000	lin ft	7.00	7,000	
		(M			6.00	6,000	
	Floor plate	(L	2,500	sq ft	6.00	15,000	
		(M			6.00	15,000	
	Painting	(L				20,000	
		(M				10,000	
		(L				197,000	
		(M				99,100	

Date: ____________

ESTIMATE OF COST
FOR
1000 MW PWR POWER PLANT

ACCT. NO.	DESCRIPTION		QUANTITY	UNIT	RATES	AMOUNTS	TOTALS
21.	STRUCTURES AND IMPROVEMENTS (cont'd)					$	$
212.	Containment Building (cont'd)						
	Steel Containment and Components						
212.37	Containment Liner Plate						
	Cylinder and dome						
	Bottom plate and drain sumps						
	Reactor and instrumentation sumps						
	Test channels						
	Piping sleeves						
	Instrumentation sleeves						
	Electrical sleeves						
	Ventilation sleeves						
	Hatch penetrations						
	Fuel transfer penetration						
	Equipment hatch						
	Personnel hatches						
	Construction openings						
	Vacuum box test						
	Strength and leak tests						
	Radiographing						
	High pressure test						
	Leak rate test	(L				1,000,000	
	Nelson studs	(M				1,000,000	
212.37	Insulation						
	Insulation on inside of steel liner plate	(L	8,000	sq ft		30,000	
		(M				25,000	
212.37	Expansion bellows for pipe penetrations through	(L				75,000	
	containment walls	(M				25,000	
212.37	Isolation valve seal	(L				75,000	
	water system	(M				35,000	
		(L				150,000	
		(M				60,000	
	Total Superstructure,-	(L				7,205,700	
		(M				3,209,800	10,415,500

ACCT. NO.	DESCRIPTION		QUANTITY	UNIT	RATES	AMOUNTS	TOTALS
21.	STRUCTURES AND IMPROVEMENTS (cont'd)					$	$
212.	Containment Building (cont'd)						
	Building Services						
	Heating						
212.222	Heaters, piping connections,	(L	Allowance			15,000	
	etc.	(M				10,000	
	Ventilation Systems						
	Containment Recirculation System						
212.223	Fans - 65,000 cfm	(M	5	@		30,000	
	Motors - 350 hp	(M	5	@		25,000	
	Installation of fans	(L	5	@		30,000	
	and motors	(M				2,000	
212.224	Cooling water coils	(L	5	@		50,000	
		(M				100,000	
212.226	Dampers and drives	(L				15,000	
	(butterfly valves)	(M				125,000	
212.227	Ductwork	(L	160,000	lb		150,000	
		(M				100,000	
	Filter equipment	(L				150,000	
		(M				750,000	
212.229	Automatic Controls	(L				7,500	
		(M				12,000	
		(L				402,500	
		(M				1,144,000	
	Containment Purge System						
212.223	Air supply fans and	(L	3			3,000	
	motors	(M				20,000	
212.225	Ductwork stack and	(L				100,000	
212.227	penetrations	(M				75,000	
212.227	Dampers and drives	(L				5,000	
		(M				25,000	
212.227	Filter equipment	(L				5,000	
		(M				25,000	
212.228	Piping connections	(L				2,500	
		(M				7,500	
212.229	Automatic control	(L				6,000	
		(M				10,000	
		(L				121,500	
		(M				162,500	

ACCT. NO.	DESCRIPTION		QUANTITY	UNIT	RATES	AMOUNTS	TOTALS
21.	STRUCTURES AND IMPROVEMENTS (cont'd)					$	$
212.	Containment Building (cont'd)						
	Containment Iodine Removal						
212.223	Fans and drives -	(L	2	@		1,000	
	8,000 cfm capacity	(M				5,000	
212.227	Filtration equipment	(L				2,500	
		(M				10,000	
212.227	Ductwork	(L				5,000	
		(M				5,000	
		(L				8,500	
		(M				20,000	
	Control Rod Drive Mechanism Cooling System						
212.223	Fans and drives -	(L	4	@		3,000	
	15,000 cfm capacity	(M				15,000	
212.227	Ductwork	(L				20,000	
		(M				15,000	
		(L				23,000	
		(M				30,000	
	Hot Pipe Penetrations Ventilating System						
212.223	Equipment	(L				2,000	
		(M				5,000	
212.227	Ductwork, pipe, etc.	(L				20,000	
		(M				8,000	
		(L				22,000	
		(M				13,000	
	Total Ventilation Systems,-	(L				577,500	
		(M				1,369,500	

ESTIMATE OF COST
FOR
1000 MW PWR POWER PLANT

ACCT. NO.	DESCRIPTION		QUANTITY	UNIT	RATES	AMOUNTS	TOTALS
						$	$
21.	STRUCTURES AND IMPROVEMENTS (cont'd)						
212.	Containment Building (cont'd)						
212.24	Lighting and Service Wiring Power and control equipment, conduit and trays, wire and cable, fixtures, etc.	(L (M				90,000 30,000	
	Total Building Services,-	(L (M				682,500 1,409,500	2,092,000
	Total Containment Building,-	(L (M				8,772,200 5,068,800	13,841,000

ACCT. NO.	DESCRIPTION		QUANTITY	UNIT	RATES	AMOUNTS	TOTALS
21.	STRUCTURES AND IMPROVEMENTS (cont'd)					$	$
213.	Turbine Room and Heater Bay						
	Turbine Room 340'L x 120'W =		40,800	sq ft x	120'H =	4,896,000 cu ft	
	Heater Bay 240'L x 50'W =		12,000	sq ft x	60'H =	720,000 cu ft	
			52,800	sq ft		5,616,000 cu ft	
	Substructure						
213.11	Excavation Work						
	Earth excavation	(L	20,000	cu yd	4.00	80,000	
		(M			1.50	30,000	
	Rock excavation	(L	2,000	cu yd	25.00	50,000	
		(M			5.00	10,000	
	Concrete fill	(L	1,000	cu yd	35.00	35,000	
		(M			25.00	25,000	
	Backfill	(L	15,000	cu yd	4.00	60,000	
		(M			4.00	60,000	
	Dewatering	(L	Allowance			100,000	
		(M				10,000	
		(L				325,000	
		(M				135,000	
	Concrete Work						
213.131	Formwork	(L	88,000	sq ft	3.25	286,000	
		(M			.50	44,000	
213.132	Reinforcing Steel						
		(L	320	ton	400.00	128,000	
		(M			150.00	48,000	
213.133	Structural concrete	(L	6,500	cu yd	15.00	97,500	
		(M			20.00	130,000	
213.135	Floor finish	(L	50,000	sq ft	.30	15,000	
		(M			.05	2,500	
	Total Concrete Work,-	(L				526,500	
		(M				224,500	

Date: ____________

ESTIMATE OF COST
FOR
1000 MW PWR POWER PLANT

ACCT. NO.	DESCRIPTION		QUANTITY	UNIT	RATES	AMOUNTS	TOTALS
21.	STRUCTURES AND IMPROVEMENTS (cont'd)					$	$
213.	Turbine Room and Heater Bay (cont'd)						
213.134	Miscellaneous Iron						
	Embedded steel, anchor	(L	60	ton	900.00	54,000	
	bolts, etc.	(M			500.00	30,000	
	Total Substructure,-	(L				905,500	
		(M				389,500	1,295,000
	Superstructure						
	Concrete Slabs						
213.1411	Metal forms	(L	50,000	sq ft	.70	35,000	
		(M			.35	17,500	
	Wood forms (curbs, etc.)	(L	4,000	sq ft	4.50	18,000	
		(M			.50	2,000	
213.1412	Reinforcing Steel						
	(Field fabricated)	(L	100	ton	400.00	40,000	
		(M			150.00	15,000	
213.1413	Concrete	(L	1,100	cu yd	25.00	27,500	
		(M			20.00	22,000	
213.1415	Rubbing surfaces	(L	8,000	sq ft	.25	2,000	
		(M			-	200	
213.1415	Floor finish (Kalman)	(L	30,000	sq ft	1.00	30,000	
		(M			.75	22,500	
213.1415	Floor finish (no hardener)	(L	30,000	sq ft	.20	6,000	
		(M			.05	1,500	
		(L				158,500	
		(M				80,700	
213.142	Structural Steel						
	Furnish and deliver	(M	3,200	ton	300.00	960,000	
	Erect	(L	3,200	ton	125.00	400,000	
		(M	3,200	ton	5.00	16,000	
	Plumb and connect	(L	3,200	ton	15.00	48,000	
		(M	3,200	ton	10.00	32,000	
	Field painting	(L	3,200	ton	10.00	32,000	
		(M	3,200	ton	2.50	8,000	
		(L				480,000	
		(M				1,016,000	

ACCT. NO.	DESCRIPTION		QUANTITY	UNIT	RATES	AMOUNTS	TOTALS
21.	STRUCTURES AND IMPROVEMENTS (cont'd)					$	$
213.	Turbine Room and Heater Bay (cont'd)						
213.142	Miscellaneous Iron						
	Platform framing, loose lintels, hatch framing	(L	80	ton	1000.00	80,000	
	etc.	(M			400.00	32,000	
	Floor grating and	(L	22,000	sq ft	2.00	44,000	
	trench covers	(M			1.50	33,000	
	Stair treads and nosings	(L	250	@	20.00	5,000	
		(M			10.00	2,500	
	Handrail	(L	3,000	lin ft	7.50	22,500	
		(M			3.50	10,500	
		(L				151,500	
		(M				78,000	
	Exterior Walls						
213.143	Insulated galbestos siding	(L	100,000	sq ft	1.50	150,000	
		(M			1.00	100,000	
	Roof and Roofing						
213.145	Roofing, flashing and	(L	53,000	sq ft	.50	26,500	
	insulation	(M			.75	39,750	
213.144	Metal roof deck	(L	53,000	sq ft	.50	26,500	
		(M			.35	18,550	
		(L				53,000	
		(M				58,300	
213.146	Interior Partition Walls						
	Concrete block	(L	10,000	sq ft	1.00	10,000	
		(M			.75	7,500	

ESTIMATE OF COST
FOR
1000 MW PWR POWER PLANT

ACCT. NO.	DESCRIPTION		QUANTITY	UNIT	RATES	AMOUNTS	TOTALS
						$	$
21.	STRUCTURES AND IMPROVEMENTS (cont'd)						
213.	Turbine Room and Heater Bay (cont'd)						
	Doors, Sash, etc.						
213.147	Fixed sash and glazing in north and south ends	(L	10,000	sq ft	5.00	50,000	
	of turbine room	(M			5.00	50,000	
213.147	Sash and glazing in	(L	3,000	sq ft	2.00	6,000	
	balance of building	(M			5.00	15,000	
213.147	Personnel doors and	(L	400	sq ft	5.00	2,000	
	hardware	(M			6.00	2,400	
213.147	Rolling steel doors	(L	1,000	sq ft	2.50	2,500	
		(M			7.50	7,500	
213.147	Louvres	(L	1,800	sq ft	10.00	18,000	
		(M			12.00	21,600	
		(L				78,500	
		(M				96,500	
213.149	Special Finishes						
	Painting	(L				100,000	
		(M				20,000	
	Total Superstructure,-	(L				1,181,500	
		(M				1,457,000	2,638,500
	Building Services						
	Plumbing and Drains						
213.212	Roof drains and piping	(L				65,000	
		(M				18,000	
213.211	Floor drains and piping	(L				40,000	
		(M				10,000	
213.211	Sump pumps	(L				1,000	
		(M				4,000	
		(L				106,000	
		(M				32,000	

ACCT. NO.	DESCRIPTION		QUANTITY	UNIT	RATES	AMOUNTS	TOTALS
21.	STRUCTURES AND IMPROVEMENTS (cont'd)					$	$
213.	Turbine Room and Heater Bay (cont'd)						
	Heating and Ventilating						
213.222	Heat units	(L				175,000	
213.228	Piping connections	(M				30,000	
213.223	Roof vent fans	(L	15	@		15,000	
		(M				22,500	
213.223	Wall vent fans	(L	14	@		7,000	
		(M				9,800	
213.227	Ventilating ducts	(L				7,000	
		(M				5,000	
213.228	Pipe insulation	(L				5,000	
		(M				6,000	
		(L				209,000	
		(M				73,300	
	Fire Protection System						
213.233	Hoses, hose reels,	(L	24	@	500.00	12,000	
	etc.	(M			300.00	7,200	
213.232	Pipe, valves, etc.	(L				100,000	
		(M				40,000	
		(L				112,000	
		(M				47,200	
213.24	Lighting and Service Wiring	(L				160,000	
		(M				40,000	
213.25	Elevator						
	Elevator equipment	(L	Allowance			10,000	
		(M				50,000	
	Elevator shaft	(L				10,000	
	enclosure	(M				5,000	
		(L				20,000	
		(M				55,000	
	Total Building Services,-	(L				607,000	
		(M				247,500	854,500
	Total Turbine Room	(L				2,694,000	
	and Heater Bay,-	(M				2,094,000	4,788,000

Date: ____________

ESTIMATE OF COST
FOR
1000 MW PWR POWER PLANT

ACCT. NO.	DESCRIPTION		QUANTITY	UNIT	RATES	AMOUNTS	TOTALS
						$	$
21.	STRUCTURES AND IMPROVEMENTS (cont'd)						
214.	Intake and Discharge Structures						
214.1	Screen and Pump Well						
214.11	Excavation Work						
214.111	Dredging	(L	70,000	cu yd	1.50	105,000	
		(M			.50	35,000	
214.112	Rock excavation	(L	2,500	cu yd	20.00	50,000	
		(M			5.00	12,500	
214.113	Backfill	(L	18,000	cu yd	2.50	45,000	
		(M			2.00	36,000	
		(L				200,000	
		(M				83,500	283,500
	Concrete Work						
214.131	Formwork	(L	70,000	sq ft	5.00	350,000	
		(M			.60	42,000	
214.132	Reinforcing Steel (Field fabricated)	(L	270	ton	400.00	108,000	
		(M			150.00	40,500	
214.133	Tremie concrete	(L	2,500	cu yd	20.00	50,000	
		(M			20.00	50,000	
214.133	Structural concrete	(L	4,500	cu yd	20.00	90,000	
		(M			20.00	90,000	
214.135	Concrete finish	(L				10,000	
		(M				2,000	
		(L				608,000	
		(M				224,500	832,500
	Miscellaneous Iron						
214.141	Embedded steel	(L	30	ton	1300.00	39,000	
		(M			600.00	18,000	
214.142	Platforms, covers, etc.	(L	55	ton	1200.00	66,000	
		(M			600.00	33,000	
		(L				105,000	
		(M				51,000	156,000
214.15	Cofferdam						
214.151	Sheet piling including removal, etc.	(L	600	ton	350.00	210,000	
		(M			200.00	120,000	
214.152	Bracing including moving, removal, etc.	(L	250	ton	700.00	175,000	
		(M			200.00	50,000	
214.153	Construction ramps including removal	(L				100,000	
		(M				65,000	

ACCT. NO.	DESCRIPTION		QUANTITY	UNIT	RATES	AMOUNTS	TOTALS
21.	STRUCTURES AND IMPROVEMENTS (cont'd)					$	$
214.	Intake and Discharge Structures (cont'd)						
214.154	Dolphins	(L	30	ton	300.00	9,000	
		(M			200.00	6,000	
214.155	Rock fill of toe of	(L	500	cu yd	10.00	5,000	
	sheeting	(M			15.00	7,500	
214.156	Dewatering	(L				200,000	
		(M				25,000	
		(L				699,000	
		(M				273,500	972,500
214.16	Bulkhead at River						
214.1601	Excavation and rip-rap	(L				30,000	
	to hold sheeting	(M				125,000	
214.1602	Steel sheet piling	(L	300	ton	150.00	45,000	
		(M			200.00	60,000	
214.1603	Wales and tie-backs	(L				15,000	
		(M				5,000	
214.1611	Formwork	(L	5,000	sq ft	5.00	25,000	
		(M			.60	3,000	
214.1612	Reinforcing steel	(L	10	ton	400.00	4,000	
		(M			150.00	1,500	
214.1613	Concrete	(L	150	cu yd	30.00	4,500	
		(M			20.00	3,000	
214.162	Block walls	(L	5,000	sq ft	1.00	5,000	
		(M			1.00	5,000	
214.163	Coping	(L	200	cu ft	5.00	1,000	
		(M			5.00	1,000	
214.164	Sprinkler system	(L				5,000	
		(M				2,000	
214.165	Lighting	(L				7,500	
		(M				6,000	
		(L				142,000	
		(M				211,500	353,500
	Total Screen and Pump Well,-	(L				1,754,000	
		(M				844,000	2,598,000

ESTIMATE OF COST
FOR
1000 MW PWR POWER PLANT

ACCT. NO.	DESCRIPTION		QUANTITY	UNIT	RATES	AMOUNTS	TOTALS
21.	STRUCTURES AND IMPROVEMENTS (cont'd)					$	$
215.	Primary Auxiliary Building and Tunnels Primary auxiliary building structure and connecting tunnels to containment building and control room.						
	Substructure and Superstructure						
215.11	Excavation Work Earth excavation	(L	10,000	cu yd	4.00	40,000	
		(M			1.00	10,000	
	Rock excavation	(L	10,000	cu yd	25.00	250,000	
		(M			6.50	65,000	
	Concrete fill	(L	Allowance			13,000	
	(or caissons)	(M				10,000	
	Backfill	(L	5,000	cu yd	5.00	25,000	
		(M			5.00	25,000	
	Dewatering	(L				100,000	
		(M				25,000	
		(L				428,000	
		(M				135,000	
215.1411	Concrete Work Formwork	(L	290,000	sq ft	4.50	1,305,000	
		(M			.50	145,000	
215.1412	Reinforcing Steel (Field fabricated)	(L	1,300	ton	400.00	520,000	
		(M			150.00	195,000	
215.1413	Structural concrete	(L	18,000	cu yd	13.00	234,000	
		(M			20.00	360,000	
215.1415	Floor finish	(L	80,000	sq ft	.25	20,000	
		(M			.04	3,200	
215.1415	Rubbing concrete surfaces	(L	280,000	sq ft	.25	70,000	
		(M			.02	5,600	
		(L				2,149,000	
		(M				708,800	
215.142	Miscellaneous Iron Frames, curb angles, anchor bolts, etc.	(L	125	ton	1200.00	150,000	
		(M			800.00	100,000	
	Stair treads	(L	250	@	20.00	5,000	
		(M			10.00	2,500	
	Floor grating, chk'd plate, etc.	(L	2,000	sq ft	3.00	6,000	
		(M			3.00	6,000	
	Handrailing	(L	2,000	lin ft	7.00	14,000	
		(M			4.00	8,000	
		(L				175,000	
		(M				116,500	

ACCT. NO.	DESCRIPTION		QUANTITY	UNIT	RATES	AMOUNTS	TOTALS
21.	STRUCTURES AND IMPROVEMENTS (cont'd)					$	$
215.	Primary Auxiliary Building and Tunnels (cont'd)						
	Walls, Roof, etc.						
215.146	Metal partitions	(L	1,500	sq ft	2.00	3,000	
		(M			3.00	4,500	
215.147	Sash and glazing	(L	10	sq ft	100.00	1,000	
	(Lead window)	(M			700.00	7,000	
215.147	Personnel doors and	(L	300	sq ft	5.00	1,500	
	hardware	(M			7.00	2,100	
215.149	Painting	(L	Allowance			40,000	
		(M				10,000	
215.145	Roofing and flashing,	(L	25,000	sq ft	.60	15,000	
	waterproofing, etc.	(M			.60	15,000	
		(L				60,500	
		(M				38,600	
	Total Substructure and	(L				2,812,500	
	Superstructure,-	(M				998,900	3,811,400
	Building Services						
	Plumbing and Drains						
215.212	Roof drains	(L				15,000	
		(M				5,000	
215.211	Floor drains	(L				10,000	
		(M				7,500	
215.211	Sump pump and	(L				2,000	
	other equipment	(M				3,500	
		(L				27,000	
		(M				16,000	
215.222	Heating						
	Equipment and piping connections, ductwork, insulation, etc.	(L				45,000	
		(M				20,000	
	Ventilation						
215.223	Equipment and controls	(L				15,000	
		(M				30,000	
215.227	Ductwork	(L				55,000	
		(M				45,000	
		(L				70,000	
		(M				75,000	

Date: ____________

ESTIMATE OF COST
FOR
1000 MW PWR POWER PLANT

ACCT. NO.	DESCRIPTION		QUANTITY	UNIT	RATES	AMOUNTS	TOTALS
21.	STRUCTURES AND IMPROVEMENTS (cont'd)					$	$
215.	Primary Auxiliary Building and Tunnels (cont'd)						
	Fire Protection System						
	Hoses, hose reels,	(L	None			-	
	racks, etc.	(M				-	
215.232	Piping, valves, sprinklers,	(L				25,000	
	etc.	(M				15,000	
		(L				25,000	
		(M				15,000	
215.24	Lighting and Service Wiring						
	Power and control equipment, conduit, trays, wire and						
	cable, fixtures, etc.	(L				57,500	
		(M				20,000	
	Total Building Services,-	(L				224,500	
		(M				146,000	370,500
	Total Primary Auxiliary	(L				3,037,000	
	Building,-	(M				1,144,900	4,181,900

ACCT. NO.	DESCRIPTION		QUANTITY	UNIT	RATES	AMOUNTS	TOTALS
21.	STRUCTURES AND IMPROVEMENTS (cont'd)					$	$
217.	Fuel Handling Building						
	Substructure						
217.11	Excavation Work						
	Earth excavation	(L	2,000	cu yd	4.00	8,000	
		(M			1.00	2,000	
	Rock excavation	(L	300	cu yd	40.00	12,000	
		(M			5.00	1,500	
	Concrete fill	(L	400	cu yd	25.00	10,000	
		(M			25.00	10,000	
	Backfill	(L	500	cu yd	5.00	2,500	
		(M			5.00	2,500	
	Dewatering	(L	Allowance			2,000	
		(M				500	
		(L				34,500	
		(M				16,500	
	Concrete Work						
217.131	Formwork	(L	28,000	sq ft	4.50	126,000	
		(M			.50	14,000	
217.132	Reinforcing Steel (Field fabricated)	(L	170	ton	400.00	68,000	
		(M			150.00	25,500	
217.133	Structural concrete	(L	3,000	cu yd	10.00	30,000	
		(M			20.00	60,000	
217.135	Floor finish	(L	6,000	sq ft	.20	1,200	
		(M			.02	250	
217.135	Rubbing concrete	(L	25,000	sq ft	.40	10,000	
		(M			.01	250	
		(L				235,200	
		(M				100,000	

ACCT. NO.	DESCRIPTION		QUANTITY	UNIT	RATES	AMOUNTS	TOTALS
21.	STRUCTURES AND IMPROVEMENTS (cont'd)					$	$
217.	Fuel Handling Building (cont'd)						
217.134	Miscellaneous Iron						
	Floor plates in decontamination room	(L	500	sq ft	50.00	25,000	
		(M			10.00	5,000	
	Stainless steel lining in storage pool including gate, etc.	(L	10,000	sq ft	30.00	300,000	
		(M			15.00	150,000	
	Miscellaneous iron embedded in concrete including anchor bolts, curb angles, anchors, etc.	(L	30	ton	3000.00	90,000	
		(M			800.00	24,000	
		(L				415,000	
		(M				179,000	
	Total Substructure,-	(L				684,700	
		(M				295,500	980,200
	Superstructure						
	Concrete Work						
217.1411	Formwork	(L	14,000	sq ft	4.00	56,000	
		(M			.50	7,000	
217.1412	Reinforcing steel	(L	50	ton	400.00	20,000	
		(M			150.00	7,500	
217.1413	Concrete	(L	500	cu yd	20.00	10,000	
		(M			20.00	10,000	
217.1415	Rubbing surfaces	(L	14,000	sq ft	.15	2,100	
		(M				150	
217.1415	Floor finish	(L	1,500	sq ft	.40	600	
		(M				50	
		(L				88,700	
		(M				24,700	
217.142	Structural Steel						
	Furnish and deliver fabricated steel	(M	130	ton	400.00	52,000	
	Erect	(L	130	ton	200.00	26,000	
		(M	130	ton	10.00	1,300	
	Plumb and connect	(L	130	ton	30.00	3,900	
		(M	130	ton	10.00	1,300	
	Field painting	(L	130	ton	20.00	2,600	
		(M	130	ton	10.00	1,300	
		(L				32,500	
		(M				55,900	

ACCT. NO.	DESCRIPTION		QUANTITY	UNIT	RATES	AMOUNTS	TOTALS
21.	STRUCTURES AND IMPROVEMENTS (cont'd)					$	$
217.	Fuel Handling Building (cont'd)						
	Superstructure (cont'd)						
217.142	Miscellaneous Iron						
	Stair treads	(L	50	@	20.00	1,000	
		(M			8.00	400	
	Floor plates	(L	1,500	sq ft	2.00	3,000	
		(M			2.00	3,000	
	Handrail	(L	700	lin ft	7.00	4,900	
		(M			4.00	2,800	
		(L				8,900	
		(M				6,200	
	Walls, Roof, etc.						
217.143	Siding	(L	12,000	sq ft	.75	9,000	
		(M			.75	9,000	
217.143	Masonry walls	(L	2,000	sq ft	1.00	2,000	
		(M			1.00	2,000	
217.147	Personnel doors	(L	100	sq ft	5.00	500	
	and hardware	(M			8.00	800	
217.147	Rolling metal doors	(L	200	sq ft	5.00	1,000	
		(M			7.00	1,400	
217.146	Wire partitions	(L	300	sq ft	1.00	300	
		(M			1.00	300	
217.145	Roofing and flashing,	(L	6,000	sq ft	1.00	6,000	
	crickets, etc.	(M			.75	4,500	
217.144	Roof deck	(L	6,000	sq ft	1.00	6,000	
		(M			.50	3,000	
217.144	Roof hatches	(L				1,000	
		(M				500	
		(L				25,800	
		(M				21,500	
217.149	Painting						
	Includes all finish	(L				8,500	
	painting	(M				2,000	
	Total Superstructure,-	(L				164,400	
		(M				110,300	274,700

Date: ____________________

ESTIMATE OF COST
FOR
1000 MW PWR POWER PLANT

ACCT. NO.	DESCRIPTION		QUANTITY	UNIT	RATES	AMOUNTS	TOTALS
21.	STRUCTURES AND IMPROVEMENTS (cont'd)					$	$
217.	Fuel Handling Building (cont'd)						
	Building Services						
	Plumbing and Drains						
217.212	Roof drains	(L				7,500	
		(M				1,000	
217.211	Floor drains	(L				1,000	
		(M				1,500	
217.211	Sump pumps	(L				1,000	
		(M				2,000	
		(L				9,500	
		(M				4,500	
	Heating						
217.222	Air intake tempering units	(L				3,000	
		(M				2,500	
217.222	Unit heaters	(L				1,000	
		(M				500	
217.228	Piping and connections	(L				20,000	
		(M				4,000	
		(L				24,000	
		(M&SC				7,000	
	Ventilation						
217.223	Equipment	(L				6,000	
		(M				15,000	
217.227	Ductwork, dampers, etc.	(L				15,000	
		(M				10,000	
217.229	Controls	(L				1,500	
		(M				2,500	
		(L				22,500	
		(M				27,500	
217.24	Lighting and Service Wiring						
	Power and control equipment	(L					
		(M				(Details	
	Conduit	(L					
		(M					
	Trays	(L				Later)	
		(M					
	Wire and cable	(L					
		(M					
	Fixtures	(L					
		(M					
		(L				7,500	
		(M				5,500	

ACCT. NO.	DESCRIPTION		QUANTITY	UNIT	RATES	AMOUNTS	TOTALS
21.	STRUCTURES AND IMPROVEMENTS (cont'd)					$	$
217.	Fuel Handling Building (cont'd)						
	Building Services (cont'd)						
217.228	Service Piping						
	Allowance for miscellaneous	(L				6,500	
	supply lines	(M				3,500	
	Total Building Services,-	(L				70,000	
		(M				48,000	118,000
	Total Fuel Handling	(L				919,100	
	Building,-	(M				453,800	1,372,900

ACCT. NO.	DESCRIPTION		QUANTITY	UNIT	RATES	AMOUNTS	TOTALS
21.	STRUCTURES AND IMPROVEMENTS (cont'd)					$	$
218A.	Control Room Building Approx 100'L x 50'W x 60'H concrete wall and slab construction						
	Substructure						
218A.11	Excavation Work						
	Earth excavation	(L	1,500	cu yd	3.00	4,500	
		(M			1.00	1,500	
	Backfill	(L	1,000	cu yd	3.00	3,000	
		(M			1.00	1,000	
		(L				7,500	
		(M				2,500	
	Concrete Work						
218A.131	Forms	(L	8,000	sq ft	4.50	36,000	
		(M			.50	4,000	
218A.132	Reinforcing steel	(L	50	ton	400.00	20,000	
		(M			150.00	7,500	
218A.133	Concrete	(L	500	cu yd	15.00	7,500	
		(M			20.00	10,000	
218A.135	Floor finish	(L	5,000	sq ft	.30	1,500	
		(M			.02	100	
		(L				65,000	
		(M				21,600	
218A.134	Miscellaneous Iron						
		(L	Allowance			1,500	
		(M				1,000	
	Total Substructure,-	(L				74,000	
		(M				25,100	99,100
	Superstructure						
	Structural Steel						
	(Reinforced concrete frame	(L	None			-	
	building)	(M				-	

Date: ____________

ESTIMATE OF COST
FOR
1000 MW PWR POWER PLANT

ACCT. NO.	DESCRIPTION		QUANTITY	UNIT	RATES	AMOUNTS	TOTALS
21.	STRUCTURES AND IMPROVEMENTS (cont'd)					$	$
218A.	Control Room Building (cont'd)						
218A.142	Miscellaneous Iron						
	Platforms, lintels, stair	(L	20	ton	1000.00	20,000	
	stringers, door bucks, etc.	(M			500.00	10,000	
	Floor grating	(L	None		-	-	
		(M			-	-	
	Stair treads	(L	150	@	20.00	3,000	
		(M			10.00	1,500	
	Handrail	(L	300	lin ft	6.00	1,800	
		(M			5.00	1,500	
		(L				24,800	
		(M				13,000	
	Concrete Slabs						
218A.1411	Wood forms	(L	18,000	sq ft	4.50	81,000	
		(M			.50	9,000	
218A.1412	Reinforcing steel	(L	280	ton	400.00	112,000	
		(M			150.00	42,000	
288A.1413	Concrete	(L	1,300	cu yd	15.00	19,500	
		(M			20.00	26,000	
218A.1415	Rubbing surfaces	(L	15,000	sq ft	.20	3,000	
		(M				300	
218A.1415	Floor finish (and roof slab)	(L	15,000	sq ft	.30	4,500	
		(M				300	
		(L				220,000	
		(M				77,600	
	Walls						
218A.147	Personnel doors and hardware	(L	500	sq ft	6.00	3,000	
		(M			8.00	4,000	
218A.1411	Forms for concrete	(L	40,000	sq ft	4.50	180,000	
		(M			.50	20,000	
218A.1412	Reinforcing steel	(L	250	ton	400.00	100,000	
		(M			140.00	35,000	
218A.1413	Concrete	(L	1,400	cu yd	15.00	21,000	
		(M			20.00	28,000	
218A.1415	Concrete finish	(L	40,000	sq ft	.25	10,000	
		(M			.05	2,000	

ESTIMATE OF COST
FOR
1000 MW PWR POWER PLANT

ACCT. NO.	DESCRIPTION		QUANTITY	UNIT	RATES	AMOUNTS	TOTALS
21.	STRUCTURES AND IMPROVEMENTS (cont'd)					$	$
218A.	Control Room Building (cont'd)						
218A.143	Masonry partitions	(L	5,000	sq ft	1.50	7,500	
		(M			2.00	10,000	
		(L				321,500	
		(M				99,000	
	Special Finishes						
218A.148	Vinyl tile floors	(L	5,000	sq ft	.50	2,500	
		(M			.50	2,500	
218A.148	Ceramic tile floors	(L	500	sq ft	1.00	500	
		(M			1.00	500	
218A.148	Suspended ceilings and	(L	3,000	sq ft	12.00	36,000	
	supporting steel	(M			10.00	30,000	
218A.148	Interior wall facing panels	(L	4,000	sq ft	1.00	4,000	
		(M			2.00	8,000	
218A.149	Painting inside walls	(L	20,000	sq ft	.25	5,000	
	and ceiling	(M			.12	2,400	
		(L				48,000	
		(M				43,400	
	Roof and Roofing						
218A.145	Roofing and flashing	(L	5,000	sq ft	.50	2,500	
		(M			1.00	5,000	
	Total Superstructure,-	(L				616,800	
		(M				238,000	854,800
	Building Services						
	Plumbing and Drains						
218A.212	Roof drains and piping	(L	4	@		8,000	
		(M				1,500	
218A.211	Floor drains and piping	(L				1,000	
		(M				500	
218A.213	Plumbing fixtures,	(L	5	@		2,500	
218A.214	pipe connections, etc.	(M				3,500	
		(L				11,500	
		(M				5,500	

ACCT. NO.	DESCRIPTION		QUANTITY	UNIT	RATES	AMOUNTS	TOTALS
21.	STRUCTURES AND IMPROVEMENTS (cont'd)					$	$
218A.	Control Room Building (cont'd)						
	Building Services (cont'd)						
	Heating						
218A.222	Electrical strip heating for first and second floor	(L	200,000	cu ft	.07	14,000	
	areas	(M			.08	16,000	
218A.228	Steam supply line to air conditioner heating coil	(L				5,000	
	for control room area	(M				5,000	
		(L				19,000	
		(M				21,000	
218A.24	Lighting and Service Wiring						
	Elevations + 18 and + 38	(L	10,000	sq ft	1.50	15,000	
		(M			2.00	20,000	
	Elevation + 60	(L	5,000	sq ft	30.00	150,000	
		(M			8.00	40,000	
		(L				165,000	
		(M				60,000	
	Air Conditioning						
218A.224	Equipment and controls	(L				15,000	
		(M				35,000	
218A.227	Ductwork	(L				15,000	
		(M				10,000	
		(L				30,000	
		(M				45,000	
	Ventilation						
218A.223	Vent fans, controls, etc.	(L	Allowance			8,000	
		(M				10,000	
	Total Building Services,-	(L				233,500	
		(M				141,500	375,000
	Total Control Room Building,-	(L				924,300	
		(M				404,600	1,328,900

ACCT. NO.	DESCRIPTION		QUANTITY	UNIT	RATES	AMOUNTS	TOTALS
21.	STRUCTURES AND IMPROVEMENTS (cont'd)					$	$
218B.	Diesel Generator Building 60'-0"L x 55'-0"W x 40'-0"H reinforced concrete structure						
218B.11	Excavation Work						
	Earth excavation	(L	2,000	cu yd	4.00	8,000	
		(M			1.00	2,000	
	Backfill	(L	1,000	cu yd	2.50	2,500	
		(M			2.50	2,500	
		(L				10,500	
		(M				4,500	
	Generator Foundations, Building Foundations and Floor Slab on Ground						
218B.131	Forms	(L	4,000	sq ft	5.00	20,000	
		(M			.50	2,000	
218B.132	Reinforcing steel	(L	20	ton	400.00	8,000	
		(M			150.00	3,000	
218B.133	Concrete	(L	400	cu yd	20.00	8,000	
		(M			20.00	8,000	
218B.135	Concrete finish	(L	4,000	sq ft	.25	1,000	
		(M			.05	200	
218B.134	Anchor bolts	(L	100	@	10.00	1,000	
		(M			10.00	1,000	
		(L				38,000	
		(M				14,200	
	Operating Floor Platforms						
218B.141	Concrete platform	(L	200	sq ft	8.00	1,600	
		(M			2.00	400	
218B.142	Platform support steel	(L	2,400	sq ft	10.00	24,000	
		(M			5.00	12,000	
218B.142	Floor grating and chk'd plate	(L	2,200	sq ft	5.00	11,000	
		(M			5.00	11,000	
218B.142	Miscellaneous iron	(L	Allowance			5,000	
		(M				3,000	
218B.142	Handrail	(L	100	lin ft	8.00	800	
		(M			5.00	500	
		(L				42,400	
		(M				26,900	

ACCT. NO.	DESCRIPTION		QUANTITY	UNIT	RATES	AMOUNTS	TOTALS
21.	STRUCTURES AND IMPROVEMENTS (cont'd)					$	$
218B.	Diesel Generator Building (cont'd)						
	Exterior Walls and Roof Slab						
218B.1411	Forms	(L	24,000	sq ft	5.00	120,000	
		(M			.50	12,000	
218B.1412	Reinforcing steel	(L	150	ton	400.00	60,000	
		(M			150.00	22,500	
218B.1413	Concrete	(L	1,000	cu yd	25.00	25,000	
		(M			20.00	20,000	
218B.1415	Concrete finish	(L	20,000	sq ft	.25	5,000	
		(M				250	
218B.145	Roofing	(L	3,500	sq ft	1.00	3,500	
		(M			.50	1,750	
		(L				213,500	
		(M				56,500	
218B.147	Doors, Louvres, etc.						
	Personnel doors	(L	100	sq ft	6.00	600	
		(M			12.00	1,200	
	Overhead door	(L	120	sq ft	10.00	1,200	
		(M			10.00	1,200	
	Louvres	(L	600	sq ft	6.00	3,600	
		(M			12.00	7,200	
		(L				5,400	
		(M				9,600	
	Building Services						
218B.21	Floor and roof drainage	(L				15,000	
		(M				10,000	
218B.22	Heating	(L	120,000	cu ft		15,000	
		(M				6,000	
218B.22	Ventilation	(L	120,000	cu ft		12,000	
		(M				12,000	
218B.24	Lighting and service wiring	(L	3,000	sq ft		15,000	
		(M				5,000	
218B.29	Overhead traveling crane	(L	1			2,500	
		(M				10,000	
		(L				59,500	
		(M				43,000	
218B.141	Fire Walls Between Units						
	Reinforced concrete with fire doors	(L	4,500	sq ft	12.00	67,500	
		(M			3.00	13,500	
	Total Diesel Generator Building,-	(L				436,800	
		(M				168,200	605,000

ESTIMATE OF COST
FOR
1000 MW PWR POWER PLANT

ACCT. NO.	DESCRIPTION		QUANTITY	UNIT	RATES	AMOUNTS	TOTALS
21.	STRUCTURES AND IMPROVEMENTS (cont'd)					$	$
218C.	Administration Building Four-story building 100'L x 50'W x 60'H Floor area = 20,000 sq ft; cube = 300,000 cu ft						
	Substructure						
218C.11	Excavation and backfill	(L	2,500	cu yd	3.00	7,500	
		(M			1.00	2,500	
218C.13	Concrete work	(L	250	cu yd	200.00	50,000	
		(M			50.00	12,500	
		(L				57,500	
		(M				15,000	72,500
	Superstructure						
218C.142	Structural steel and miscellaneous iron	(L	200	ton	200.00	40,000	
		(M			400.00	80,000	
218C.141	Floor slabs above grade	(L	15,000	sq ft	2.50	37.500	
		(M			1.50	22,500	
218C.144	Roof and roofing	(L	5,000	sq ft	1.50	7,500	
218C.145		(M			1.50	7,500	
218C.143	Exterior walls	(L	18,000	sq ft	3.50	63,000	
		(M			2.50	45,000	
218C.146	Interior partitions	(L	20,000	sq ft	1.50	30,000	
		(M			1.50	30,000	
218C.148	Special finishes,	(L	Allowance			15,000	
218C.149	painting, etc.	(M				35,000	
		(L				193,000	
		(M				220,000	413,000
	Building Services						
218C.21	Plumbing and drains	(L	Allowance			40,000	
		(M				35,000	
218C.22	Heating, ventilating & air conditioning	(L				100,000	
		(M				150,000	
218C.23	Fire protection	(L				10,000	
		(M				10,000	
218C.24	Lighting and service wiring	(L				40,000	
		(M				40,000	
		(L				190,000	
		(M				235,000	425,000
	Total Administration Building,-	(L				440,500	
		(M				470,000	910,500

ACCT. NO.	DESCRIPTION		QUANTITY	UNIT	RATES	AMOUNTS	TOTALS
21.	STRUCTURES AND IMPROVEMENTS (cont'd)					$	$
218D.	Service Building Four-story building 110'L x 50'W x 55'H Floor area = 22,000 sq ft; cube = 313.500 cu ft						
	Substructure						
218D.11	Excavation and backfill	(L	3,000	cu yd	3.00	9,000	
		(M			1.00	3,000	
218D.13	Concrete work	(L	300	cu yd	200.00	60,000	
		(M			50.00	15,000	
		(L				69,000	
		(M				18,000	87,000
	Superstructure						
218D.142	Structural steel and	(L	200	ton	200.00	40,000	
	miscellaneous iron	(M			400.00	80,000	
218D.141	Floor slabs above grade	(L	16,500	sq ft	2.50	41,250	
		(M			1.50	24,750	
218D.144	Roof and roofing	(L	6,000	sq ft	1.50	9,000	
218D.145		(M			1.50	9,000	
218D.143	Exterior walls	(L	18,000	sq ft	3.50	63,000	
		(M			2.50	45,000	
218D.146	Interior partitions	(L	25,000	sq ft	1.50	37,500	
		(M			1.50	37,500	
218D.148	Special finishes,	(L				15,000	
218D.149	painting, etc.	(M				35,000	
218D.15	Environmental	(L				15,000	
	shielding	(M				15,000	
		(L				220,750	
		(M				246,250	467,000

ACCT. NO.	DESCRIPTION		QUANTITY	UNIT	RATES	AMOUNTS	TOTALS
21.	STRUCTURES AND IMPROVEMENTS (cont'd)					$	$
218D.	Service Building (cont'd)						
218D.2	Building Services						
218D.21	Plumbing and Drainage						
	Toilet room fixtures and drinking fountains including water supply and	(L				45,000	
	drain piping	(M				40,000	
	Floor and roof drains	(L				10,000	
		(M				10,000	
	Distilled water, air and	(L				5,000	
	vacuum piping	(M				5,000	
	Contaminated drainage	(L				12,000	
	system	(M				8,000	
218D.22	Heating, ventilating and	(L				80,000	
	air conditioning	(M				90,000	
218D.23	Fire protection system	(L				5,000	
		(M				5,000	
218D.24	Lighting and building	(L				100,000	
	service wiring	(M				75,000	
		(L				257,000	
		(M				233,000	490,000
	Total Service Building,-	(L				546,750	
		(M				497,250	1,044,000

Date: ____________

ESTIMATE OF COST
FOR
1000 MW PWR POWER PLANT

ACCT. NO.	DESCRIPTION		QUANTITY	UNIT	RATES	AMOUNTS	TOTALS
21.	STRUCTURES AND IMPROVEMENTS (cont'd)					$	$
218E.	Fan Room Building						
218E.142	Structural steel and	(L	40	ton	1000.00	40,000	
	miscellaneous iron	(M			500.00	20,000	
218E.1411	Formwork	(L	15,000	sq ft	8.00	120,000	
		(M			.50	7,500	
218E.1412	Reinforcing steel	(L	60	ton	700.00	42,000	
		(M			150.00	9,000	
218E.1413	Concrete	(L	700	cu yd	20.00	14,000	
		(M			20.00	14,000	
218E.143	Concrete block walls	(L	7,000	sq ft	1.00	7,000	
		(M			1.00	7,000	
218E.147	Doors, louvres, etc.	(L				3,000	
		(M				8,000	
218E.22	Heating	(L				10,000	
		(M				5,000	
218E.24	Lighting	(L				10,000	
		(M				5,000	
218E.21	Roof drains	(L				5,000	
		(M				2,500	
218E.149	Painting	(L				2,000	
		(M				1,000	
	Total Fan Room	(L				253,000	
	Building,-	(M				79,000	332,000

ESTIMATE OF COST
FOR
1000 MW PWR POWER PLANT

ACCT. NO.	DESCRIPTION	QUANTITY	UNIT	RATES	AMOUNTS	TOTALS
21.	STRUCTURES AND IMPROVEMENTS (cont'd)				$	$
218F.	Auxiliary Feed Pump Enclosure					
	Enclosed area between containment					
	building and Turbine room (L				100,000	
	(M				60,000	160,000
	Total Structures and (L				21,216,650	
	Improvements,- (M				12,321,550	33,538,200

ACCT. NO.	DESCRIPTION		QUANTITY	UNIT	RATES	AMOUNTS	TOTALS
22.	REACTOR PLANT EQUIPMENT					$	$
221.	Reactor Equipment						
	Equipment Components						
221.12	Reactor vessel shell	(M	460	ton		5,112,000	
		(L				280,000	
		(M				15,000	
221.12	Reactor vessel head including bolting, etc.	(M	90	ton		1,000,000	
		(L				144,000	
		(M				2,500	
221.13	Upper and lower internals and thermal shield	(M	215	ton		3,278,000	
		(L				100,000	
		(M				10,000	
		(L				524,000	
		(M				9,417,500	
221.11	Supports						
	Reactor support ring	(L				45,000	
		(M				55,000	
	Seal ring adapter	(L				10,000	
		(M				2,500	
	Dry box (Pipe inspection plugs)	(L				17,000	
		(M				8,000	
		(L				72,000	
		(M				65,500	
	Insulation						
221.126	Lower vessel insulation	(L	2,000	sq ft		25,000	
		(M				100,000	
221.126	Reactor head insulation	(L	500	sq ft		5,000	
		(M				25,000	
		(L				30,000	
		(M				125,000	

ESTIMATE OF COST
FOR
1000 MW PWR POWER PLANT

ACCT. NO.	DESCRIPTION		QUANTITY	UNIT	RATES	AMOUNTS	TOTALS
						$	$
22.	REACTOR PLANT EQUIPMENT (cont'd)						
221.	Reactor Equipment (cont'd)						
	Reactor Control Equipment						
221.212	Control rod drives	(M	60	@		3,334,000	
	Installation	(L			1000.00	60,000	
		(M			100.00	6,000	
221.211	Control rods	(M	60	@		889,000	
	Installation (preoperat-ional)	(L				30,000	
		(M				3,000	
		(L				90,000	
		(M				4,232,000	
221.43	Control Rod Drive Missile Shield	(L	Allowance			10,000	
		(M				12,000	
	Total Reactor Equipment,-	(L				726,000	
		(M				13,852,000	14,578,000

Date: ____________

ESTIMATE OF COST
FOR
1000 MW PWR POWER PLANT

ACCT. NO.	DESCRIPTION		QUANTITY	UNIT	RATES	AMOUNTS	TOTALS
22.	REACTOR PLANT EQUIPMENT (cont'd)					$	$
222.	Reactor Coolant System						
	Equipment Components						
222.111	Coolant pumps & motors-	(M	4	@		3,612,000	
	88,500 gpm @ 277 FTDH-	(L	400	ton		160,000	
	6000 hp - 6000 V motors	(M				3,500	
222.131	Steam generators	(M	4	@		13,002,000	
		(L	1220	ton		350,000	
		(M				5,000	
222.141	Pressurizer and heater	(M	1	@		1,084,000	
		(L	125	ton		35,000	
		(M				1,000	
222.143	Pressurizer relief tank-	(M	1	@		72,000	
		(L	15	ton		5,000	
		(M				500	
		(L				550,000	
		(M				17,780,000	
	Supports						
222.114	Coolant pump supports	(L	75	ton	200.00	15,000	
		(M			2000.00	150,000	
222.136	Steam generator	(L	330	ton	2250.00	742,500	
	supports	(M			1320.00	435,000	
222.141	Pressurizer support	(L	10	ton	600.00	6,000	
		(M			2500.00	25,000	
222.143	Relief tank support	(L	5	ton	600.00	3,000	
		(M			1300.00	6,500	
		(L				766,500	
		(M				616,500	
	Missile Shields						
	Coolant pump shields	(L	None			-	
		(M				-	
222.136	Steam generator	(L	200	cu yd	150.00	30,000	
	shields	(M			50.00	10,000	
222.141	Pressurizer shield	(L	200	cu yd	150.00	30,000	
		(M			50.00	10,000	
		(L				60,000	
		(M				20,000	

ESTIMATE OF COST FOR 1000 MW PWR POWER PLANT

ACCT. NO.	DESCRIPTION		QUANTITY	UNIT	RATES	AMOUNTS	TOTALS
						$	$
22.	REACTOR PLANT EQUIPMENT (cont'd)						
222.	Reactor Coolant System (cont'd)						
222.12	Piping						
	Reactor Coolant						
	Pipe and fittings including shop fabrication-Stainless steel	(M				1,945,000	
	Valves	(M	None			-	
	Hangers and supports	(M	Allowance			75,000	
	Miscellaneous piping materials	(M				10,000	
	Erection, welding, testing and cleaning	(L				900,000	
		(M				50,000	
	Preheating and stress relieving	(L	None			-	
		(M				-	
	Radiographing	(L				5,000	
		(M				15,000	
		(L				905,000	
		(M				2,095,000	
222.12	Pressure Surge Line and Pressurizer Relief Line						
	Stainless steel pipe & fittings fabricated	(M				167,000	
	Control and relief valves	(M				139,000	
	Hangers and supports	(M				5,000	
	Installation and Welding	(L				70,000	
		(M				5,000	
		(L				70,000	
		(M				316,000	
	Total Piping	(L				975,000	
		(M				2,411,000	
222.11	Insulation						
222.13	Equipment insulation	(L				50,000	
222.14		(M				40,000	
222.12	Piping insulation	(L				25,000	
		(M				20,000	
		(L				75,000	
		(M				60,000	
	Total Reactor Coolant System,-	(L				2,426,500	
		(M				20,887,500	23,314,000

Date: ______________

ESTIMATE OF COST
FOR
1000 MW PWR POWER PLANT

ACCT. NO.	DESCRIPTION		QUANTITY	UNIT	RATES	AMOUNTS	TOTALS
22.	REACTOR PLANT EQUIPMENT (cont'd)					$	$
223.	Safeguards Cooling Systems						
223.1	Residual Heat Removal System						
223.111	Residual heat removal pumps - 3000 gpm @ 350 FTDH/350 hp motor drives	(M	2	@		28,000	
	Installation	(L				15,000	
		(M				500	
223.121	Residual heat removal heat exchangers	(M	2	@		100,000	
	Installation	(L	15	ton		7,500	
		(M				500	
223.14	Piping connections including pipe, fittings, fabrication, valves, hangers, erection,	(L				250,000	
	welding, testing, etc.	(M				153,000	
223.15	Insulation						
	Equipment and piping	(L				11,000	
		(M				10,500	
		(L				283,500	
		(M				292,500	576,000
223.3	Safety Injection System						
223.311	Safety injection pumps- 400 gpm @ 2500 FTDH 1350 hp motors	(M	3	@		50,000	
	Installation	(L				15,000	
		(M				500	
223.312	Recirculation pumps- 3000 gpm @ 350 FTDH/ 400 hp motors	(M	2	@		66,700	
	Installation	(L				10,000	
		(M				300	
223.331	Accumulator tanks- 10'-0"Ø x 14'-0"(±)	(M	4	@		111,000	
	Installation	(L	125	ton		20,000	
		(M				2,000	
223.332	Boron injection tank- 6'-6"Ø x 13'-6"(±)	(M	1			11,000	
	Installation	(L				3,000	
		(M				300	

ESTIMATE OF COST
FOR
1000 MW PWR POWER PLANT

ACCT. NO.	DESCRIPTION		QUANTITY	UNIT	RATES	AMOUNTS	TOTALS
						$	$
22.	REACTOR PLANT EQUIPMENT (cont'd)						
223.	Safeguards Cooling Systems (cont'd)						
223.34	Piping connections including pipe, fittings, fabrication, valves, hangers, erection,	(L				800,000	
	welding, testing, etc.	(M				778,000	
		(L				848,000	
		(M				1,019,800	1,867,800
223.4	Containment Heat Absorption/ Rejection Systems						
223.471	Containment spray pumps- 2600 gpm @ 450 FTDH/ 350 hp motors	(M	2	@		33,000	
	Installation	(L				10,000	
		(M				300	
223.473	Spray additive tank- 8'-0"Ø x 16'-0" ±	(M	1	@		33,000	
	Installation	(L				3,000	
		(M				200	
223.474	Piping connections including pipe, fittings, fabrication, valves, hangers, spray nozzles, erection, weld-	(L				335,000	
	ing, testing, etc.	(M				363,000	
		(L				348,000	
		(M				429,500	777,500
	Total Safeguards	(L				1,479,500	
	Cooling Systems,-	(M				1,741,800	3,221,300

Date: ____________

ESTIMATE OF COST
FOR
1000 MW PWR POWER PLANT

ACCT. NO.	DESCRIPTION		QUANTITY	UNIT	RATES	AMOUNTS	TOTALS
22.	REACTOR PLANT EQUIPMENT (cont'd)					$	$
224.	Radioactive Waste Treatment and Disposal Systems						
224.1	Liquid Waste Processing Equipment						
224.111	Waste Hold-up tank- 12'-0"Ø x 33'-6"L	(M	1			52,000	
	Installation	(L				2,500	
		(M				500	
224.112	Spent resin storage tank- 7'-0"Ø x 12'-0"H x 13'-6"O.A.	(M	1			13,000	
	Installation	(L				1,200	
		(M				100	
224.113	Reactor coolant drain tank- 3'-0"Ø x 6'-0"O.A.	(M	1			9,700	
	Installation	(L				600	
		(M				50	
224.114	Chemical drain tank- 7'-6"Ø x 9'-0"H	(M	1			6,500	
	Installation	(L				600	
		(M				50	
224.115	Sump tank- 4'-0" x 7'-6"	(M	1			2,500	
	Installation	(L				700	
		(M				50	
224.116	Caustic mix regenerant tank-	(M	1			2,000	
	Installation	(L				500	
		(M				50	
224.117	Waste condensate tank-	(M	1			3,900	
	Installation	(L				500	
		(M				50	
224.121	Waste Condensate pumps and motors	(M	2	@		2,600	
	Installation	(L				500	
		(M				100	
224.122	Reactor coolant drain tank pumps and motors	(M	2	@		6,500	
	Installation	(L				3,500	
		(M				300	
224.123	Containment sump pump and motor	(M	1	@		6,500	
	Installation	(L				1,000	
		(M				100	
224.124	Sump tank pumps and motors	(M	2	@		5,000	
	Installation	(L				1,500	
		(M				100	
224.125	Chemical drain tank pumps and motors	(M	2	@		6,500	
	Installation	(L				1,500	
		(M				100	

ESTIMATE OF COST
FOR
1000 MW PWR POWER PLANT

ACCT. NO.	DESCRIPTION		QUANTITY	UNIT	RATES	AMOUNTS	TOTALS
22.	REACTOR PLANT EQUIPMENT (cont'd)					$	$
224.	Radioactive Waste Treatment and Disposal Systems (cont'd)						
224.127	Regenerant pump and motor	(M	1			2,000	
	Installation	(L				500	
		(M				50	
224.129	Primary make-up pumps and motors	(M	2	@		2,500	
	Installation	(L				1,000	
		(M				100	
224.141	Waste evaporator package	(M				204,100	
	Installation	(L				17,500	
		(M				2,700	
224.17	Piping connections including pipe, fittings, fabrication, valves, hangers, erection,	(L				240,000	
	welding, testing, etc.	(M				75,000	
224.18	Insulation for piping	(L				15,000	
	and equipment	(M				10,000	
		(L				288,600	
		(M				413,700	702,300
224.2	Gaseous Waste Processing Equipment						
224.21	Gas decay tanks- 2'-6"Ø x 7'-0"H x 10'-0"O.A.	(M	6	@		12,300	
	7'-0"Ø x 15'-0"O.A.	(M	4	@		43,200	
	Installation	(L	10	@		15,000	
		(M				1,000	
224.25	Waste gas compressors and motors	(M	2	@		49,300	
	Installation	(L				5,000	
		(M				500	
224.26	Gas Analyser	(M				6,200	
	Installation	(L				500	
		(M				50	
224.28	Piping including by-pass from condenser vacuum	(L				56,500	
	piping system	(M				26,000	
		(L				77,000	
		(M				138,550	215,550

ACCT. NO.	DESCRIPTION		QUANTITY	UNIT	RATES	AMOUNTS	TOTALS
22.	REACTOR PLANT EQUIPMENT (cont'd)					$	$
224.	Radioactive Waste Treatment and Disposal Systems (cont'd)						
224.3	Solid Waste Processing Equipment						
224.35	Hydraulic baler	(M	1			11,100	
	Installation	(L				2,500	
		(M				500	
224.37	Drumming station equipment	(M				50,000	
	Installation	(L				10,000	
		(M				1,000	
		(L				12,500	
		(M				62,600	75,100
	Total Radioactive Waste Treatment	(L				378,100	
	and Disposal,-	(M				614,850	992,950

ACCT. NO.	DESCRIPTION		QUANTITY	UNIT	RATES	AMOUNTS	TOTALS
						$	$
22.	REACTOR PLANT EQUIPMENT (cont'd)						
225.	Nuclear Fuel Handling and Storage Systems						
225.1	Fuel Handling Tools and Equipment						
225.11	Fuel handling building bridge crane - 40 ton capacity	(M	1			60,000	
	Erection	(L				15,000	
		(M				1,000	
225.12	Fuel handling tools and accessories	(M	Allowance			55,600	
	Handling and storing	(L				1,000	
		(M				500	
225.13	Fuel transfer chute from reactor cavity to fuel storage pool including pipe, valves, handling mechanisms, etc.	(M	1	Lot		55,600	
	Installation	(L				45,000	
		(M				20,000	
		(L				61,000	
		(M				192,700	253,700
225.2	Remote Viewing Equipment						
	Television, optical systems,					-	
	special lighting, etc.	(M	(Not Included)			-	None
225.3	Service Platforms and Equipment						
225.31	Reactor cavity manipulator crane	(M	1			55,600	
	Erection	(L				12,000	
		(M				1,000	
225.32	Spent fuel storage pool manipulator crane and platform	(M	1			55,600	
	Erection	(L				15,000	
		(M				1,000	
		(L				27,000	
		(M				113,200	140,200
225.4	Fuel Storage, Cleaning and Inspection Equipment						
225.41	New fuel storage racks &						
225.42	Spent fuel storage racks	(M				216,700	
	Installation	(L				75,000	
		(M				5,000	

Date: ____________

ESTIMATE OF COST
FOR
1000 MW PWR POWER PLANT

ACCT. NO.	DESCRIPTION		QUANTITY	UNIT	RATES	AMOUNTS	TOTALS
22.	REACTOR PLANT EQUIPMENT (cont'd)					$	$
225.	Nuclear Fuel Handling and Storage Systems (cont'd)						
225.4311	Spent fuel pit pump- 2300 gpm @ 150 FTDH/ 75 hp motor	(M	1			7,200	
	Installation	(L				4,000	
		(M				300	
225.4312	Spent fuel pit skimmer pump and motor	(M	1			2,800	
	Installation	(L				2,000	
		(M				200	
225.432	Spent fuel pit heat exchanger	(M	1			27,800	
	Installation	(L	4	Ton		2,500	
		(M				200	
225.433	Spent fuel pit demineralizer- 2'-8"Ø x 11'-6"H	(M	1			8,300	
	Installation	(L				600	
		(M				50	
225.434	Spent fuel pit filter, skimmer & strainer	(M	1	Lot		1,700	
	Installation	(L				1,200	
		(M				100	
225.436	Piping connections including pipe, fittings, fabrication, valves, hangers, erection,	(L				325,000	
	welding, testing, etc.	(M				287,800	
	Insulation	(L				7,500	
		(M				7,500	
225.4371	Refueling water storage tank - 350,000 gallon	(L				25,000	
	capacity	(M				40,000	
	Foundation	(L				30,000	
		(M				10,000	
225.4372	Refueling water purification pump	(M	1			2,200	
	Installation	(L				500	
		(M				100	
225.45	Spent fuel pit under-	(L				25,000	
	water lighting system	(M				25,000	
		(L				498,300	
		(M				642,950	1,141,250

Date: ______________

ESTIMATE OF COST FOR 1000 MW PWR POWER PLANT

ACCT. NO.	DESCRIPTION		QUANTITY	UNIT	RATES	AMOUNTS	TOTALS
						$	$
22.	REACTOR PLANT EQUIPMENT (cont'd)						
225.	Nuclear Fuel Handling and Storage Systems (cont'd)						
225.5	Fuel Shipping Containers Shipping containers are not included as a part of this estimate	(L (M	Not Included			- -	None
	Total Nuclear Fuel Handling and Storage Systems,-	(L (M				586,300 948,850	1,535,150

Date: ______________

ESTIMATE OF COST
FOR
1000 MW PWR POWER PLANT

ACCT. NO.	DESCRIPTION		QUANTITY	UNIT	RATES	AMOUNTS	TOTALS
22.	REACTOR PLANT EQUIPMENT (cont'd)					$	$
226.	Other Reactor Plant Equipment						
226.1	Nitrogen and Hydrogen Gas Systems						
226.112	Nitrogen storage tanks	(M				30,000	
	Hydrogen storage tanks	(M				15,000	
	Installation	(L				8,000	
		(M				250	
226.115	Distribution piping	(L				25,000	
		(M				10,000	
		(L				33,000	
		(M				55,250	88,250
226.4	Coolant Charging and Volume Control System						
226.421	Volume control tank- 7'-6"Ø x 10'-0"±H x 12'-0"O.A.	(M	1			13,300	
	Installation	(L				1,000	
		(M				100	
226.422	Charging pumps- 98 gpm @ 3000 psi/ 250 hp motors	(M	3			166,700	
	Installation	(L				22,500	
		(M				1,500	
226.423	Piping connections	(L				165,000	
		(M				235,000	
		(L				188,500	
		(M				416,600	605,100
226.5	Coolant Purification and Chemical Treatment Systems						
226.5211	Gas stripper feed pumps and motors	(M	2	@		1,700	
	Installation	(L				1,000	
		(M				100	
226.5212	Monitor tank pumps and motors	(M	3	@		8,300	
	Installation	(L				3,500	
		(M				300	
226.5213	Hold-up Tank recirculation pump and motor	(M	1	@		5,600	
	Installation	(L				1,000	
		(M				100	
226.5214	Concentrate holding tank transfer pumps and motors	(M	2	@		1,700	
	Installation	(L				700	
		(M				50	

ACCT. NO.	DESCRIPTION		QUANTITY	UNIT	RATES	AMOUNTS	TOTALS
						$	$
22.	REACTOR PLANT EQUIPMENT (cont'd)						
226.	Other Reactor Plant Equipment (cont'd)						
226.5215	Boric acid pumps- 80 gpm @ 190 FTDH/ 15 hp motors	(M	2	@		3,300	
	Installation	(L				2,000	
		(M				200	
226.5216	Sump pumps and motor drives, etc.	(M	3	@		6,700	
	Installation	(L				3,000	
		(M				300	
226.5221	Boric acid tanks- 12'-0"Ø x 14'-0"H	(M	2	@		55,500	
	Installation	(L				5,000	
		(M				250	
226.5222	Boric acid batch tank- 4'-0"Ø x 11'-0"H & scale	(M	1			6,200	
	Installation	(L				500	
		(M				50	
226.5223	Chemical mixing tank- 4"Ø x 3'-0"L	(M	1			1,100	
	Installation	(L				500	
		(M				50	
226.5224	Resin fill tank-conical 36"Ø x 6'-0"O.A.	(M	1			1,100	
	Installation	(L				500	
		(M				50	
226.5225	Hold-up tanks- 13'-0"Ø x 66'-6"L	(M	3	@		305,500	
	Installation	(L				9,000	
		(M				500	
226.5226	Monitor tanks- 8'-6"Ø x 23'-0"L	(M	3	@		55,500	
	Installation	(L				7,500	
		(M				500	
226.5227	Concentrates holding tank- 4'-6"Ø x 9'-6"H	(M	1			3,900	
	Installation	(L				1,500	
		(M				150	
226.5228	Primary water storage tank - 165,000 gallon	(L				15,000	
		(M				50,000	
	Foundation	(L				40,000	
		(M				15,000	
226.5229	Piping connections including pipe, fittings, fabrication, hangers, erection, welding, testing, etc.	(L				800,000	
		(M				555,400	
226.5229	Insulation for piping and equipment	(L				51,500	
		(M				34,500	

ACCT. NO.	DESCRIPTION		QUANTITY	UNIT	RATES	AMOUNTS	TOTALS
22.	REACTOR PLANT EQUIPMENT (cont'd)					$	$
226.	Other Reactor Plant Equipment (cont'd)						
226.5231	Regenerative heat exchangers	(M	2	@		50,000	
	Installation	(L				3,000	
		(M				200	
226.5232	Non-regenerative heat exchanger- 24"Ø x 18'-0"L	(M	1			16,700	
	Installation	(L				1,500	
		(M				100	
226.5233	Excess letdown heat exchanger	(M	1			8,300	
	Installation	(L				1,000	
		(M				100	
226.5241	Mixed bed demineralizers- 2'-8"Ø x 11'-6"H	(M	2	@		16,700	
	Installation	(L				1,200	
		(M				100	
226.5242	Deborating demineralizers- 2'-8"Ø x 11'-6"H	(M	2	@		16,700	
	Installation	(L				1,200	
		(M				150	
226.5243	Base removal ion exchanger	(M	1			3,900	
	Installation	(L				600	
		(M				50	
226.5244	Cation removal ion exchangers	(M	2	@		7,800	
	Installation	(L				1,200	
		(M				100	
226.5245	Evaporator condensate demineralizers- 20"Ø x 9'-0"H x 11'-6"O.A.	(M	2	@		11,100	
	Installation	(L				1,000	
		(M				100	
226.525	Reactor coolant, seal water, boric acid and evaporator condensate filters	(M	7	@		9,400	
	Installation	(L				1,500	
		(M				150	
226.527	Boric acid evaporator packages	(M	2	@		333,200	
	Installation	(L				30,000	
		(M				5,000	
226.5281	Sample heat exchangers	(M	7	@		3,900	
	Installation	(L				1,500	
		(M				100	
226.5282	Sample vessels	(M	4	@		2,200	
	Installation	(L	(Portable)			-	
226.5283	Sample sink and hood	(M	1			5,600	
	Installation	(L				3,000	
		(M				1,000	

Date: ___________

ESTIMATE OF COST
FOR
1000 MW PWR POWER PLANT

ACCT. NO.	DESCRIPTION		QUANTITY	UNIT	RATES	AMOUNTS	TOTALS
22.	REACTOR PLANT EQUIPMENT (cont'd)					$	$
226.	Other Reactor Plant Equipment (cont'd)						
226.5291	Blowdown Tank-						
	7'-6"Ø x 12' High	(M				5,600	
	Installation	(L				1,000	
		(M				100	
		(L				989,900	
		(M				1,611,950	2,601,850
226.7	Auxiliaries Cooling Systems						
226.711	Component cooling pumps						
	3600 gpm @ 220 FTDH/						
	150 hp motors	(M	3	@		27,800	
	Installation	(L				20,000	
		(M				500	
226.712	Auxiliary component cooling						
	pumps 80 gpm @ 100 FTDH/	(M	2	@		3,300	
	Installation	(L				2,000	
		(M				200	
226.721	Component cooling surge tanks	(M	2	@		16,700	
	Installation	(L				2,500	
		(M				500	
226.761	Component cooling heat						
	exchangers	(M	2	@		238,900	
	Installation	(L				15,000	
		(M				1,000	
226.762	Main coolant pump seal water						
	heat exchanger	(M	1			11,100	
	Installation	(L				1,000	
		(M				100	
226.731	Piping connections	(L				575,000	
		(M				332,500	
226.741	Insulation for piping	(L				10,000	
	and equipment	(M				10,000	
		(L				625,500	
		(M				642,600	1,268,100

ACCT. NO.	DESCRIPTION		QUANTITY	UNIT	RATES	AMOUNTS	TOTALS
22.	REACTOR PLANT EQUIPMENT (cont'd)					$	$
226.	Other Reactor Plant Equipment (cont'd)						
226.9	Miscellaneous Suspense Items						
226.91	Final Alignment and Checking						
	Allowance for miscellaneous checking and adjusting of equipment after initial rotation tests. (This item shall be used as a suspense account. Cost of work should be charged to equipment benefited and this allowance	(L	Allowance			450,000	
	reduced a like amount)	(M				25,000	
226.92	Field Painting						
	Allowance for painting of all reactor plant	(L	Allowance			100,000	
	equipment and piping	(M				25,000	
226.93	Qualification of Welders						
	Cost of qualifying welders	(L				50,000	
	and welding procedure	(M				20,000	
226.94	Preliminary Operating						
	Allowance for stand-by craft labor and expense	(L				300,000	
	during plant start-up	(M				15,000	
		(L				900,000	
		(M				85,000	985,000
	Total Other Reactor	(L				2,736,900	
	Plant Equipment,-	(M				2,811,400	5,548,300

ESTIMATE OF COST
FOR
1000 MW PWR POWER PLANT

ACCT. NO.	DESCRIPTION		QUANTITY	UNIT	RATES	AMOUNTS	TOTALS
22.	REACTOR PLANT EQUIPMENT (cont'd)					$	$
227.	Instruments and Controls						
227.1	Nuclear Plant Instruments						
	All flow, temperature and pressure indicating, recording and controlling instrumentation including control valves, panels (piped and wired to terminal blocks), etc. for the following systems:						
	Reactor plant control						
	Heat transfer						
	Fuel handling system						
	Radioactive waste system						
	Radiation monitoring						
	Steam generators						
	In-core instrumentation						
	Other nuclear systems instrumentation.						
	Purchase cost of above	(M				2,200,000	
	Installation	(L				250,000	
		(M				30,000	
		(L				250,000	
		(M				2,230,000	2,480,000
227.2	Computer Equipment						
	For complete plant	(L	Allowance			100,000	
		(M				1,584,700	1,684,700
227.3	Monitoring Systems						
227.38	Containment Leakage Monitoring System						
	Penetration pressurization system-						
	Gauges, valves, pressure	(L				10,000	
	switches, etc.	(M				70,000	
	Pipe, fittings, tubing,	(L				225,000	
	hangers, supports, etc.	(M				50,000	
	Instrument racks	(L				10,000	
		(M				5,000	
	Air manifold tanks	(L	4	@		5,000	
		(M				13,000	
	Nitrogen bottles,	(L				5,000	
	manifold, etc.	(M				15,000	
		(L				255,000	
		(M				153,000	408,000

Date: ____________

ESTIMATE OF COST
FOR
1000 MW PWR POWER PLANT

ACCT. NO.	DESCRIPTION		QUANTITY	UNIT	RATES	AMOUNTS	TOTALS
22.	REACTOR PLANT EQUIPMENT (cont'd)					$	$
227.	Instruments and Controls (cont'd)						
227.5	Instrument and Control Piping						
227.51	Instrument and control piping connections for nuclear	(L				450,000	
	plant instrumentation	(M				260,000	710,000
	Total Instruments	(L				1,055,000	
	and Controls,-	(M				4,227,700	5,282,700
	Total Reactor Plant	(L				9,388,300	
	Equipment,-	(M				45,084,100	54,472,400

ACCT. NO.	DESCRIPTION		QUANTITY	UNIT	RATES	AMOUNTS	TOTALS
23.	TURBINE PLANT EQUIPMENT					$	$
231.	Turbine Generator Equipment						
231.1	Turbine-Generator 1,065,786 KWe tandem compound, six flow, 1800 rpm unit with 44 inch last row blades, designed for throttle steam at 960 psia, with moisture separation and 2 stage reheating at the crossover point with a 1184 MVA, 22,000 volt, 0.9 PF, 75 psig hydrogen cooled generator, complete with hydrogen and lube oil systems, seal oil system, stop-throttle valves and piping, reheaters and moisture separators, cross-over piping, motors for auxiliary equipment, heat insulation for turbine, and reheater equipment, etc.	(M				29,950,000	
	Erection of above	(L				2,000,000	
		(M				200,000	
		(L				2,000,000	
		(M				30,150,000	32,150,000
231.2	Foundation and Supports						
231.211	Turbine-Generator Foundation Mat						
231.2111	Excavation - earth	(L	3,000	cu yd	4.00	12,000	
		(M			1.00	3,000	
231.2112	Concrete fill	(L	1,000	cu yd	15.00	15,000	
		(M			25.00	25,000	
231.2113	Dewatering	(L	Included	with		-	
		(M	"Turbine	Room"		-	
231.2114	Forms	(L	6,600	sq ft	5.00	33,000	
		(M			.50	3,300	
231.2115	Reinforcing steel	(L	120	ton	250.00	30,000	
		(M			150.00	18,000	
231.2116	Concrete	(L	2,000	cu yd	6.00	12,000	
		(M			20.00	40,000	
231.2119	Miscellaneous iron	(L	12	ton	1500.00	18,000	
		(M			500.00	6,000	
		(L				120,000	
		(M				95,300	

ACCT. NO.	DESCRIPTION		QUANTITY	UNIT	RATES	AMOUNTS	TOTALS
23.	TURBINE PLANT EQUIPMENT (cont'd)					$	$
231.	Turbine Generator Equipment (cont'd)						
231.212	Turbine-Generator Support Reinforced concrete structure above foundation mat.						
231.2124	Forms	(L	35,000	sq ft	6.00	210,000	
		(M			1.00	35,000	
231.2125	Reinforcing steel	(L	380	ton	300.00	114,000	
	(Field fabricated)	(M			150.00	57,000	
231.2126	Concrete	(L	3,200	cu yd	20.00	64,000	
		(M			20.00	64,000	
231.2127	Rubbing Surfaces	(L	30,000	sq ft	.20	6,000	
		(M			.02	600	
231.2128	Expansion joint	(L				2,500	
		(M				2,600	
231.2129	Miscellaneous iron	(L	50	ton	1500.00	75,000	
		(M			600.00	30,000	
		(L				471,500	
		(M				189,200	
	Reheater and Moisture Separator Supports						
231.221	Structural steel supports above turbine room	(L				25,000	
	operating floor	(M				25,000	
	Total Foundations &	(L				616,500	
	supports	(M				309,500	926,000
231.4	Lubricating Oil System						
231.411	Lube oil purification unit and accessories	(M				13,500	
	Installation	(L				7,500	
		(M				1,500	
231.412	Lube oil transfer pump and motor	(M				1,800	
	Installation	(L				1,000	
		(M				200	
231.421	Clean and dirty oil storage tanks	(M				23,500	
	Installation including	(L				12,500	
	foundations, etc.	(M				9,500	
231.422	Interconnecting piping between equipment oil reservoirs and oil	(L				75,000	
	purification equipment	(M				50,000	

ESTIMATE OF COST
FOR
1000 MW PWR POWER PLANT

ACCT. NO.	DESCRIPTION		QUANTITY	UNIT	RATES	AMOUNTS	TOTALS
						$	$
23.	TURBINE PLANT EQUIPMENT (cont'd)						
231.	Turbine Generator Equipment (cont'd)						
231.431	Automatic spray system for fire protection at lube oil and hydrogen	(L				20,000	
	areas	(M				15,000	
231.45	Initial oil supply	(M				25,000	
		(L				116,000	
		(M				140,000	256,000
231.5	Gas Systems						
	Hydrogen and CO_2 Equipment						
231.511	Hydrogen and CO_2 bottle	(L				15,000	
	storage racks	(M				50,000	
231.512	Manifolds at bottle storage racks and piping to turbine-generator	(L				30,000	
	area	(M				17,000	
		(L				45,000	
		(M				67,000	112,000
	Total Turbine-	(L				2,777,500	
	Generators,-	(M				30,666,500	33,444,000

ACCT. NO.	DESCRIPTION		QUANTITY	UNIT	RATES	AMOUNTS	TOTALS
23.	TURBINE PLANT EQUIPMENT (cont'd)					$	$
232.	Circulating Water System						
232.1	Water Intake Facilities						
232.11	Traveling screens- 6-12' wide & 1-6' wide	(M	7	@		180,000	
	Installation	(L				100,000	
		(M				10,000	
232.131	Trash racks (coarse screens)	(M	5,000	sq ft	11.00	55,000	
	Installation	(L				10,000	
		(M				5,000	
232.132	Trash rake	(M	1			23,500	
	Installation	(L				5,000	
		(M				1,500	
232.133	Fine screens	(M				9,000	
	Installation	(L				2,500	
		(M				500	
232.15	Water chlorination equipment and piping	(M				30,000	
	Installation	(L				15,000	
		(M				5,000	
232.161	Sluice gates for service water by-pass	(M	2			14,000	
	Installation	(L				3,000	
		(M				1,000	
232.162	Stop logs	(L				20,000	
		(M				10,000	
		(L				155,500	
		(M				344,500	500,000
232.211	Pumps and Drives						
232.2111	Circulating water pumps- 125,000 gpm @ 21 FTDH	(M	6			600,000	
	Motor drives - 900 hp	(M	6			250,000	
	Installation of pumps	(L				65,000	
	and motors	(M				5,000	
232.2112	De-icing water supply pumps	(M	2			70,000	
	Motor drives - 400 hp	(M	2			15,000	
	Priming ejectors	(M	2			1,000	
	Installation of above	(L				15,000	
		(M				1,500	
		(L				80,000	
		(M				942,500	1,022,500

Date: ____________

ESTIMATE OF COST
FOR
1000 MW PWR POWER PLANT

ACCT. NO.	DESCRIPTION		QUANTITY	UNIT	RATES	AMOUNTS	TOTALS
23.	TURBINE PLANT EQUIPMENT (cont'd)					$	$
232.	Circulating Water System (cont'd)						
232.212	Intake and Discharge Lines Connections from pump discharges to condenser inlets and from condenser outlets to discharge tunnel						
	Steel pipe and fittings	(L	310	ton	500.00	155,000	
		(M			600.00	186,000	
	Expansion joints	(L	18	@	1000.00	18,000	
		(M			1500.00	27,000	
	Steel supports including	(L	50	ton	600.00	30,000	
	H-piles, etc.	(M			250.00	12,500	
	Earth excavation	(L	3,500	cu yd	4.00	14,000	
		(M			1.00	3,500	
	Rock excavation	(L	3,000	cu yd	25.00	75,000	
		(M			5.00	15,000	
	Backfill	(L	6,000	cu yd	2.50	15,000	
		(M			1.00	6,000	
	Dewatering	(L	Allowance			25,000	
		(M				10,000	
	Formwork	(L	25,000	sq ft	4.00	100,000	
		(M			.50	12,500	
	Reinforcing steel	(L	120	ton	300.00	36,000	
		(M			140.00	16,800	
	Concrete	(L	1,500	cu yd	12.00	18,000	
		(M			20.00	30,000	
	Insulation	(L				12,000	
		(M				8,000	
		(L				498,000	
		(M				327,300	825,300
232.213	Warming Line Connections from de-icing pumps discharge to outlets at screenwells						
	Steel pipe and fittings	(L	80	ton	500.00	40,000	
		(M			600.00	48,000	
	Expansion joints - 60"x54"	(L	4	@	500.00	2,000	
		(M			1000.00	4,000	
	Steel supports	(L	10	ton	600.00	6,000	
		(M			250.00	2,500	
	Earth excavation	(L	1,000	cu yd	5.00	5,000	
		(M			1.00	1,000	
	Backfill	(L	1,000	cu yd	2.50	2,500	
		(M			1.00	1,000	

ACCT. NO.	DESCRIPTION		QUANTITY	UNIT	RATES	AMOUNTS	TOTALS
23.	TURBINE PLANT EQUIPMENT (cont'd)					$	$
232.	Circulating Water System (cont'd)						
232.213	Warming Line (cont'd)						
	Dewatering	(L				5,000	
		(M				2,000	
	Formwork	(L	1,000	sq ft	4.00	4,000	
		(M			.50	500	
	Reinforcing steel	(L	10,000	lb	.20	2,000	
		(M			.08	800	
	Concrete	(L	70	cu yd	20.00	1,400	
		(M			20.00	1,400	
	Anchors	(L				1,000	
		(M				600	
		(L				68,900	
		(M				61,800	130,700
232.221	Discharge Tunnel Includes tunnel below turbine room floor and connection to discharge canal						
	Earth excavation	(L	2,500	cu yd	4.00	10,000	
		(M			1.00	2,500	
	Rock excavation	(L	4,000	cu yd	25.00	100,000	
		(M			5.00	20,000	
	Backfill	(L	1,000	cu yd	3.00	3,000	
		(M			2.00	2,000	
	Dewatering	(L	Allowance			45,000	
		(M				5,000	
	Formwork	(L	40,000	sq ft	4.00	160,000	
		(M			.50	20,000	
	Reinforcing steel	(L	200	ton	300.00	60,000	
		(M			140.00	28,000	
	Concrete including	(L	2,200	cu yd	12.50	27,500	
	finish	(M			20.00	44,000	
	Miscellaneous iron	(L	20	ton	1000.00	20,000	
		(M			500.00	10,000	
	Granite wear slabs	(L	1,500	sq ft	4.00	6,000	
		(M			6.00	9,000	
	Stop logs	(L				10,000	
		(M				25,000	
	Adjustable weir	(L				10,000	
		(M				60,000	
		(L				451,500	
		(M				225,500	677,000

Date: ____________

ESTIMATE OF COST
FOR
1000 MW PWR POWER PLANT

ACCT. NO.	DESCRIPTION		QUANTITY	UNIT	RATES	AMOUNTS	TOTALS
23.	TURBINE PLANT EQUIPMENT (cont'd)					$	$
232.	Circulating Water System (cont'd)						
232.222	Discharge Canal Extension of discharge tunnel from turbine room wall to river						
	Excavation Work (Also includes excavation work for deicing pump pit)						
	Earth excavation	(L	5,000	cu yd	3.00	15,000	
		(M			1.00	5,000	
	Rock excavation	(L	8,000	cu yd	25.00	200,000	
		(M			5.00	40,000	
	Backfill	(L	10,000	cu yd	2.50	25,000	
		(M			1.50	15,000	
	Temporary sheet pile	(L				20,000	
	cut-off walls	(M				10,000	
	Stop logs	(L	Allowance			15,000	
		(M				15,000	
	Pumping	(L	Allowance			100,000	
		(M				15,000	
	Rip-rap on bank and	(L				15,000	
	bottom of canal	(M				35,000	
		(L				390,000	
		(M				135,000	
	Concrete Work						
	Formwork	(L	50,000	sq ft	4.00	200,000	
		(M			.50	25,000	
	Reinforcing steel	(L	200	ton	350.00	70,000	
		(M			150.00	30,000	
	Concrete	(L	4,500	cu yd	10.00	45,000	
		(M			20.00	90,000	
	Miscellaneous iron	(L	Allowance			10,000	
		(M				5,000	
		(L				325,000	
		(M				150,000	
	Permanent Sheet Piling Flume						
	Steel sheeting	(L	700	ton	150.00	105,000	
		(M			200.00	140,000	
	Bracing	(L				40,000	
		(M				30,000	
	Protective coating	(L				30,000	
		(M				15,000	
		(L				175,000	
		(M				185,000	

ACCT. NO.	DESCRIPTION		QUANTITY	UNIT	RATES	AMOUNTS	TOTALS
23.	TURBINE PLANT EQUIPMENT (cont'd)					$	$
232.	Circulating Water System (cont'd)						
	Discharge Structure						
	Outfall facilities	(L	Allowance			50,000	
		(M				50,000	
	Total Discharge Canal,-	(L				940,000	
		(M				520,000	1,460,000
232.223	Deicing Pump Pit Structure (Excavation work is included with Discharge Canal)						
	Formwork	(L	12,000	sq ft	4.00	48,000	
		(M			.50	6,000	
	Reinforcing steel	(L	60	ton	300.00	18,000	
		(M			150.00	9,000	
	Concrete	(L	700	cu yd	10.00	7,000	
		(M			20.00	14,000	
	Miscellaneous iron,	(L	10,000	lbs	.50	5,000	
	hatch covers, etc.	(M			.30	3,000	
	Shut-off gates	(L	2	@		3,000	
	(sluice gates)	(M				13,000	
	Stop logs	(L	400	sq ft	5.00	2,000	
		(M			5.00	2,000	
		(L				83,000	
		(M				47,000	130,000
	Total Circulating	(L				2,276,900	
	Water System,-	(M				2,468,600	4,745,500

ACCT. NO.	DESCRIPTION		QUANTITY	UNIT	RATES	AMOUNTS	TOTALS
23.	TURBINE PLANT EQUIPMENT (cont'd)					$	$
233.	Condensing Systems						
233.1	Condensers						
233.11	204,000 sq. ft. surface, single pass condensers including shells, tube sheets, tubes, air ejectors, etc.	(M	3	@		2,900,000	
	Installation	(L				775,000	
		(M				25,000	
		(L				775,000	
		(M				2,925,000	3,700,000
233.2	Condensate System						
233.211	Condensate pumps- 6162 gpm @ 1150 FTDH	(M	3	@		200,000	
	2500 hp motors	(M				150,000	
	Installation of pumps	(L				35,000	
	and motors	(M				3,000	
233.221	Condensate storage tank 500,000 gallon capacity	(M	1			130,000	
	Field erection	(L				60,000	
		(M				5,000	
233.23	Condensate Piping						
	Includes all condensate piping from condenser through condensate pumps and heaters to boiler feed pump suction. Also includes makeup water connections						
	Pipe and fittings including shop fabrication	(M				400,000	
	Valves	(M				200,000	
	Hangers and supports	(M				75,000	
	Erection and welding including preheating and stress relief,	(L				1,650,000	
	etc.	(M				75,000	
	Radiographs	(L	None			-	
		(M				-	

Date: ____________

ESTIMATE OF COST
FOR
1000 MW PWR POWER PLANT

ACCT. NO.	DESCRIPTION		QUANTITY	UNIT	RATES	AMOUNTS	TOTALS
23.	TURBINE PLANT EQUIPMENT (cont'd)					$	$
233.	Condensing Systems (cont'd)						
233.24	Insulation						
		(L				40,000	
		(M				25,000	
233.25	Foundations and Supports						
233.251	Condensate pump	(L				15,000	
	foundations	(M				15,000	
233.252	Condensate storage	(L				20,000	
	tank foundation	(M				20,000	
	Total Condensate	(L				1,820,000	
	System,-	(M				1,298,000	3,118,000
233.3	Gas Removal System						
233.31	Steam jet air ejectors		(Included with Condenser)			-	
						-	
233.34	Condenser Air Removal Piping						
	Pipe and fittings including shop fabrication	(M				65,000	
	Valves	(M				15,000	
	Hangers and supports	(M				5,000	
	Erection and Welding	(L				180,000	
		(M				10,000	
233.35	Insulation						
		(L				3,000	
		(M				2,000	
	Total Gas Removal	(L				183,000	
	System,-	(M				97,000	280,000
	Total Condensing	(L				2,778,000	
	Systems,-	(M				4,320,000	7,098,000

ESTIMATE OF COST
FOR
1000 MW PWR POWER PLANT

ACCT. NO.	DESCRIPTION		QUANTITY	UNIT	RATES	AMOUNTS	TOTALS
23.	TURBINE PLANT EQUIPMENT (cont'd)					$	$
234.	Feedwater System						
234.1	Feedwater Heaters						
234.11	High and low pressure heaters						
	with integral drains coolers	(M				1,500,000	
	Installation	(L				100,000	
		(M				10,000	
234.13	Insulation	(L				30,000	
		(M				30,000	
		(L				130,000	
		(M				1,540,000	1,670,000
234.2	Feedwater Pumps						
234.21	Main feed pumps-						
	15590 gpm @ 3144 FTDH	(M	2	@		140,000	
	Turbine drives - 12,300 hp	(M	2	@		700,000	
	Installation of pumps	(L				75,000	
	and drives	(M				5,000	
234.22	Auxiliary feed pumps-	(M	3	@		60,000	
	Turbine drive	(M	1	@		18,000	
	Motor drives	(M	2	@		20,000	
	Installation of pumps	(L				25,000	
	and drives	(M				5,000	
234.231	Heater drain pumps	(M	2	@		120,000	
	Motor drives	(M	2	@		50,000	
	Installation of pumps	(L				15,000	
	and drives	(M				1,000	
234.232	Hotwell dump pump and motor	(M	1	@		3,000	
	Installation	(L				1,500	
		(M				200	
234.233	Drip tank drain pump						
	and motor	(M				1,600	
	Installation	(L				500	
		(M				100	
234.25	Foundations for pumps						
	including concrete work,						
	anchor bolts,	(L				10,000	
	etc.	(M				5,000	
234.26	Lube oil purification						
	equipment for feed						
	pumps and turbines	(M				5,300	
	Installation	(L				1,000	
		(M				200	
		(L				128,000	
		(M				1,134,400	1,262,400

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ACCT. NO.	DESCRIPTION		QUANTITY	UNIT	RATES	AMOUNTS	TOTALS
23.	TURBINE PLANT EQUIPMENT (cont'd)					$	$
234.	Feedwater System (cont'd)						
234.3	Piping and Tanks						
234.31	Feedwater Piping Includes piping from main feed pump discharge through high pressure heaters to steam generators						
	Pipe and fittings including shop fabrication	(M				375,000	
	Valves	(M				400,000	
	Hangers and supports	(M				200,000	
	Erection and welding including preheating,	(L				1,800,000	
	stress relief, etc.	(M				95,000	
	Radiographs	(L				20,000	
		(M				40,000	
		(L				1,820,000	
		(M				1,110,000	
234.341	Extraction Steam Piping Includes piping from turbine extraction points to heaters						
	Pipe and fittings including shop fabrication	(M				125,000	
	Valves	(M				115,000	
	Hangers and supports	(M				20,000	
	Erection and welding	(L				530,000	
		(M				50,000	
		(L				530,000	
		(M				310,000	
234.342	Heater Drain and Vent Piping Includes drains from heaters to condensers						
	Pipe and fittings including shop fabrication	(M				150,000	
	Valves	(M				225,000	
	Hangers and supports	(M				30,000	
	Erection and welding	(L				600,000	
		(M				30,000	
		(L				600,000	
		(M				435,000	

ACCT. NO.	DESCRIPTION		QUANTITY	UNIT	RATES	AMOUNTS	TOTALS
23.	TURBINE PLANT EQUIPMENT (cont'd)					$	$
234.	Feedwater System (cont'd)						
234.35	Insulation						
	Feedwater piping	(L				90,000	
		(M				60,000	
	Extraction steam	(L				40,000	
	piping	(M				25,000	
	Heater drain and	(L				60,000	
	vent piping	(M				40,000	
		(L				190,000	
		(M				120,000	
	Total Piping and Tanks,-	(L				3,140,000	
		(M				1,975,000	5,115,000
	Total Feedwater	(L				3,398,000	
	System,-	(M				4,649,400	8,047,400

ACCT. NO.	DESCRIPTION		QUANTITY	UNIT	RATES	AMOUNTS	TOTALS
23.	TURBINE PLANT EQUIPMENT (cont'd)					$	$
235.	Other Turbine Plant Equipment						
235.1	Main Vapor Piping						
235.11	Main Steam Piping						
	Includes main steam lines from steam generators to turbine stop valves; steam to reheaters; steam to feed pump turbines; steam dump system, etc.						
	Pipe and fittings including shop fabrication	(M				600,000	
	Valves	(M				450,000	
	Hangers and supports	(M				180,000	
	Erection and welding including preheating	(L				2,250,000	
	and stress relief, etc.	(M				100,000	
	Radiographs	(L				20,000	
		(M				40,000	
		(L				2,270,000	
		(M				1,370,000	
235.13	Insulation	(L				115,000	
		(M				85,000	
235.14	Pipe Supports from Containment Structure to Turbine Room						
	Foundations including excavation, forms, reinforcing, concrete,	(L				10,000	
	anchor bolts, etc.	(M				10,000	
	Structural steel and	(L				175,000	
	miscellaneous iron	(M				100,000	
		(L				185,000	
		(M				110,000	
	Total Main Vapor	(L				2,570,000	
	Piping,-	(M				1,565,000	4,135,000

ACCT. NO.	DESCRIPTION		QUANTITY	UNIT	RATES	AMOUNTS	TOTALS
23.	TURBINE PLANT EQUIPMENT (cont'd)					$	$
235.	Other Turbine Plant Equipment (cont'd)						
235.2	Turbine Auxiliaries						
235.221	Drains collecting tank	(M	1			11,500	
	Installation	(L				2,500	
		(M				500	
235.222	Moisture separator and reheater drain tanks	(M	8	@		19,500	
	Installation	(L				8,000	
		(M				500	
235.223	Heater drain tank	(M				9,500	
	Installation	(L				2,500	
		(M				500	
235.224	Miscellaneous tanks	(M				9,000	
	Installation	(L				10,000	
		(M				1,000	
235.241	Gland seal pumps and motors	(M	2	@		3,500	
	Installation	(L				1,500	
		(M				100	
235.251	Drip, drain and vent piping from turbine	(L				350,000	
	plant equipment, etc.	(M				165,000	
235.261	Insulation- Equipment	(L				15,000	
		(M				15,000	
	Piping	(L				10,000	
		(M				6,000	
235.27	Steel supports for tanks,	(L				10,000	
	etc.	(M				5,000	
	Total Turbine Auxiliaries,-	(L				409,500	
		(M				246,600	656,100
235.3	Auxiliaries Cooling System						
235.31	Closed cooling water system pumps and motors	(M	3	@		45,000	
	Installation	(L				15,000	
		(M				1,000	
235.321	Surge tank for closed cooling water system	(M				7,500	
	Installation	(L				1,000	
		(M				500	
235.322	Heat exchangers for closed cooling water system	(M	3	@		65,000	
	Installation	(L				10,000	
		(M				1,000	
235.33	Cooling Water Piping						
	Closed systems for cooling air compressors, sample coolers, condensate pump motor bearings, etc.						

ACCT. NO.	DESCRIPTION		QUANTITY	UNIT	RATES	AMOUNTS	TOTALS
23.	TURBINE PLANT EQUIPMENT (cont'd)					$	$
235.	Other Turbine Plant Equipment (cont'd)						
235.33	Cooling Water Piping (cont'd)						
	Pipe and fittings including shop fabrication	(M				180,000	
	Valves	(M				90,000	
	Hangers and supports	(M				30,000	
	Erection and welding	(L				305,000	
		(M				30,000	
235.34	Insulation						
	Piping system	(L				18,000	
		(M				12,000	
235.36	Chemical feed equipment	(M				1,400	
	Installation	(L				1,500	
		(M				100	
	Total Auxiliaries	(L				350,500	
	Cooling System,-	(M				463,500	814,000
235.4	Water Treatment System						
235.41	Water treating plant including pretreatment and demineralizer	(L	Allowance			250,000	
	facilities complete	(M				1,000,000	1,250,000
235.5	Chemical Treatment System						
235.51	Secondary chemical treatment for reactor feed-	(L	Allowance			10,000	
	water	(M				20,000	30,000
235.9	Miscellaneous Suspense Items						
235.92	Field painting of turbine plant equipment	(L				100,000	
	and piping	(M				25,000	
235.93	Qualification of welders	(L				50,000	
	and welding procedure	(M				15,000	
235.94	Stand-by craft labor and expense during plant	(L				300,000	
	start-up	(M				10,000	
		(L				450,000	
		(M				50,000	500,000
	Total Other Turbine	(L				4,040,000	
	Plant Equipment,-	(M				3,345,100	7,385,100

ACCT. NO.	DESCRIPTION		QUANTITY	UNIT	RATES	AMOUNTS	TOTALS
						$	$
23.	TURBINE PLANT EQUIPMENT (cont'd)						
236.	Instrumentation and Control						
236.1	Turbine Plant Instruments Main control panels with instruments piped and wired to terminal blocks Local control boards with instruments piped and wired to terminal blocks Control systems for process and auxiliary systems in turbine plant						
	Purchase cost of above	(M	Allowance			785,000	
	Installation	(L				150,000	
		(M				15,000	
		(L				150,000	
		(M				800,000	950,000
236.4	Instrument and Control Piping Instrument and control piping for turbine	(L				500,000	
	plant instruments	(M				175,000	675,000
	Total Instrumentation	(L				650,000	
	and Control,-	(M				975,000	1,625,000
	Total Turbine Plant	(L				15,920,400	
	Equipment,-	(M				46,424,600	62,345,000

ACCT. NO.	DESCRIPTION		QUANTITY	UNIT	RATES	AMOUNTS	TOTALS
24.	ELECTRIC PLANT EQUIPMENT					$	$
241.	Switchgear						
241.1	Generator Equipment Switchgear						
241.12	Neutral grounding compartment including transformer, resistor, etc.	(M	Included	with "Unit"			
	Installation	(L				2,000	
		(M				100	
241.131	Bushing type current transformers - 4 sets	(M	Included	with "Unit"			
	Installation	(L				3,500	
		(M				100	
241.132	Potential transformers, fuses, etc.	(M	6	@		15,000	
	Installation	(L				2,500	
		(M				100	
241.15	Exciter switchgear	(M	Included	with "Unit"			
	Installation	(L				3,000	
		(M				500	
		(L				11,000	
		(M				15,800	26,800
241.2	Station Service Switchgear						
241.21	6900 Volt switchgear- metal clad, indoor type, consisting of 19 feeder breakers, 8 transformer and 8 incoming line breakers, 4 bus-tie breakers and 6 PT compartments	(M	37	unit		700,000	
	Installation	(L				70,000	
		(M				5,000	
241.22	480 Volt motor control centers	(M	10	@		300,000	
	Installation	(L				60,000	
		(M				3,000	
241.24	Miscellaneous power panels, starters, push-button	(L				50,000	
	stations, etc.	(M				50,000	
		(L				180,000	
		(M				1,058,000	1,238,000
	Total Switchgear,-	(L				191,000	
		(M				1,073,800	1,264,800

ESTIMATE OF COST
FOR
1000 MW PWR POWER PLANT

ACCT. NO.	DESCRIPTION		QUANTITY	UNIT	RATES	AMOUNTS	TOTALS
						$	$
24.	ELECTRIC PLANT EQUIPMENT (cont'd)						
242.	Station Service Equipment						
242.1	Transformers						
242.11	Unit auxiliary transformer- 43 MVA, FOA, 22/6.9 KV	(M	1			200,000	
	Installation	(L				25,000	
		(M				1,000	
242.12	Station auxiliary transformer- 43 MVA, FOA, 138/6.9 KV	(M	1			340,000	
	Installation	(L				25,000	
		(M				1,000	
242.13	Foundations for trans- formers	(L	70	cu yd	200.00	14,000	
		(M			50.00	3,500	
		(L				64,000	
		(M				545,500	609,500
242.2	Low Voltage Substations						
242.211	480 Volt substations- 4 - 6900/480 Volt- 2000/2666 KVA transformers, 4 - incoming breakers, 3 - bus-tie breakers, 45 feeder breakers and 4 - PT compartments	(M				600,000	
	Installation	(L				115,000	
		(M				3,000	
242.212	Low voltage AC supply transformer - 480/120 V	(M				9,500	
	Installation	(L				5,000	
		(M				500	
		(L				120,000	
		(M				613,000	733,000
242.3	Auxiliary Power Sources						
242.31	Battery Systems						
242.311	Control batteries- 60 cell, 125 V, 1200 amp/hr batteries	(M	2	@		18,500	
	Installation	(L				10,000	
		(M				1,500	
242.312	Charging equipment	(M	2	@		9,500	
	Installation	(L				4,000	
		(M				500	
		(L				14,000	
		(M				30,000	

ACCT. NO.	DESCRIPTION		QUANTITY	UNIT	RATES	AMOUNTS	TOTALS
24.	ELECTRIC PLANT EQUIPMENT (cont'd)					$	$
242.	Station Service Equipment (cont'd)						
242.32	Auxiliary Generators						
242.3211	2000 kw diesel generators complete with controls, switchgear, etc.	(M	3	@		750,000	
	Installation	(L				175,000	
		(M				15,000	
242.3212	Fuel oil storage facilities	(L				35,000	
		(M				25,000	
242.3213	Automatic sprinkler	(L				7,500	
	system at diesels	(M				8,000	
		(L				217,500	
		(M				798,000	
242.3221	Gas Turbine						
	23.4 MVA, 0.9 P.F. gas turbine-generator complete with operating controls cooling systems, etc.	(M	1			1,600,000	
	Installation	(L				150,000	
		(M				50,000	
	Gas Turbine generator switchgear	(M				20,000	
		(L				2,000	
	Gas Turbine generator bus duct	(M				50,000	
		(L				5,000	
	Foundations Fuel storage facilities, weather	(L				168,000	
	protection	(M				42,000	
		(L				325,000	
		(M				1,762,000	

Date. ____________

ESTIMATE OF COST

FOR

1000 MW PWR POWER PLANT

ACCT. NO.	DESCRIPTION		QUANTITY	UNIT	RATES	AMOUNTS	TOTALS
24.	ELECTRIC PLANT EQUIPMENT (cont'd)					$	$
242.	Station Service Equipment (cont'd)						
242.33	Motor-Generator Sets						
242.331	M-G sets for rod control	(M	2	@		50,000	
	Installation	(L				10,000	
		(M				500	
242.332	Inverters - 125 VDC/115 VAC with switchgear, etc.	(M	2	@		20,000	
	Installation	(L				5,000	
		(M				500	
		(L				15,000	
		(M				71,000	
	Total Auxiliary Power Sources,-	(L				571,500	
		(M				2,661,000	3,232,500
	Total Station Service Equipment,-	(L				755,500	
		(M				3,819,500	4,575,000

ACCT. NO.	DESCRIPTION		QUANTITY	UNIT	RATES	AMOUNTS	TOTALS
24.	ELECTRIC PLANT EQUIPMENT (cont'd)					$	$
243.	Switchboards						
243.11	Main control boards	(M				300,000	
	Installation	(L				50,000	
		(M				5,000	
243.12	Protective relay panels	(M				150,000	
	Installation	(L				25,000	
		(M				5,000	
243.22	DC distribution panels	(M				9,000	
	Installation	(L				5,000	
		(M				1,000	
	Total Switchboards,-	(L				80,000	
		(M				470,000	550,000

Date: ____________

ESTIMATE OF COST
FOR
1000 MW PWR POWER PLANT

ACCT. NO.	DESCRIPTION		QUANTITY	UNIT	RATES	AMOUNTS	TOTALS
24.	ELECTRIC PLANT EQUIPMENT (cont'd)					$	$
244.	Protective Equipment						
244.111	General station ground	(L				75,000	
	system	(M				45,000	
244.112	Cathodic protection	(L				65,000	
		(M				35,000	
244.113	Lightning masts on	(L				5,000	
	containment structure	(M				15,000	
244.211	Automatic fire protection	(L				10,000	
	for transformers	(M				7,000	
	Total Protective	(L				155,000	
	Equipment,-	(M				102,000	257,000

ACCT. NO.	DESCRIPTION		QUANTITY	UNIT	RATES	AMOUNTS	TOTALS
24.	ELECTRIC PLANT EQUIPMENT (cont'd)					$	$
245.	Electrical Structures and Wiring Containers						
245.1	Underground Duct Runs						
	Concrete envelope including	(L				50,000	
	excavation, etc.	(M				25,000	
	Manholes	(L				15,000	
		(M				15,000	
		(L				65,000	
		(M				40,000	105,000
245.2	Cable Trays						
	6" wide trays & fittings	(M	2,000	lin ft	3.25	6,500	
	12" " " " "	(M	2,000	" "	3.50	7,000	
	18" " " " "	(M	4,000	" "	3.75	15,000	
	24" " " " "	(M	3,000	" "	4.00	12,000	
	36" " " " "	(M	5,000	" "	4.50	22,500	
	Erection including	(L				275,000	
	supports, hangers, etc.	(M				27,000	
		(L				275,000	
		(M				90,000	365,000
245.3	Conduit						
	Galvanized steel conduit	(L				750,000	
	fittings, supports, etc.	(M				250,000	
	PVC conduit, fittings,	(L				80,000	
	etc.	(M				20,000	
		(L				830,000	
		(M				270,000	1,100,000
245.4	Other Structures						
	Concrete footings for	(L				8,500	
	main bus supports	(M				3,000	
	Concrete footings for	(L				10,000	
	6900 volt bus supports	(M				2,500	
		(L				18,500	
		(M				5,500	24,000
	Total Electrical Structure	(L				1,188,500	
	and Wiring Containers,-	(M				405,500	1,594,000

ESTIMATE OF COST
FOR
1000 MW PWR POWER PLANT

ACCT. NO.	DESCRIPTION		QUANTITY	UNIT	RATES	AMOUNTS	TOTALS
						$	$
24.	ELECTRIC PLANT EQUIPMENT (cont'd)						
246.	Power and Control Wiring						
246.1	Generator Bus Work						
	Main generator bus- 22 kv - 16,000 amp and 32,000 amp connections between generator and main transformers including forced air cooling equipment	(M				435,000	
	Installation	(L				145,000	
		(M				5,000	
	Connections to neutral ground equipment including enclosure	(M	Included with "Bus"				
	Installation	(L				6,500	
		(M				200	
	Auxiliary power transformer connection- 22 kv - 1500 amp bus	(M				60,000	
	Installation	(L				14,000	
		(M				1,000	
		(L				165,500	
		(M				501,200	666,700
246.2	Station Service Power Wiring						
246.211	Auxiliary transformer secondary leads to switchgear - 6900 volt, 4000 amp non-segregated bus duct - 3 phase	(M	250	lin ft		100,000	
	Installation	(L				120,000	
		(M				1,000	
246.212	6900 Volt cable- 3/c - 8 kv cable	(L				130,000	
		(M				75,000	
	1/c - 15 kv cable	(L				5,000	
		(M				5,000	
246.221	600 Volt power cable- 1/c - #12 to 1/c - 750 MCM	(L				1,200,000	
		(M				475,000	
246.222	Freeze protection cable	(L				100,000	
		(M				50,000	

ACCT. NO.	DESCRIPTION		QUANTITY	UNIT	RATES	AMOUNTS	TOTALS
24.	ELECTRIC PLANT EQUIPMENT (cont'd)					$	$
246.	Power and Control Wiring (cont'd)						
246.223	Bus from diesel generators to switchgear- single phase- 4000 amp-600 volt	(L (M	700	lin ft		50,000 65,000	
246.224	Bus from gas turbine generator to switchgear- single phase- 2500 amp-6900 volt	(M (L (M	600	lin ft		65,000 75,000 5,000	
		(L (M				1,695,000 826,000	2,521,000
246.3	Control Wiring Multi-conductor #12 wire	(L (M				1,000,000 450,000	1,450,000
246.4	Instrument Wiring Twisted pair, thermocouple leads, coaxial, triaxial and other special instrument cable	(L (M				600,000 175,000	775,000
246.5	Containment Penetrations Canisters Installation and connections	(M (L (M				450,000 350,000 15,000	
		(L (M				350,000 465,000	815,000
	Total Power and Control Wiring,-	(L (M				3,810,500 2,417,200	6,227,700
	Total Electric Plant Equipment,-	(L (M				6,180,500 8,288,000	14,468,500

Date: ____________

ESTIMATE OF COST
FOR
1000 MW PWR POWER PLANT

ACCT. NO.	DESCRIPTION		QUANTITY	UNIT	RATES	AMOUNTS	TOTALS
						$	$
25.	MISCELLANEOUS PLANT EQUIPMENT						
251.	Transportation and Lifting Equipment						
251.1	Cranes and Hoists						
251.11	Overhead traveling crane for turbine room- 175/25 ton capacity	(M	1			170,000	
	Erection	(L				50,000	
		(M				5,000	
251.12	Polar crane in containment structure- 175/35 ton capacity	(M	1			325,000	
	Erection	(L				90,000	
		(M				10,000	
251.131	Miscellaneous hoists	(L				7,000	
		(M				25,000	
251.132	PAB monorail system	(L				6,000	
		(M				10,000	
		(L				153,000	
		(M				545,000	698,000

Date: ________

ESTIMATE OF COST

FOR

1000 MW PWR POWER PLANT

ACCT. NO.	DESCRIPTION		QUANTITY	UNIT	RATES	AMOUNTS	TOTALS
25.	MISCELLANEOUS PLANT EQUIPMENT (cont'd)					$	$
252.	Air, Water and Steam Service Systems						
252.1	Air Systems						
252.1111	Station service air compressor- 625 scfm @ 100 psig with control equipment, inter-cooler, after cooler, intake filter, receiver, etc.	(M	1			16,500	
	Motor drive	(M	1			5,000	
	Installation	(L				8,000	
		(M				1,000	
252.1112	Instrument air compressors- 215 scfm @ 100 psig with control equipment, motors, coolers, filters, receivers, etc.	(M	2	@		25,000	
	Installation	(L				7,500	
		(M				1,500	
	Instrument air dryers	(L				2,500	
		(M				15,000	
252.112	Air distribution piping (excludes instrument	(L				136,000	
	air and control piping)	(M				39,000	
		(L				154,000	
		(M				103,000	257,000
252.2	Water Systems						
	Service Water System						
252.211	River water supply pumps- 6500 gpm @ 115 ft TDH	(M	6	@		26,000	
	Motor drives - 250 hp	(M	6	@		40,000	
	Installation	(L				34,000	
		(M				2,000	
	River water strainers- 6500 gpm capacity	(M	6	@		50,000	
	Installation	(L				5,000	
		(M				1,500	
252.291	Service water piping- complete river water distribution system from pump discharges at intake structure through the yard area and various buildings including connections	(L				755,000	
	to equipment	(M				475,000	

Date: ________________

ESTIMATE OF COST FOR 1000 MW PWR POWER PLANT

ACCT. NO.	DESCRIPTION		QUANTITY	UNIT	RATES	AMOUNTS	TOTALS
25.	MISCELLANEOUS PLANT EQUIPMENT (cont'd)					$	$
252.	Air, Water and Steam Service Systems (cont'd)						
	Excavation and backfill for underground	(L	5,000	cu yd	7.00	35,000	
	portion of piping	(M			2.00	10,000	
		(L				829,000	
		(M				604,500	
	Yard Fire Protection System						
252.221	Diesel and motor driven fire pumps including controls etc.	(M				60,000	
	Installation	(L				10,000	
		(M				1,000	
252.242	Water storage tank including foundations,	(L				75,000	
	painting, etc.	(M				50,000	
252.292	Pipe and fittings (10"Ø)	(M	3,500	lin ft	10.00	35,000	
	Hydrants and accessories	(M	15	@	500.00	7,500	
	Valves	(M				2,000	
	Hose stations	(M				6,000	
	Installation	(L	120,000	lb	.75	90,000	
		(M			.10	12,000	
	Excavation and backfill	(L	3,000	cu yd	7.00	21,000	
		(M			2.00	6,000	
		(L				196,000	
		(M				179,500	
	City Water Piping						
252.293	Extension of existing city water line and distribution pipe. (Excludes building	(L	Allowance			48,000	
	plumbing)	(M				14,000	
	Total Water Systems,-	(L				1,073,000	
		(M				798,000	1,871,000

ACCT. NO.	DESCRIPTION		QUANTITY	UNIT	RATES	AMOUNTS	TOTALS
25.	MISCELLANEOUS PLANT EQUIPMENT (cont'd)					$	$
252.	Air, Water and Steam Service Systems (cont'd)						
252.3	Auxiliary Heating Steam						
252.31	Auxiliary Heating Boilers 2 - 50,000 #/hr oil fired units complete with fuel storage facilities, fuel and steam piping connections, electrical controls and wiring,	(L	Allowance			600,000	
	boiler enclosure, etc.	(M				400,000	1,000,000
	Total Air, Water and	(L				1,827,000	
	Steam Service Systems,-	(M				1,301,000	3,128,000

ACCT. NO.	DESCRIPTION		QUANTITY	UNIT	RATES	AMOUNTS	TOTALS
25.	MISCELLANEOUS PLANT EQUIPMENT (cont'd)					$	$
253.	Communications Equipment						
253.1	Local Communications Systems						
253.15	Public Address and Inter-Communication System						
	Hand-sets, speakers,	(L				50,000	
	wire, etc.	(M				35,000	85,000
253.2	Signal Systems						
253.21	Fire detection system	(L				15,000	
		(M				10,000	
253.25	Noise monitoring system	(L				10,000	
		(M				5,000	
		(L				25,000	
		(M				15,000	40,000
	Total Communications	(L				75,000	
	Equipment,-	(M				50,000	125,000

ACCT. NO.	DESCRIPTION		QUANTITY	UNIT	RATES	AMOUNTS	TOTALS
25.	MISCELLANEOUS PLANT EQUIPMENT (cont'd)					$	$
254.	Furnishings and Fixtures						
254.1	Safety Equipment						
254.12	Portable fire extinguishers, fire blankets, etc.	(M	Allowance			10,000	10,000
254.2	Shop, Laboratory and Test Equipment						
254.21	Machine Shop Equipment		(Not Included)			-	
254.22	Electrical Shop Equipment		(Not Included)			-	
254.23	Chemical Laboratory						
	Special laboratory furniture & fixtures	(M	Allowance			44,500	
	Installation	(L				5,000	
		(M				500	
		(L				5,000	
		(M				45,000	50,000
254.3	Office Equipment and Furnishings						
254.31	Office furniture	(M	Allowance			50,000	
254.32	Office equipment	(M	(Not Included)			-	
		(L				-	
		(M				50,000	50,000
254.4	Change Room Equipment						
254.41	Lockers and benches	(L				500	
		(M				8,000	
254.42	Laundry facilities	(L	(Not Included)			-	
		(M				-	
		(L				500	
		(M				8,000	8,500
254.6	Dining Facilities						
	Cafeteria equipment	(L	Allowance			25,000	
		(M				125,000	150,000
	Total Furnishings and Fixtures,-	(L				30,500	
		(M				238,000	268,500
	Total Miscellaneous Plant Equipment,-	(L				2,085,500	
		(M				2,134,000	4,219,500
	Subtotal,-	(L				54,791,350	
		(M				115,252,250	170,043,600

Date: ____________

ESTIMATE OF COST FOR 1000 MW PWR POWER PLANT

ACCT. NO.	DESCRIPTION		QUANTITY	UNIT	RATES	AMOUNTS	TOTALS
						$	$
91.	UNDISTRIBUTED COSTS						
910.	Engineering, Construction, Management and Field Supervision (Professional Services)						
910.11	Engineering, Design and Drafting					9,600,000	
910.12	Licensing Expense					2,250,000	
910.13	Home Office Purchasing and Expediting Services					750,000	
910.14	Home Office Construction Management					500,000	
910.15	Field Supervision					7,500,000	
910.16	Relocation Expense of Key Personnel					200,000	
910.17	Job Office Expense					250,000	
910.18	Compensation					2,700,000	
	Total Professional Services					23,750,000	23,750,000
	Other Undistributed Costs (Classified)						
911.	Temporary Facilities	(L				2,820,000	
		(M				1,260,000	
912.	Construction Equipment	(L				745,000	
		(M				6,035,000	
913.	Construction Services	(L				665,000	
		(M				1,965,000	
	Total (Classified)	(L				4,230,000	
		(M				9,260,000	
	Other Undistributed Costs (Unclassified)						
*	Operator Training	(M				500,000	
	Spare Parts	(M				1,000,000	
*	Owners General Office and Administrative Cost	(M				2,700,000	
	Total (Unclassified)	(M				4,200,000	
	Total Other Undistributed Costs	(L				4,230,000	
		(M				13,460,000	17,690,000
	Total Base Construction Cost						211,483,600
*	Defined as material dollars to differentiate from craft labor dollars.						