POWER CONVERSION SYSTEMS

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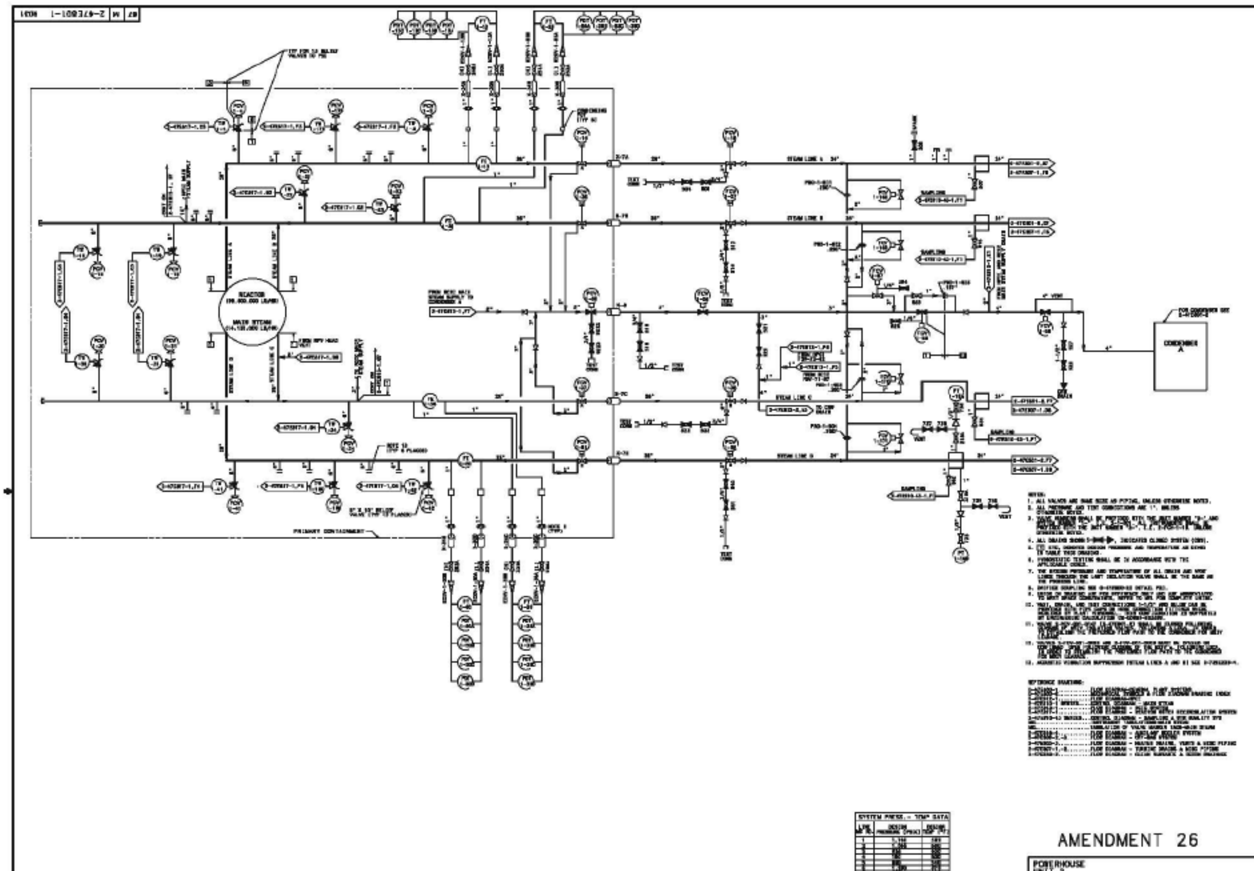
11.0 POWER CONVERSION SYSTEMS

11.1 SUMMARY DESCRIPTION

The equipment and evaluations presented in this section are applicable to all three units.

Steam from the reactor flows directly to the steam turbine (see Figures 11.1-1a, -1b, -1c, -1d, -1e, and -1f). Condensed extraction steam is cascaded through the feedwater heaters to the main condenser where it is deaerated and collected in the condenser hotwell along with condensed steam from the turbine exhaust and miscellaneous drains from the turbine cycle. Condensate pumps, taking suction from the hotwell, pump the condensate through the air ejector condensers, steam packing exhauster condenser, off-gas condenser, and filter/demineralizers to the condensate booster pumps which increase the condensate pressure and discharge through the low-pressure heaters to the reactor feed pump suctions. The reactor feed pumps discharge through the high-pressure heaters to the reactor.

Normally, the turbine will utilize all the steam being generated by the reactor. Automatic pressure-controlled bypass valves are supplied which will discharge excess steam directly to the condenser. The capacity of the bypass valves is sufficient to allow load rejections of up to approximately 21.3% of rated steam flow without a turbine trip or reactor scram.



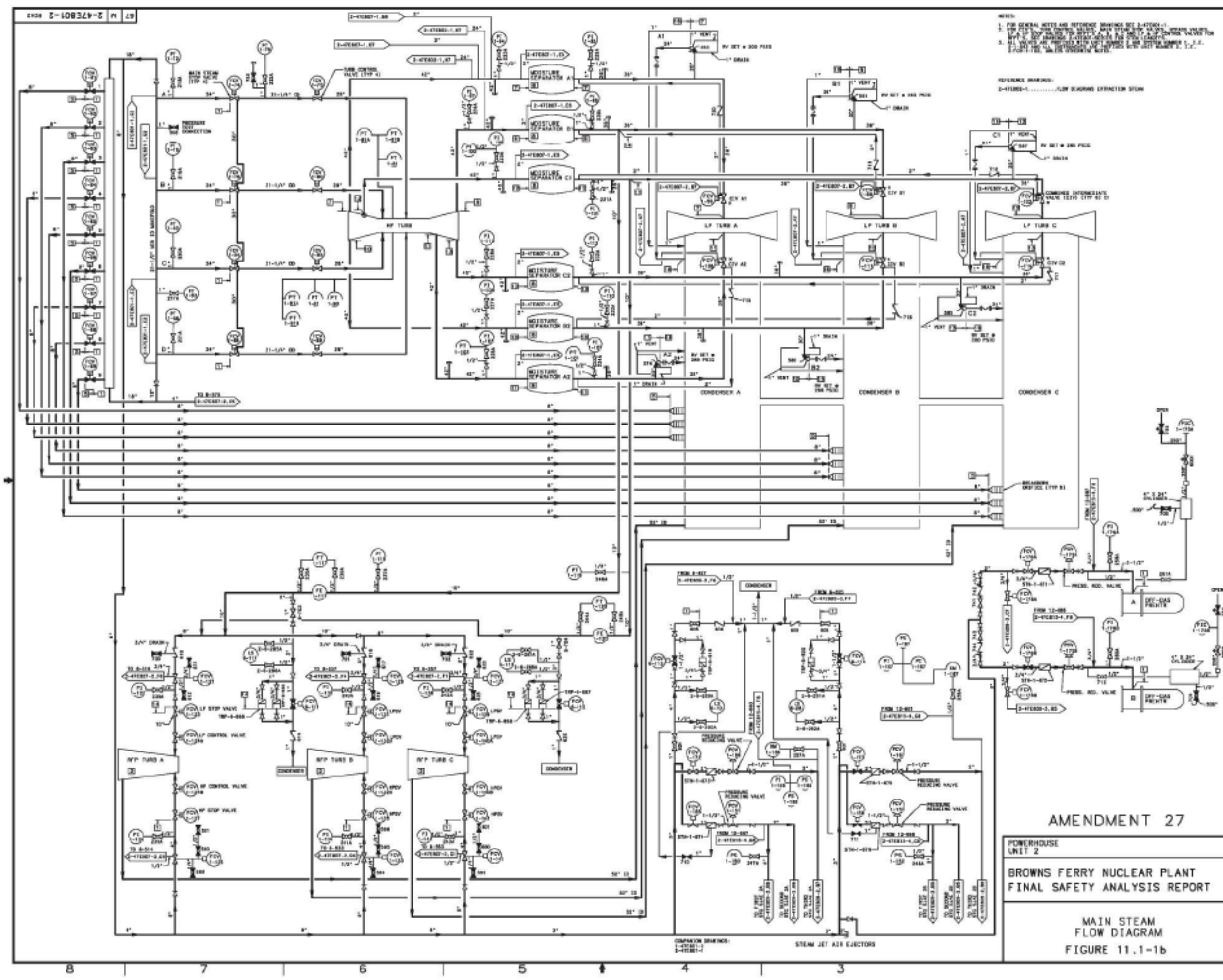
AMENDMENT 26

POWERHOUSE
UNIT 2

BROWNS FERRY NUCLEAR PLANT
FINAL SAFETY ANALYSIS REPORT

MAIN STEAM
FLOW DIAGRAM

FIGURE 11.1-1a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UNIT 2
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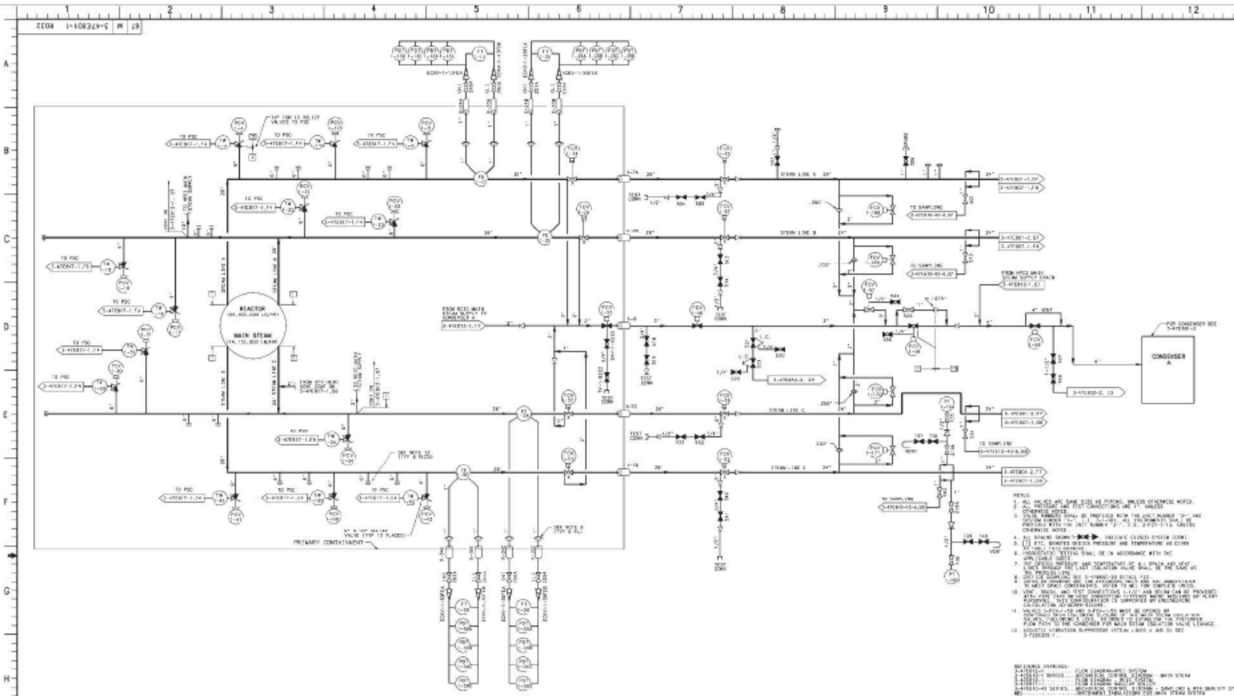
MAIN STEAM
FLOW DIAGRAM
FIGURE 11.1-1b
CONDENSER A
CONDENSER B
CONDENSER C
LP TURB A
LP TURB B
LP TURB C
RFP TURB A
RFP TURB B
RFP TURB C
STEAM JET AIR EJECTORS



RELIEF VALVE DATA			
VALVE ID	ST LINE	SETPOINT	ADS
1-4	A	[illegible]	[illegible]
[illegible]	A	[illegible]	[illegible]
[illegible]	A	[illegible]	[illegible]
[illegible]	B	[illegible]	[illegible]
[illegible]	B	[illegible]	[illegible]
[illegible]	B	[illegible]	[illegible]
[illegible]	B	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	C	[illegible]	[illegible]
[illegible]	C	[illegible]	[illegible]
[illegible]	D	[illegible]	[illegible]
[illegible]	D	[illegible]	[illegible]
[illegible]	D	[illegible]	[illegible]

SYSTEM PRESS.- TEMP DATA		
LINE NO.	DESIGN PRESSURE (PSIG)	DESIGN TEMP (°F)
[illegible]	[illegible]	[illegible]

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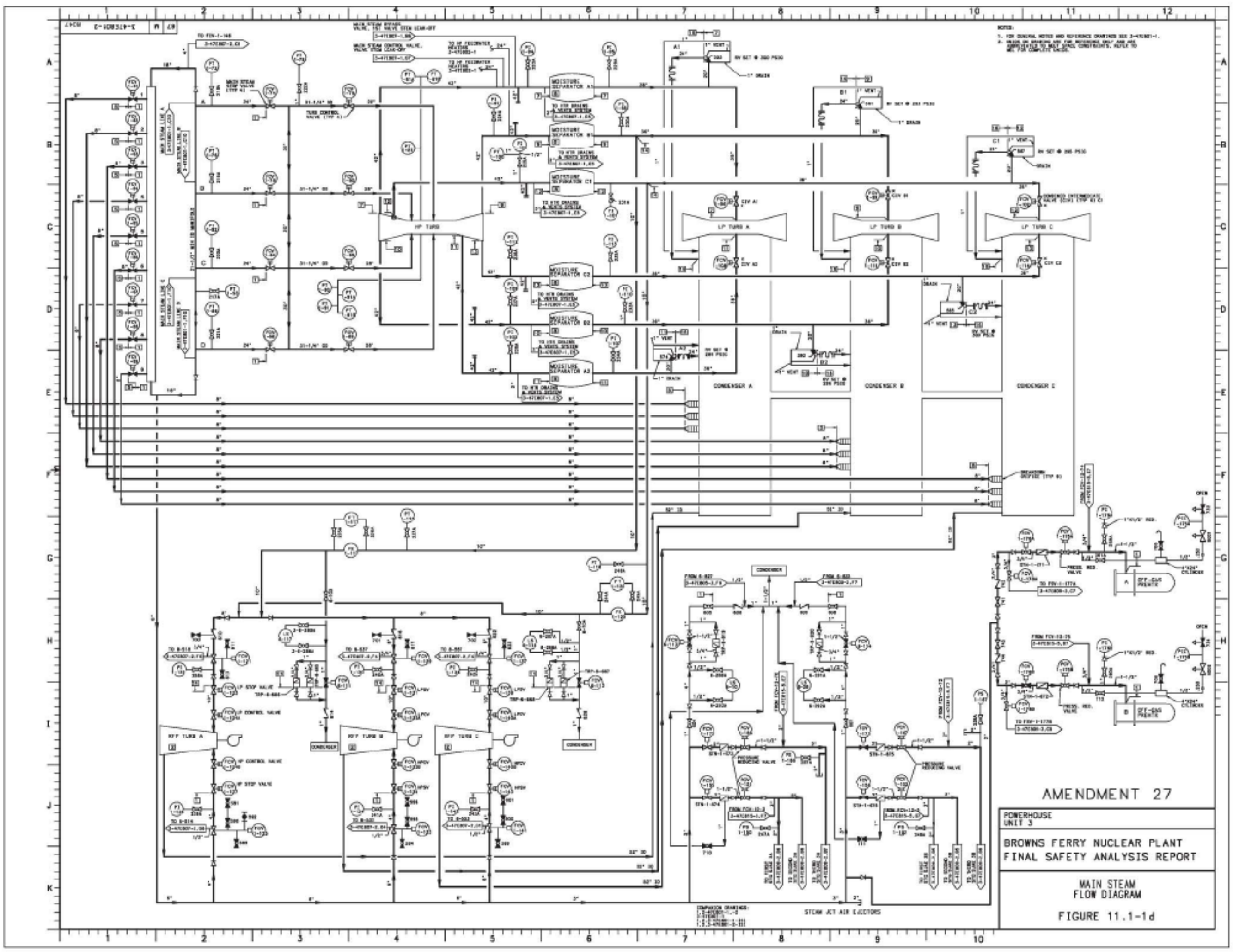
POWERHOUSE
UNIT 3

BROWNS FERRY NUCLEAR PLANT
FINAL SAFETY ANALYSIS REPORT

MAIN STEAM
FLOW DIAGRAM

FIGURE 11.1-1c


HP TURB
LP TURB A
LP TURB B
LP TURB C
CONDENSER A
CONDENSER B
CONDENSER C
RFP TURB A
RFP TURB B
RFP TURB C
STEAM JET AIR EJECTORS
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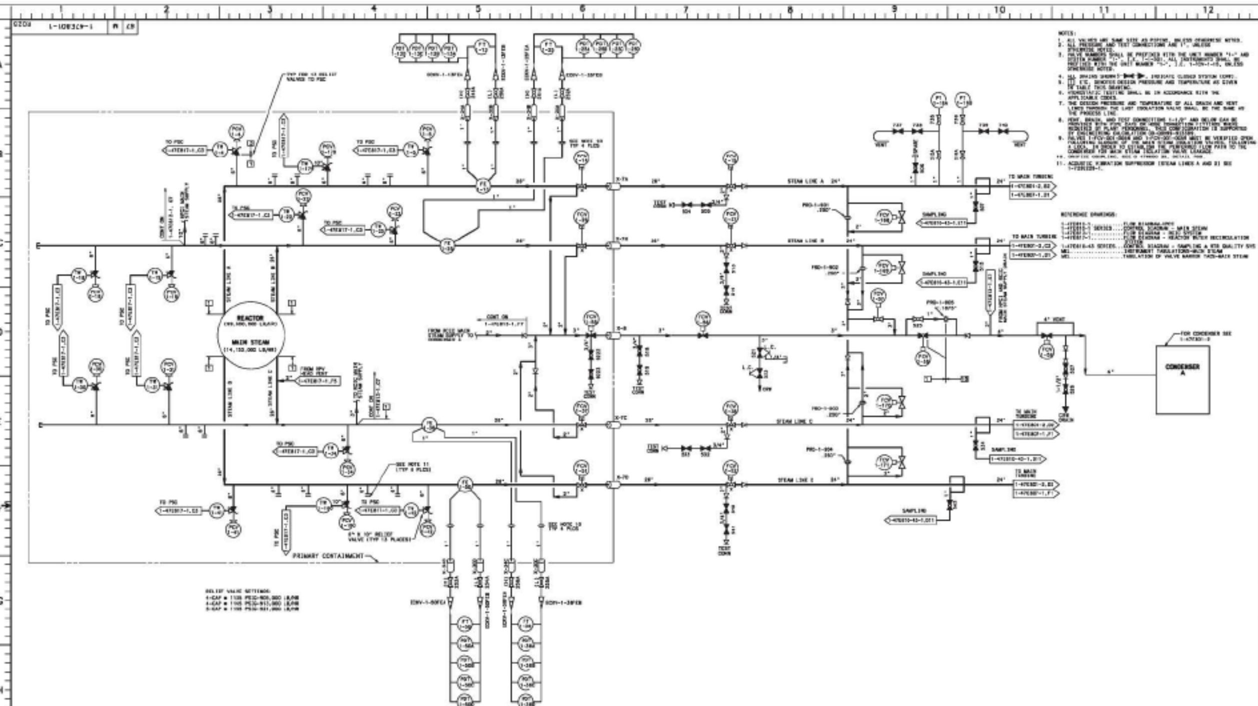
POWERHOUSE
UNIT 3
BROWNS FERRY NUCLEAR PLANT
FINAL SAFETY ANALYSIS REPORT
MAIN STEAM
FLOW DIAGRAM
FIGURE 11.1-1d



RELIEF VALVE DATA			
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1-179	A	1155	N
1-5	A	1145	Y
1-18	B	1145	N
1-19	B	1135	Y
1-22	B	1145	Y
1-23	B	1135	N
1-30	C	1145	Y
1-31	C	1135	Y
1-34	C	1135	Y
1-41	D	1150	N
1-180	D	1155	N
1-42	D	1155	N

SYSTEM PRESS.- TEMP DATA		
LINE NO.	DESIGN PRESSURE (PSIG)	DESIGN TEMP (°F)
1	1146	563
2	[illegible]	[illegible]
3	[illegible]	[illegible]
4	[illegible]	[illegible]
5	[illegible]	[illegible]
6	1250	[illegible]
7	[illegible]	415
8	[illegible]	[illegible]
9	[illegible]	415
10	[illegible]	415
11	[illegible]	415
12	[illegible]	415
13	[illegible]	415
14	[illegible]	415
15	450	450
16	[illegible]	[illegible]

COMPANION DRAWING:
1-47E801-2

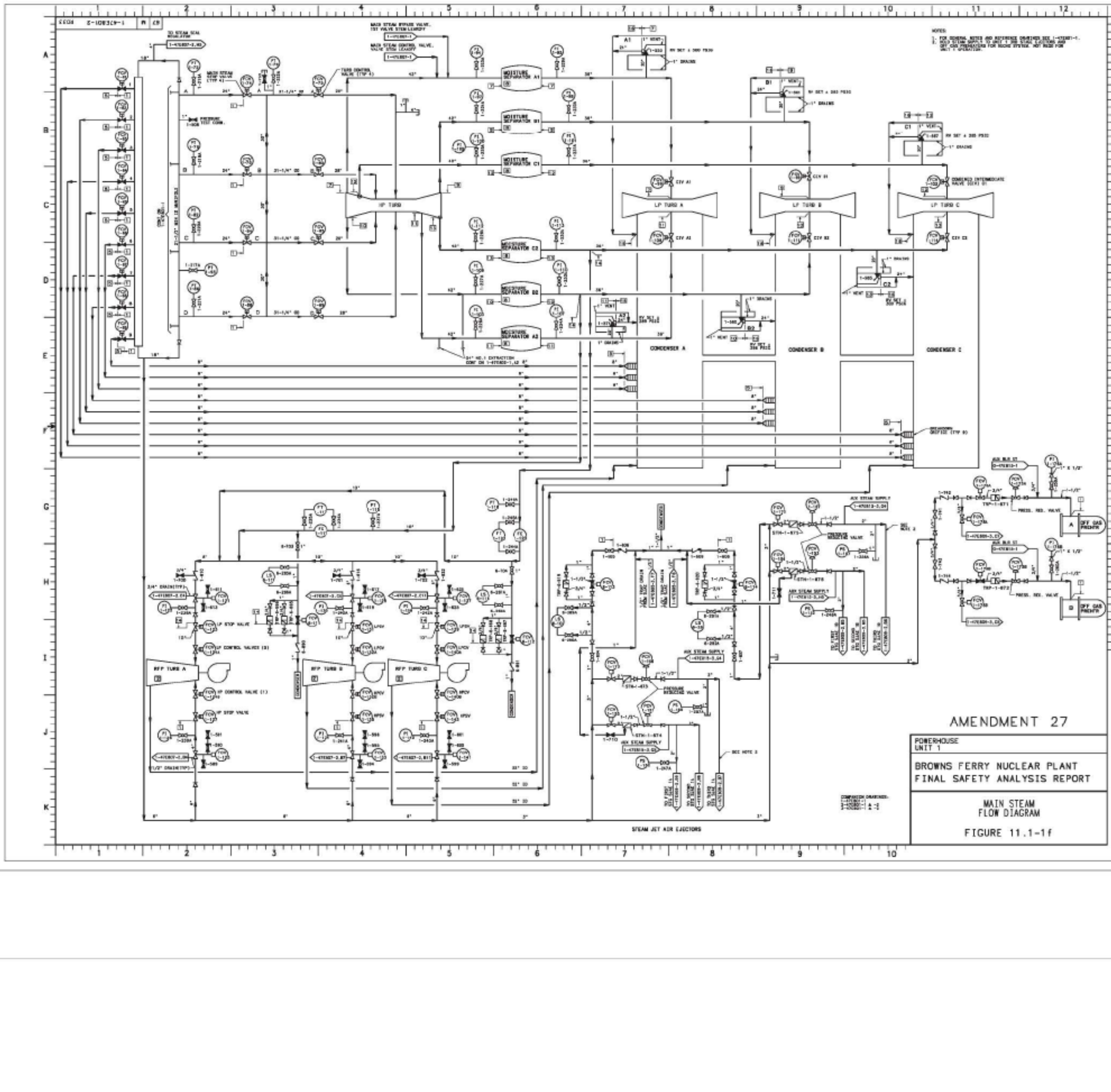
AMENDMENT 27

POWERHOUSE
UNIT 1

BROWNS FERRY NUCLEAR PLANT
FINAL SAFETY ANALYSIS REPORT

MAIN STEAM
MECHANICAL FLOW DIAGRAM

FIGURE 11.1-1e



AMENDMENT 27

POWERHOUSE
UNIT 1

BROWNS FERRY NUCLEAR PLANT
FINAL SAFETY ANALYSIS REPORT

MAIN STEAM
FLOW DIAGRAM

FIGURE 11.1-1f

11.2 TURBINE-GENERATOR

11.2.1 Power Generation Objective

The power generation objective of the turbine-generator is to utilize steam produced in the reactor core to produce electric power. The turbine-generator controls work in conjunction with the Nuclear Steam Supply System controls to maintain essentially constant reactor pressure and to limit transients during load variations.

11.2.2 Power Generation Design Basis

The turbine-generator shall be capable of accepting the steam flow from the reactor vessel and producing a nominal electrical output of 1318 Mw(e).

The favorable orientation of the low pressure turbines provides assurance that safety related systems, structures, and components would not be damaged in the unlikely event a turbine missile is generated. The probability of a turbine generator failure leading to the ejection of external missiles will be controlled to be less than 1E-4/year (for favorably oriented turbines) in accordance with the methodology described in GE report dated January 1984 entitled “Probability of Missile Generation in General Electric Nuclear Turbines.” This report describes GE’s method for evaluating the probability of wheel missile generation for nuclear turbines manufactured by GE. Since approval of the method by the NRC in 1985 (reference NUREG-1048, Appendix U), it has been routinely applied to establish reinspection intervals for low-pressure (LP) rotors with shrunk on wheels and to furnish unit specific wheel probabilities.

Testing intervals of the tests listed below may impact the turbine missile generation evaluation:

1. Main stop valve testing
2. Control valve testing
3. Combined intermediate valve testing
4. Extraction system check valve testing
5. EHC hydraulic fluid sampling
6. Master trip solenoid valve testing
7. Over speed trip testing

The Unit 1 upgrade of the low pressure turbines to a monoblock rotor design further decreases the probability of a turbine generated missile from that previously evaluated for original plant shrunk-on rotors (Reference: Letter from H. A. Morgan (GE) to R. Smith (TVA), LP Turbine Missile Probability Concerns, Rev 1, dated Dec 5, 2003).”

11.2.3 Description

The turbine is an 1,800-rpm tandem-compound, six-flow, nonreheat unit with 43-inch last stage buckets. It has a double-flow, high-pressure cylinder and three double-flow low-pressure cylinders. Steam from the high-pressure cylinder passes through moisture separators before entering the low-pressure units. The turbine has five extraction stages for reactor feedwater system heating. Turbine controls include an electric-hydraulic speed governor, overspeed protection, steam admission control valves, emergency stop valves, combined intermediate stop-intercept valves, bypass valves, and pressure regulators (see Subsection 7.11 for turbine instrumentation and control).

Design conditions for the turbine are:

a. 983 psia steam pressure at the stop valves (essentially saturated), maximum moisture 0.48 percent,

b. 3.79-in Hg absolute backpressure,

c. Zero-percent system makeup, and

d. Extraction of steam and moisture from turbine to provide five stages of feedwater heating with feedwater return temperature to the reactor at 394.8ºF.

The rated design flow is 16,440,000 pounds of steam per hour. The turbine is designed to accept, however, a maximum expected flow of 17,245,870 pounds of steam per hour under the above conditions with the control valves wide open.

For Unit 1 only, the generator is rated at 1,330,000 kVA at a 0.95 power factor and a 75-psig hydrogen pressure. The Unit 2 and Unit 3 generators are rated at 1,332,000 kVA at a 0.93 power factor and a 75-psig hydrogen pressure. All three of the generators have a short circuit ratio of 0.58. The generator exciter system is of the Alterrex type rated at 2,635 kW and 500-V. The generator is a direct-oupled 60-Hz, 22,000-V synchronous unit, with a water-cooled armature winding and a hydrogen-cooled rotor and stator core. When the turbine is operating at design backpressure, with valves wide open and all feedwater heaters in service, the generator will not be overloaded at a 0.95 power factor (Unit 1) or 0.93 (Units 2 and 3).

The Unit 1 HP turbine is retrofitted with an Advance Design Steam Path for uprated conditions. Replacement diaphragms and buckets incorporate high efficiency nozzle vanes to increase efficiency and reduce secondary losses.

During normal operations, the steam admitted to the turbine is controlled by the pressure regulator which maintains essentially constant pressure at the turbine inlet, thus controlling reactor vessel pressure. The EHC system pressure regulator can control reactor pressure directly. The ability of the station to follow system load depends on adjustment of reactor power level. This is accomplished by changing Reactor Coolant Recirculation System flow or repositioning of control rods.

The steam admission valves close if an increase in system frequency or loss of generator load causes an increase in turbine speed. The loss of generator load is detected with power/load unbalance circuitry that results in a turbine control valve fast closure. This circuitry includes both an imbalance and a rate of change logic, which must be satisfied to generate the TCV fast closure signal. Reactor steam in excess of that which the admission valve will pass is bypassed directly to the main condenser through pressure-controlled bypass valves.

All other interlocks and features necessary to maintain system integrity, such as those for lube-oil pressure, seal oil pressure, and backpressure, are similar to those used in conventional turbine-generator systems.

The turbine-generator system is illustrated in Figures 1.6-29, sheets 1, 2, and 3 Subsection 1.6.

11.2.4 Tests and Inspections

The standard turbine tests at the factory consist of tests of such components as governor and control mechanisms, regulators, auxiliary oil pumps system, mechanical balance, and overspeed of rotors. The turbine was assembled at the factory to establish and verify the fits and operating clearances.

The generator was given standard factory tests which include the following:

Mechanical inspection,
Rotor balance,
Rotor overspeed run,
Measurement of cold resistance of stator and rotor windings,
Winding-insulation resistance measurement,
Dielectric tests,
Air leakage test on hydrogen cooled stator frame,
Resistance-temperature detector test, and
Flow continuity for armature winding.

Tests and inspection are conducted prior to and during operation to ensure functional performance as required for continued safe operation, and to provide maximum protection for operating personnel. Among these tests which are periodically performed are the following:

Testing of main stop valves and protective valves,
Testing of bypass valves and power-operated extraction system check valves,
Oil-level gauge testing,
Emergency overspeed protection
Thrust-bearing wear-detector testing,
Automatic pump starting,
Control valve tightness test, and
Main stop valve tightness test.

During normal operating periods duplicate equipment is rotated on a regular basis to assure backup equipment is in operational readiness at all times.

11.3 MAIN CONDENSER SYSTEM

11.3.1 Power Generation Objective

The objective of the Main Condenser System is to provide a heat sink for the steam leaving the turbine-generator during power operation.

11.3.2 Power Generation Design Basis

The Main Condenser System shall be capable of providing an adequate heat sink for the turbine-generator at rated reactor vessel steam flow and at 105% rated steam flow.

11.3.3 System Description

The Main Condenser System consists of three deaerating, single-pass, single-pressure, radial flow type surface condensers with divided waterboxes. Each one-third-capacity condenser is located beneath one of the three low-pressure turbines with the tubes oriented transverse to the turbine-generator axis and is rigidly supported on a foundation. A rubber belt-type expansion joint is installed between the upper and lower steam inlet sections to permit movement resulting from the temperature changes of the equipment. Cross connections are provided for equalization of pressure between condenser shells. Two one-third-capacity low-pressure extraction feedwater heaters and a separate drain cooler are mounted in the neck of each condenser.

The design heat load for the main condensers is 8.825 X 10^9 Btu/hr which includes exhaust flow from three reactor feed pump turbines. Deaeration is provided to remove dissolved gases from the condensate, limiting oxygen content to approximately 0.005 cc per liter at any load during normal operation.

The condenser hotwells have sufficient condensate storage capacity to provide the quantity of condensate required of full-power turbine operation. Baffling in the hotwell is arranged to assure a retention time for condensate. This will permit decay of short-lived radioactive isotopes. The main condenser storage capacity has been evaluated to a 2-minute retention time and found to be acceptable for operation at 3952 MWt. As the 2-minutes retention time for decay of short-lived radioisotopes remains a conservative decay time, this remains acceptable for operation at 3952 MWt.

A circulating water temperature of 90°F, the condenser can accept 3,529,207 lb/hr of bypass steam flow based on approximately 21.3% of rated main steam flow at a maximum enthalpy of 1190.4 Btu/lb. Moreover, the turbine exhaust hood temperature will not exceed 175°F.

The Main Condenser System will produce a back pressure of 3.79 inches of mercury, absolute, when operating at rated turbine output. A continuous tube cleaning system is provided to keep the condenser operating at peak performance. The condensate leaving the system will have negligible dissolved gas concentrations.

SEACURE® tubes are used throughout Unit 1 condenser; Allegheny Ludlum's AL-6XN tubes are used throughout Unit 2 and Unit 3 condensers. The condenser shells, tube sheets, tube support plates, and waterboxes are constructed of carbon steel, ASTM A 285, Grade C.

The Condenser Circulating Water (CCW) system is provided with a chemical treatment system designed to reduce Main Condenser tube fouling and improve heat transfer.

The condenser maintains a negligible oxygen concentration in the effluent condensate by limiting subcooling and thereby limiting gas solubility. Steam jet air ejectors evacuate the noncondensible gases during normal operation. Mechanical vacuum pumps evacuate noncondensible gases during startup. Subsection 11.4 includes a description of the Main Condenser Gas Removal System.

The extraction steam and turbine drain piping located internal to the condensers are designed in accordance with USAS B31.1, 1967.

11.3.4 Inspection and Testing

The condenser may be tested for leaks by completely filling with water, by helium leak detection, or by other methods. Manways provide access to waterboxes, tube sheets, lower steam inlet section, shell, and hotwell for purposes of inspection, repair, or tube cleaning.

11.4 MAIN CONDENSER GAS REMOVAL AND TURBINE SEALING SYSTEMS

11.4.1 Power Generation Objective

The objective of the Main Condenser Gas Removal System is to remove noncondensible gases from the main condenser and deliver these gases to the Gaseous Radwaste System (modified) (see Subsection 9.5).

The objective of the Turbine Sealing System is to prevent the leakage of steam into the Turbine Building and also prevent the leakage of air into the main condenser.

11.4.2 Power Generation Design Basis

1. The Main Condenser Gas Removal System shall be capable of handling the oxygen and hydrogen produced by disassociation of water in the reactor and the estimated air inleakage rate.

2. The Turbine Sealing System shall provide adequate sealing steam to the main turbine and the three reactor feed pump turbines with double clearances on all shaft seals.

11.4.3 System Description

Two full-capacity steam jet air ejectors complete with inter-condensers are provided for each unit. Two half-capacity, motor-driven, rotary vacuum pumps are provided to establish the vacuum for the condenser-turbine system at startup. These vacuum pumps discharge into the same pipe system as the steam-packing exhauster blowers. Additional air ejector and mechanical vacuum pump system details are shown in the Offgas System Flow Diagram (Figures 9.5-1 sheets 1, 2, 3, 4, 5, and 6, 9.5-2, 9.5-3, and 9.5-4).

Each Turbine Sealing System includes a steam seal regulator with the necessary valves to maintain a constant positive pressure in the steam seal supply header and a single steam-packing exhauster condenser equipped with two full-capacity blowers to prevent steam leakage at the turbine shaft seals.

The Turbine Sealing System is operated in a semi-automatic mode.

During normal power operations, a pressure regulator valve and two self-regulating seal steam header unloader valves maintain the seal steam header pressure approximately 4 psig. To regulate the seal steam header pressure, the unloader valves divert excess seal steam to the Main Condenser. The pressure regulator valve provides the ability for online seal steam header pressure adjustments.

The unloader valves are augmented with a manually-positioned, motor-operated throttle unloader valve which provides additional unloading capacity during operating periods where excessive seal steam is present.

During operating periods where low-pressure seal steam is available, such as initial condenser vacuum operations on auxiliary boiler steam, a motor-operated bypass valve is used to bypass the pressure regulator valve. The manual bypass valve reduces the flow restriction caused by the pressure regulator valve by opening an additional steam flow path. This action ensures adequate low-pressure steam is available to the Turbine Sealing System during initial reactor startups.

11.4.4 Inspection and Testing

The SJAE was shop-tested in accordance with Heat Exchanger Institute (HEI) steam jet ejector section requirements.

The mechanical vacuum pumps were shop-tested to verify the capacity and horsepower requirements over the entire operating range.

11.5 TURBINE BYPASS SYSTEM

11.5.1 Power Generation Objective

The objective of the Turbine Bypass System is to provide a bypass around the turbine directly to the condenser for steam flow which cannot be processed through the turbine.

11.5.2 Power Generation Design Basis

The Turbine Bypass System shall provide adequate bypass capacity to limit primary system pressure increases resulting from sudden load changes.

11.5.3 System Description

The Turbine Bypass System consists of nine bypass valves individually piped to the condenser through a pressure breakdown device (called a trumpet). The steam is delivered to the condenser at 250 psig.

The bypass system is capable of accepting up to approximately 21.3 percent of rated main steam flow. The Turbine Bypass System is designed to pass approximately 3.5 Mlbm/hr of main steam at 1190.4 Btu/lb to the condenser. The bypassed steam at a discharge pressure of about 250 psig is delivered to the condenser. The bypass valves are controlled by the initial pressure regulator to minimize pressure spikes and to compensate for sudden load changes.

This system also provides a means for utilizing the condenser as a heat sink during startup and shutdown.

Heating and loading of the turbine are accomplished by first establishing a flow of steam to the condenser through the bypass system, then gradually transferring this flow to the turbine.

During normal shutdown, steam is released to the main condensers through the bypass system to give the desired rate of cooldown of the reactor.

11.5.4 Inspection and Testing

Test and inspection of the system components and equipment will be conducted to assure functional performance as required for continued safe operation.

11.6 CONDENSER CIRCULATING WATER SYSTEM

11.6.1 Power Generation Objective

The power generation objective of the Condenser Circulating Water System is to provide an efficient means of rejecting waste heat from the power generation cycle into the ambient surroundings, while meeting all applicable thermal criteria. A secondary purpose is to provide water for the Raw Cooling Water System and to dilute and disperse low-level radioactive liquid waste from the radwaste treatment facilities. It also provides a discharge path to station sumps and sewage treatment plant.

11.6.2 Power Generation Design Basis

a. The Condenser Circulating Water System shall provide flow to the condensers to remove the heat produced during power operation and maintain the condenser shell pressure at an economical level.

b. The Condenser Circulating Water System shall allow the plant to operate within the applicable State water-quality standards with a minimum of load reduction.

c. The Condenser Circulating Water System provides the source of water for the Raw Cooling Water System for each unit.

d. The Condenser Circulating Water System shall be capable of providing adequate flow to the condensers under shutdown conditions without the normal offsite power supply.

e. The Condenser Circulating Water System shall provide for the dilution and dispersion of radioactive liquid wastes from the plant.

f. The Condenser Circulating Water System shall provide for a discharge path to the station sumps and sewage treatment plant.

11.6.3 System Description

The flow diagram for this system is shown in Figures 11.6-1, 11.6-2, 11.6-3 sheets 1, 2, 3, 4, and 5, 11.6-4, 11.6-5, and 11.6-6.

The Condenser Circulating Water System is designed to provide a flow of approximately 675,000 gpm to the condenser during open cycle operation, and a flow of approximately 25,000 gpm to Raw Cooling Water System of each unit.

This was the minimum number of pumps which could supply the total flow and yet remain in an economical size within manufacturer's capability. Head losses are held to a minimum by designing the system to maintain the most practical velocities and smoothness of flow commensurate with construction and operating costs.

The intake pumping station is located at the land end of the intake channel, which has a bottom EL. 523 ft above sea level.

On the reservoir end of the intake channel is located gate structure No. 3, which consists of three motor-operated wheel gates which are capable of acting as a skimmer wall by blocking the intake channel down to EL. 527.

The nine circulating water pumps are vertical, nonpullout-type, single-stage, mixed-flow, wet-pit-type. Suction for these pumps is provided to EL. 532. Each group of three pumps, operating in parallel, supplies the condenser cooling water requirements for full power requirements of a generating unit. Each pump is installed in a separate suction well with entering water strained by trash racks and traveling screens, operating in parallel. Each pump discharge is equipped with motor-operated butterfly valves. The discharges of the three pumps are brought together in a steel trifurcation transition to a single tunnel. The water is channeled to the condenser by this tunnel.

A debris filter is installed in the 78” inlet pipe of the CCW piping into the 3A1, 1C2, and 2C2 condenser water box. The debris filter is provided with a backwash line that permits manual or automatic operation of the backwash system. The backwash line bypasses the condenser and discharges directly into the 3A1 water box outlet piping for Unit 3, the 1C2 water box outlet piping for Unit 1, and the 2C2 water box outlet piping for Unit 2.

Normally, filling and operating of the condensers are accomplished by (1) venting, (2) evacuation of the condenser water box by a vacuum system, and (3) operation of one or more circulating water pumps. Each unit at BFN has one main condenser. Each main condenser has three subsections, one each for each LP turbine. Each subsection has two parallel cooling water paths, making a total of six parallel paths for each unit’s main condenser. The three cooling sections of the three condensers can be operated fully flooded by only one pump. The discharge from the condensers passes to the discharge tunnel and then to the warm water channel going to the cooling towers or to the discharge diffusers in the reservoir or a combination of these discharge paths.

Gate 1A is provided to allow the discharge from the condenser to pass out through the diffusers in the reservoir and to divert the water to the warm water channel by way of the vacuum loop. Gate 1A consists of three motor-operated wheel gates, with one gate in the discharge conduit from each unit. The gates are controlled to operate independently of one another.

The vacuum loop is a high point in each tunnel which carries water to the warm water channel while operating under vacuum at the normal design flow. The discharge of the tunnel at the warm water channel is submerged under all normal operating conditions. When gate 1A is closed, water is pumped over the high point at a reduced flow rate. The air which is displaced by the water is vented through vent valves. When all air can be vented, a vacuum is established and one circulating water pump may be stopped. The flow through the vacuum loop then stabilizes. The vacuum is maintained by a vacuum priming system.

Water is pumped to the seven cooling towers by pumps located in seven pumping stations located along the warm water channel. Each pumping station for Cooling Towers 1 through 6 have two 137,500 gpm pumps at a design head of 75 feet. The pumping station for Cooling Tower 7 has four 102,500 gpm pumps at a design head of 83.5 feet.

The twelve cooling tower supply pumps for Cooling Towers 1 though 6 are 440 rpm, mixed-flow, vertical, wet-pit, and non-pullout type above the deck discharge. The pumps are direct-connected to 3100 hp, solid-shaft electric motors. The pumps for Cooling Tower 7 are 509 rpm, mixed-flow, vertical, wet-pit, pullout-type, below the deck discharge. The pumps are direct connected to 2700 hp, solid-shaft electric motors. Each pump is installed in a separate concrete pumping pit which has long approach walls to reduce flow turbulence and to prevent vortices.

Cooling Towers 1 through 7 are mechanical-induced-draft, cross flow cooling towers.

Cooling Towers 1 through 7 fans are electrically driven by minimum 200 horsepower, 1800 rpm, totally enclosed fan cooled motors.

Standpipes are located on the top of each tower’s distribution header to provide a vent to the atmosphere in the event of a sudden reverse flow of the water due to the loss of pump flow.

Tower cool-water basins are reinforced concrete structure, and framing is of wood or fiberglass reinforced plastic (FRP); the exterior is of corrugated sheathing, and the heat exchanger fill is polyvinyl chloride.

The discharge from the cooling tower cold water basins flows into an open channel, over a discharge control structure, and then through gate 1 back to the reservoir through the diffuser. The design of the cold water channel, discharge control structure, and gates 1 and 2 is described in paragraph 12.2.7.

The Condenser Circulating Water System provides for a diffuser discharge system which injects the waste heat into the reservoir in such a way so as to maximize the area of the mixing zone.

The diffusers are extensions of the discharge tunnels, made of corrugated metal pipe laid on the bottom of the reservoir. They have a series of nozzles on the downstream side to inject the condenser discharge water into the main flow of the reservoir. For details of the diffuser system, see paragraph 12.2.7.5. The Condenser Circulating Water System is a combined system capable of operation in open or helper modes, or any combination thereof.

In the open mode, water is drawn into the circulating water pumping station forebay from the reservoir, pumped through the main condenser, passed through gate 1A, and discharged back into the reservoir through the diffusers. Gate 3 is open to allow water to flow into the pumping station forebay, gate 1A is open to allow water to flow back to the reservoir from the plant, gate 2 is closed, and gate 1 is open to allow rainfall in the cooling tower area to run off. Additionally, gate 1 can be opened to assist in CCW pump back pressure control. The vacuum loop in the tunnels to the cooling towers is vented to the atmosphere.

In the helper mode, water is drawn into the circulating water pumping station forebay from the reservoir, pumped through the main condenser, diverted through the vacuum loop into the warm water channel going to the cooling towers, and pumped out of the warm water channel through the cooling towers by the lift pumps. The discharge from the cooling towers flows into the cold water channel, over the discharge control structure, and is then diverted through gate 1 (gate 2 is closed) and is discharged back to the reservoir through the discharge diffusers. Gate 1A may be throttled to assist in warm water channel level control.

The Condenser Circulating Water System is designed so that one of the nine circulating water pumps can furnish adequate flow to the condensers of all three units under shutdown conditions and without normal offsite power supply. Two standby diesel-generators are operated in parallel to start the single pump required for this condition.

One pump cannot be operated alone without its discharge being throttled to produce a head on the pump sufficient to provide a downthrust on the pump. To operate a pump without downthrust will damage the Kingsbury-type thrust bearing in the pump motor.

Practically all of the head in the system is friction, with the exception of the loss through the diffuser nozzles. The entire Condenser Circulating Water System is below siphon-break limitations. A vacuum system operating continuously keeps all passages of the open mode system full.

The pumping station also houses the traveling screen wash pumps, motor-driven fire pumps and strainers, residual heat removal service water pumps, emergency equipment cooling water pumps and strainers, and associated electrical equipment.

The screen wash system can be operated in manual or automatic modes. Differential pressure across each pair of traveling screens is monitored by an air bubbler system. When operating the system in the automatic mode, the screen wash pump is started when a preset pressure differential is reached across any of the three pairs of screens. When a pressure of 70 psi is established at the screen wash nozzles, the screen motors are automatically started and the screens are washed. In either manual or automatic mode the pump and screens run until manually stopped.

Water supply to the RHR service water pumps passes through these screens; however, the pumps take suction from their own pit, separate from the Condenser Circulating Water pumps.

The traveling screens are not designed to operate under loss-of-power conditions. Since the ratio of flow for normal operations to that for loss of normal auxiliary power conditions is about 100:1 (33:1 with loss of Wheeler Dam), adequate flow to the RHR service water pumps is assured without automatic cleaning of the screens.

11.6.4 Power Generation and Safety Evaluation

The intake pumping station is a watertight structure below the top deck which is at EL. 565.

The design of the intake channel and pumping station structure is described in paragraph 12.2.7. The Condenser Circulating Water pumps and valves are not designed to Class I design considerations. The circulating water pump motors and traveling screens are the only parts exposed above grade. The pumps have been analyzed and determined to be stable under tornado wind conditions. They are subject to individual missile damage, but there is virtually no possibility of all nine pump motors being damaged simultaneously by missiles.

One circulating water pump has more than adequate capacity to dissipate the shutdown heat for the three units. A cross-tie with electric-operated butterfly valves is provided between the three circulating water tunnels so that any one pump in emergency, can supply water to all units. As previously stated, throttling of the pump is required to prevent its operating at too-low head conditions. If the units happen to be operating in the helper mode during a power blackout, gate 1A must be manually cranked partially open within 4 hours. This is necessary to avoid the overflow of water out of the warm water channel, due to the single circulating water pump delivering water to the warm water channel with all tower lift pumps off.

The design of gate structures 1, 1A, 2, and 3 is described in paragraph 12.2.7. None of the gates, with the exception of gates in structure 2, in the system has Class I design considerations. The vacuum priming system on the vacuum loop does not have Class I design considerations, but a vacuum breaking system with the remote manual control to break vacuum on the vacuum loop is a redundant, seismic Class I engineered safeguard. The vacuum must be broken by the operator upon loss of the downstream dam to prevent backflow of warm water from the tower warm water channel through the plant to the pumping station forebay.

The Condenser Circulating Water System would be susceptible to backflow to the pumping station forebay, until the operator breaks the siphon at the vacuum loop, if all the main condenser circulating water pumps were to stop with the level in the warm water channel above the forebay level. Therefore, whenever the CCW system is operating with a vacuum in the vacuum loop, the operator shall maintain the warm water channel level below the level of the forebay.

Whenever the level in the warm water channel exceeds the forebay level, the operator is alerted by redundant warm water channel indicator and a forebay/warm water channel differential level indicator in the control room. The control room indicators, level sensors, and control room instrumentation power supply are all designed to seismic Class I criteria. The cabling between the control room and the sensors is not seismically designed. However, the control room indicators give an indication of adverse differential water level or an indication of instrument malfunction, if the cables are short-circuited or open-circuited, respectively. In addition, both of these conditions are alarmed in the control room.

Neither operation of the mechanical draft cooling towers nor of the cooling tower lift pumps serves any safety-related function.

11.6.5 Inspection and Testing

Components of the system which are in continuous service during normal plant operation require no additional periodic testing. Gates, cooling towers, and other nonsafety-related components which operate intermittently are inspected and tested periodically for operability. All safety-related features such as the vacuum breaking system are also inspected and tested periodically to verify their operability.

11.6.6 Operational Requirements

In addition to the condenser cooling requirements, the Condenser Circulating Water System supplies water to the plant raw cooling water pumps.

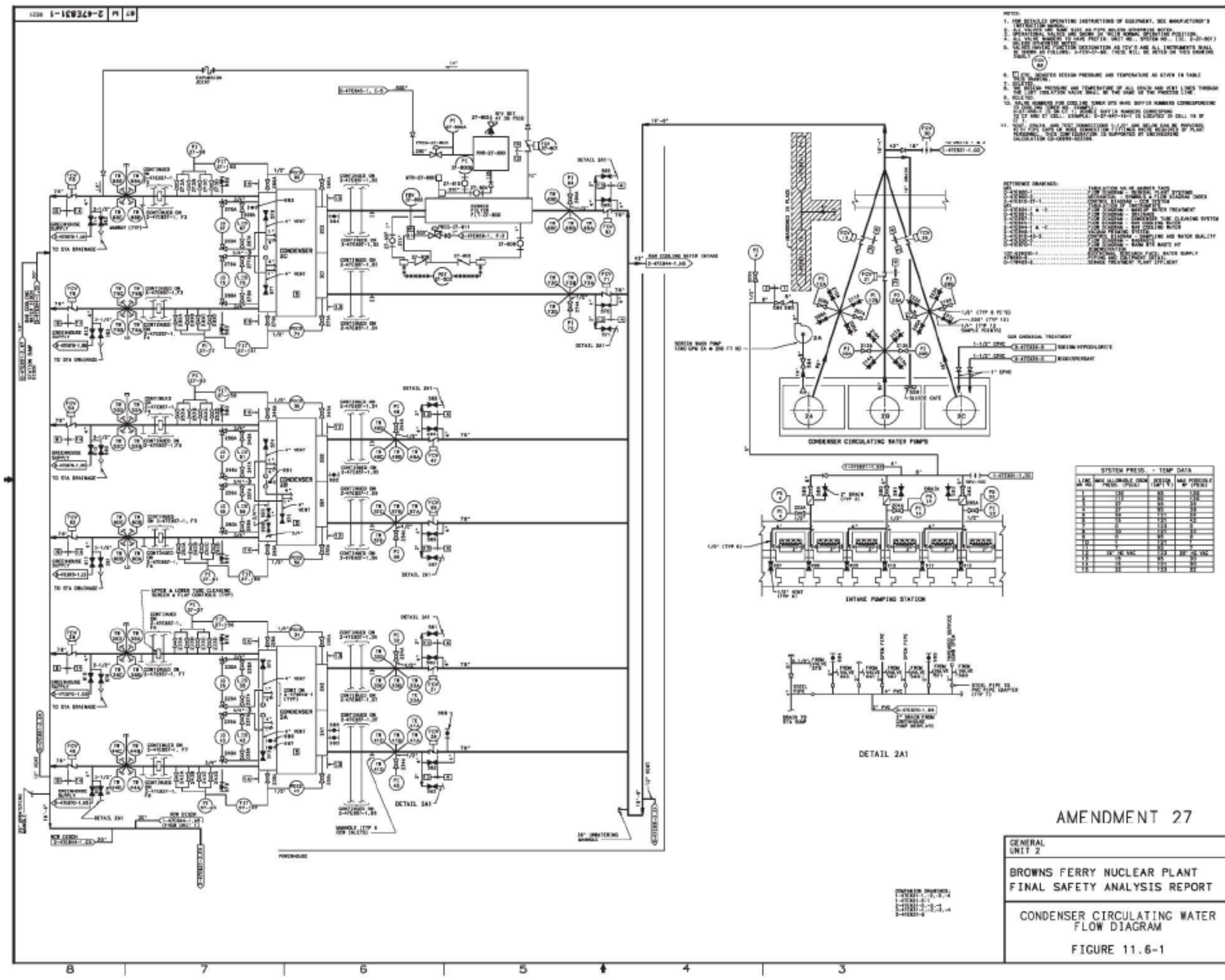
In the event of complete outage of the circulating water pumps, at least one raw cooling water pump per unit can still be supplied from the condenser intake tunnels. In the event of complete failure of the Condenser Circulating Water System, the essential systems are provided with backup supply from the RHR service water pumps feeding through the EECW system.

11.6.7 Radioactive Waste Discharge

Operation of the radioactive system discharge, in conjunction with the Condenser Circulating Water System, is described in paragraph 9.2.5.

Table 11.6-1

(Deleted by Amendment 28)



AMENDMENT 27

GENERAL
UNIT 2

BROWNS FERRY NUCLEAR PLANT
FINAL SAFETY ANALYSIS REPORT

CONDENSER CIRCULATING WATER FLOW DIAGRAM

FIGURE 11.6-1

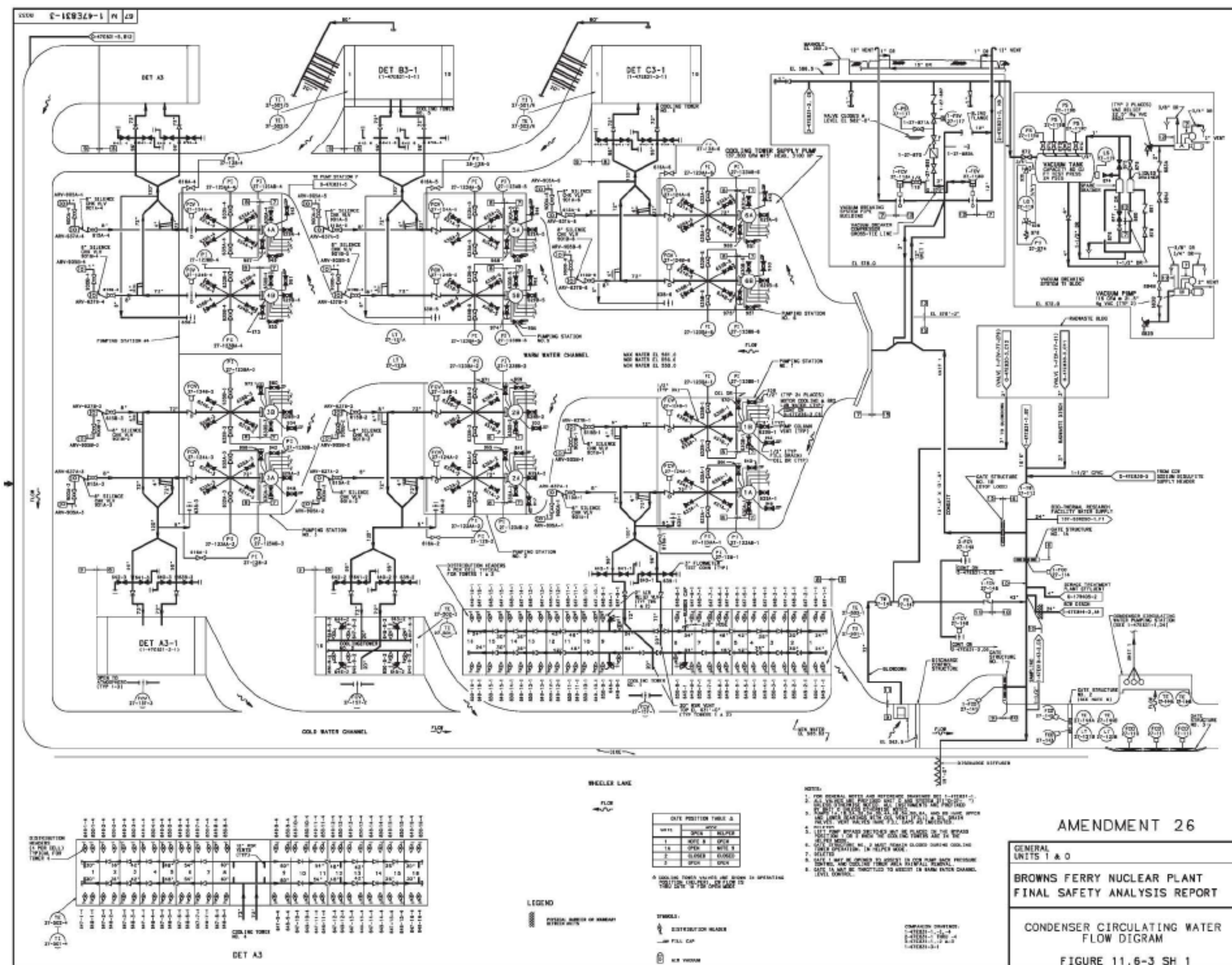
SECURITY RELATED INFORMATION
FIGURE WITHHELD UNDER 10 CFR 2.390

POWERHOUSE
UNIT 1

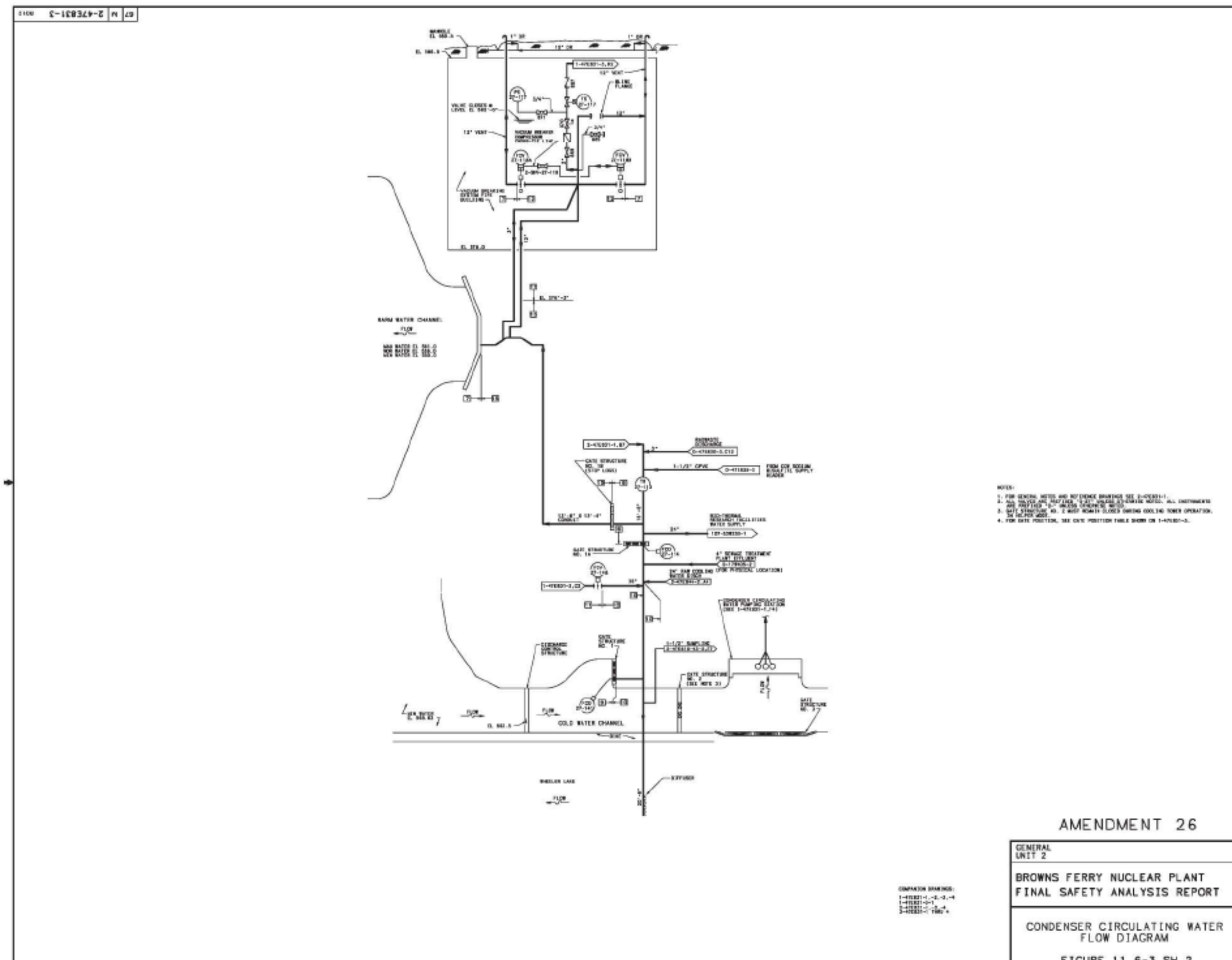
BROWNS FERRY NUCLEAR PLANT
FINAL SAFETY ANALYSIS REPORT

CONDENSER CIRCULATING WATER
FLOW DIAGRAM

FIGURE 11.6-2



DET A3
DET B3-1
DET C3-1
DET A3-1
COOLING TOWER SUPPLY PUMP
WARM WATER CHANNEL
COLD WATER CHANNEL
WHEELER LAKE
LEGEND
AMENDMENT 26
GENERAL
UNITS 1 & 0
BROWNS FERRY NUCLEAR PLANT
FINAL SAFETY ANALYSIS REPORT
CONDENSER CIRCULATING WATER
FLOW DIGRAM
FIGURE 11.6-3 SH 1



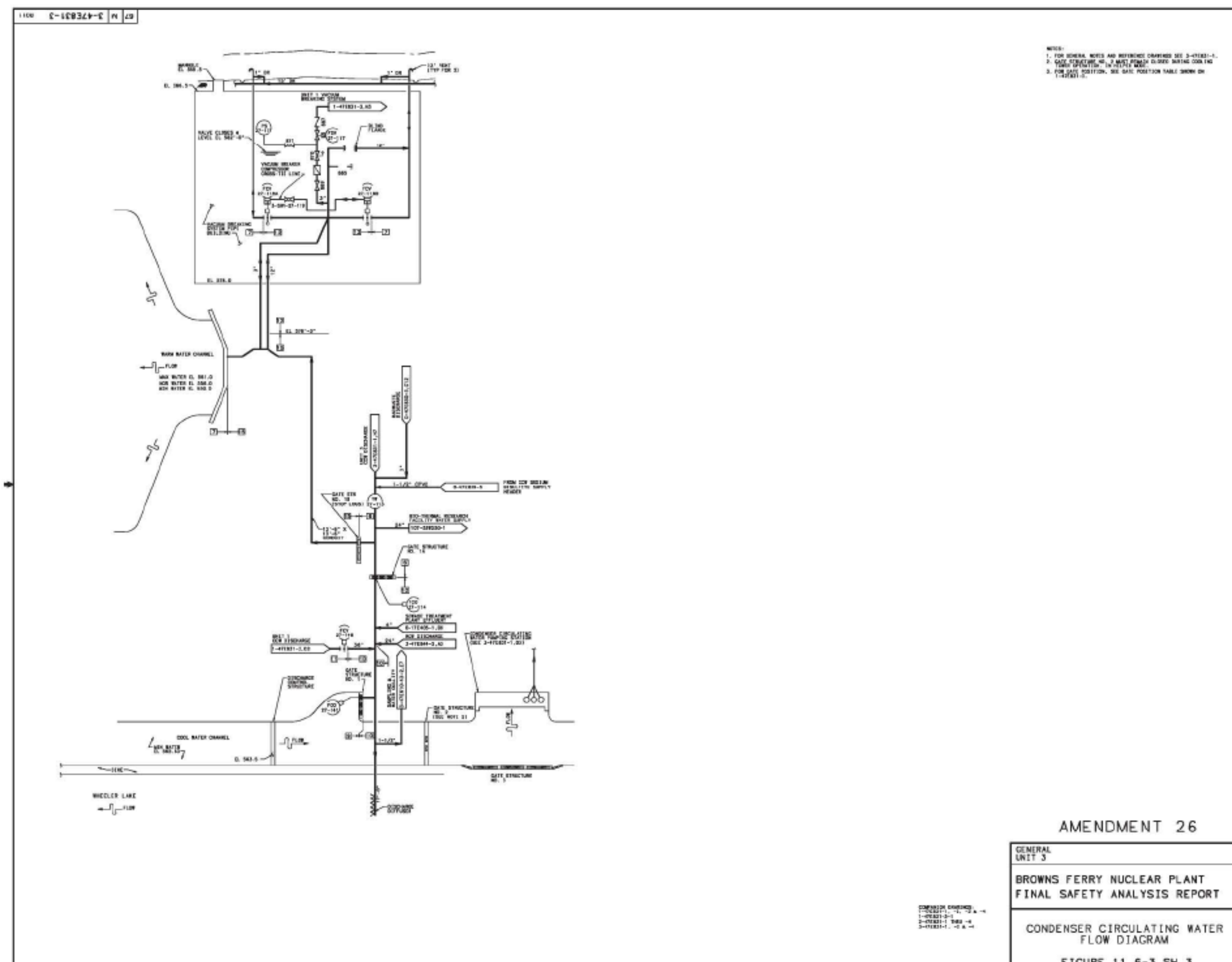
AMENDMENT 26

GENERAL
UNIT 2

BROWNS FERRY NUCLEAR PLANT
FINAL SAFETY ANALYSIS REPORT

CONDENSER CIRCULATING WATER
FLOW DIAGRAM

FIGURE 11.6-3 SH 2



AMENDMENT 26

GENERAL
UNIT 3

BROWNS FERRY NUCLEAR PLANT
FINAL SAFETY ANALYSIS REPORT

CONDENSER CIRCULATING WATER
FLOW DIAGRAM

FIGURE 11.6-3 SH 3

SECURITY RELATED INFORMATION
FIGURE WITHHELD UNDER 10 CFR 2.390

POWERHOUSE
UNIT 2

BROWNS FERRY NUCLEAR PLANT
FINAL SAFETY ANALYSIS REPORT

CONDENSER CIRCULATING WATER
FLOW DIAGRAM

FIGURE 11.6-3 SH 4

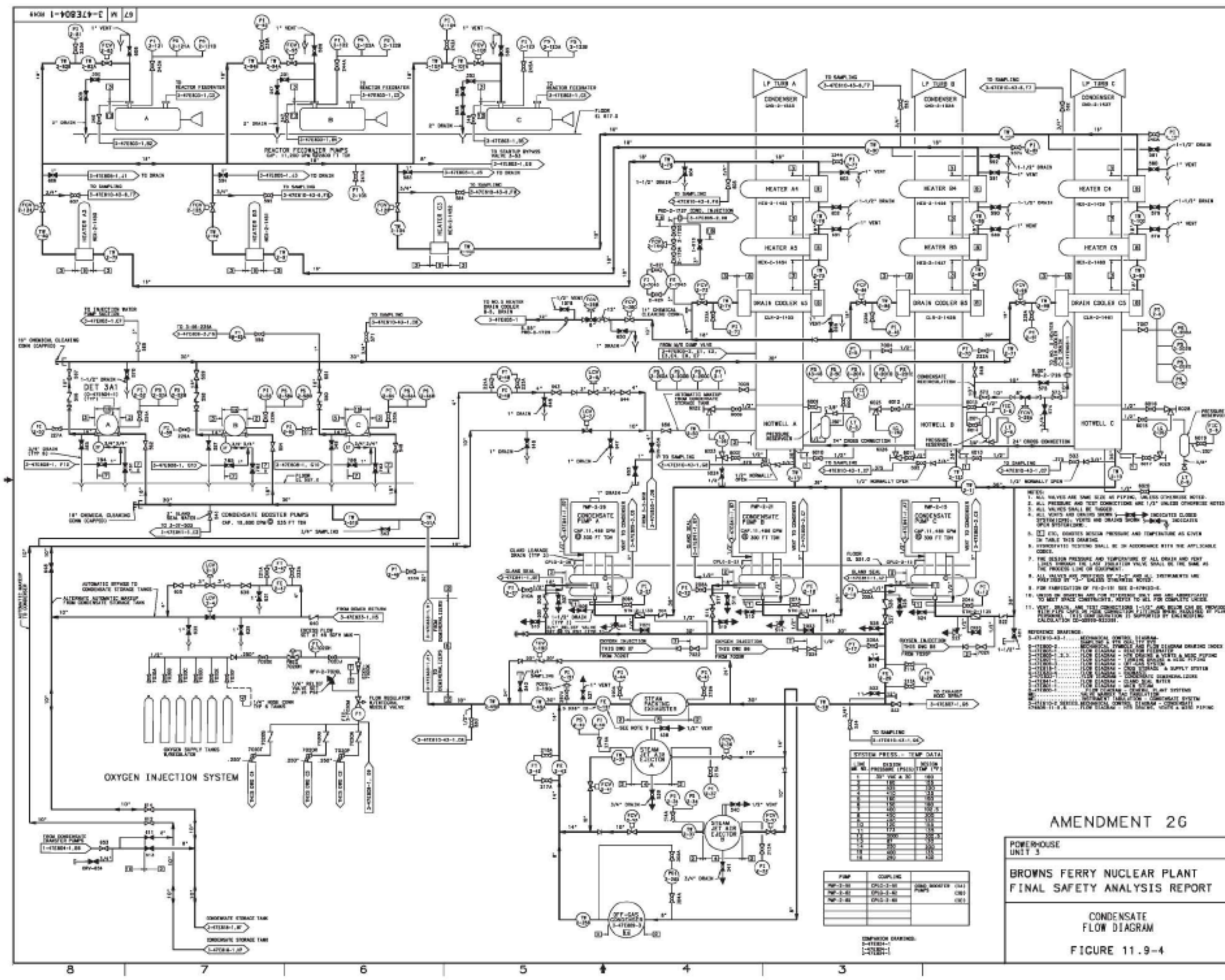
SECURITY RELATED INFORMATION
FIGURE WITHHELD UNDER 10 CFR 2.390

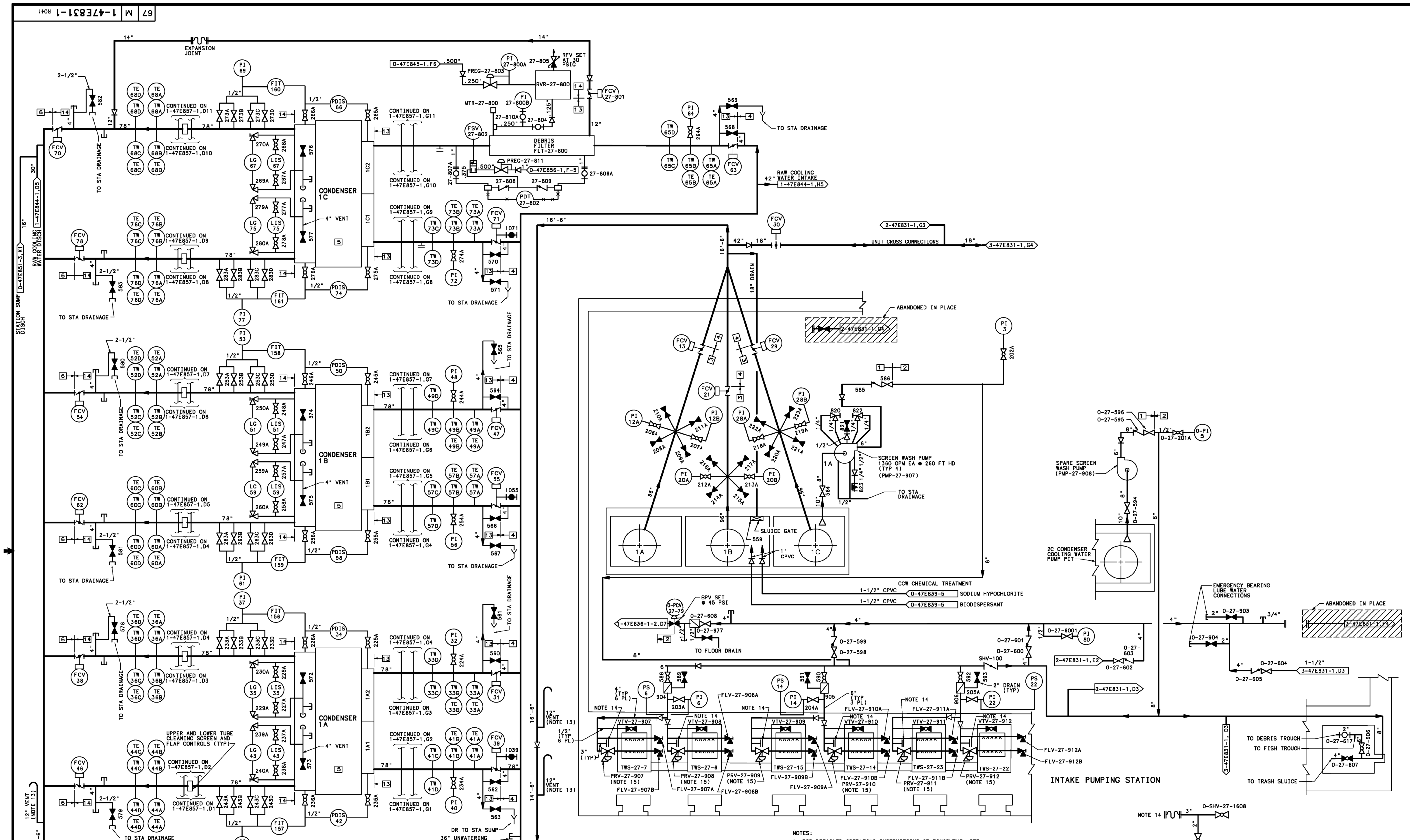
POWERHOUSE
UNIT 3

BROWNS FERRY NUCLEAR PLANT
FINAL SAFETY ANALYSIS REPORT

CONDENSER CIRCULATING WATER
FLOW DIAGRAM

FIGURE 11.6-3 SH 5


REACTOR FEEDWATER PUMPS
CONDENSATE BOOSTER PUMPS
HEATER A1
HEATER B1
HEATER C1
HEATER A5
HEATER B5
HEATER C5
DRAIN COOLER A5
DRAIN COOLER B5
DRAIN COOLER C5
LP TURB A
LP TURB B
LP TURB C
CONDENSER
HOTWELL A
HOTWELL B
HOTWELL C
24" CROSS CONNECTION
CONDENSATE PUMP A
CONDENSATE PUMP B
CONDENSATE PUMP C
STEAM PACKING EXHAUSTER
STEAM JET AIR EJECTOR A
STEAM JET AIR EJECTOR B
OXYGEN SUPPLY TANKS
OXYGEN INJECTION SYSTEM
SYSTEM PRESS.-TEMP DATA
AMENDMENT 26
POWERHOUSE
UNIT 3
BROWNS FERRY NUCLEAR PLANT
FINAL SAFETY ANALYSIS REPORT
CONDENSATE
FLOW DIAGRAM
FIGURE 11.9-4



REFERENCE DRAWINGS:

1-47E610-43-2............CONTROL DIAGRAM - SAMPLING & WATER QUALITY SYSTEM
0-47E836-2, -4...........FLOW DIAGRAM - RSW & FP SYSTEM
2-47E831-1,-3............FLOW DIAGRAM - CONDENSER CIRCULATING WATER (UNIT 2)
3-47E831-1,-3............FLOW DIAGRAM - CONDENSER CIRCULATING WATER (UNIT 3)
MEL......................INSTRUMENTS AND VALVE MARKER TAGS TABULATION
1-47E610-27 SERIES.......CONTROL DIAGRAM - CCW
0-47E834-2...............FLOW DIAGRAM - MAKEUP WATER TREATMENT
1-47E836-1...............FLOW DIAGRAM - RSW & FP SYSTEM
1-47E844-1, -2...........FLOW DIAGRAM - RAW COOLING WATER
0-47E851-3,-4............FLOW DIAGRAM-DRAINAGE
1-47E857-1...............FLOW DIAGRAM-CONDENSER TUBE CLEANING SYSTEM
0-47E800-1...............FLOW DIAGRAM - GENERAL PLANT SYSTEMS
0-47E800-2...............MECHANICAL SYMBOLS AND FLOW DIAGRAM DRAWING INDEX
0-47E830-3...............FLOW DIAGRAM - RADWASTE
47W560-6.................PIPING AND EQUIPMENT DETAILS
0-17W405-2...............FLOW DIAGRAM - SEWAGE TREATMENT PLANT
1-47E848-1...............VACUUM PRIMING SYSTEM
0-47E610-27-7............CONTROL DIAGRAM-PUMPING STATION NO. 7 AND COOLING TOWER NO. 7

SYSTEM PRESS.- TEMP DATA

LINE MK NO.	MAX ALLOWABLE DSGN PRESS. (PSIG)	DESIGN TEMP(°F)	MAX POSSIBLE WP (PSIG)
1	130	95	130
2	115	95	130
3	27	95	35
4	27	95	38
5	26	123	26
6	15	123	42
7	0	123	0
8	33	123	33
9	0	95	0
10	1	123	1
11	7	95	7
12	26" HG VAC	123	26" HG VAC
13	15	95	30
14	15	123	30
15	22	123	22
16	75	123	75
17	104	123	104

NOTES:

1. FOR DETAILED OPERATING INSTRUCTIONS OF EQUIPMENT, SEE MANUFACTURER'S INSTRUCTION MANUAL.
2. ALL VALVES ARE SAME SIZE AS PIPE UNLESS OTHERWISE NOTED.
3. OPERATIONAL VALVES ARE SHOWN IN THEIR NORMAL OPERATING POSITION.
4. ALL VALVE NUMBERS TO HAVE PREFIX: 1-27 UNLESS OTHERWISE NOTED.
5. VALVES HAVING FUNCTION DESIGNATION AS FLOW CONTROL VALVES SHALL BE SHOWN AS FOLLOWS: 1-FCV-27-88. THESE WILL BE NOTED ON THIS DRAWING THUSLY FCV 88.
6. 1 ETC, DENOTES DESIGN PRESSURE AND TEMPERATURE AS GIVEN IN TABLE THIS DRAWING.
7. HYDROSTATIC TESTING SHALL BE IN ACCORDANCE WITH THE APPLICABLE CODES.
8. THE DESIGN PRESSURE AND TEMPERATURE OF ALL DRAIN AND VENT LINES THROUGH THE LAST ISOLATION VALVE SHALL BE THE SAME AS THE PROCESS LINE.
9. DELETED.
10. VALVE NUMBERS FOR COOLING TOWER SYS HAVE SUFFIX NUMBERS CORRESPONDING TO COOLING TOWER NO. EXAMPLE: 0-27-646-1 IS ON CT 1; DOUBLE SUFFIX NUMBERS CORRESPOND TO CT AND CT CELL. EXAMPLE: 0-27-647-16-1 IS LOCATED IN CELL 16 OF CT 1.
11. UNIDS ON DRAWING ARE FOR REFERENCE ONLY AND ARE ABBREVIATED TO MEET SPACE CONSTRAINTS. REFER TO MEL FOR COMPLETE UNIDS.
12. VENT, DRAIN, AND TEST CONNECTIONS 1-1/2" AND BELOW CAN BE PROVIDED WITH PIPE CAPS OR HOSE CONNECTION FITTINGS WHERE REQUIRED BY PLANT PERSONNEL. THIS CONFIGURATION IS SUPPORTED BY ENGINEERING CALCULATION CD-Q0999-923399.
13. FOR INTAKE AND DISCHARGE VENT DETAILS, SEE DRAWINGS 0-47E851-3, COORDINATES D3, D5 AND D9.
14. ALTERNATE TROUGH FLUSHING LINE MAY BE CONNECTED AT ANY EXISTING FLANGE CONNECTION BETWEEN LOW PRESSURE AND HIGH PRESSURE SPRAY HEADERS. SEE 0-37W205-22, 0-37W205-23, 0-37W205-24 AND 0-37W205-26.
15. PRV-27-907 THRU -912 ARE NOT PRESENT WHEN THE FISH SPRAY HEADER IS NOT USED. SEE 0-37W205-25 NOTE 3.

PHYSICAL BARRIER OR BOUNDARY BETWEEN UNITS

AMENDMENT 28

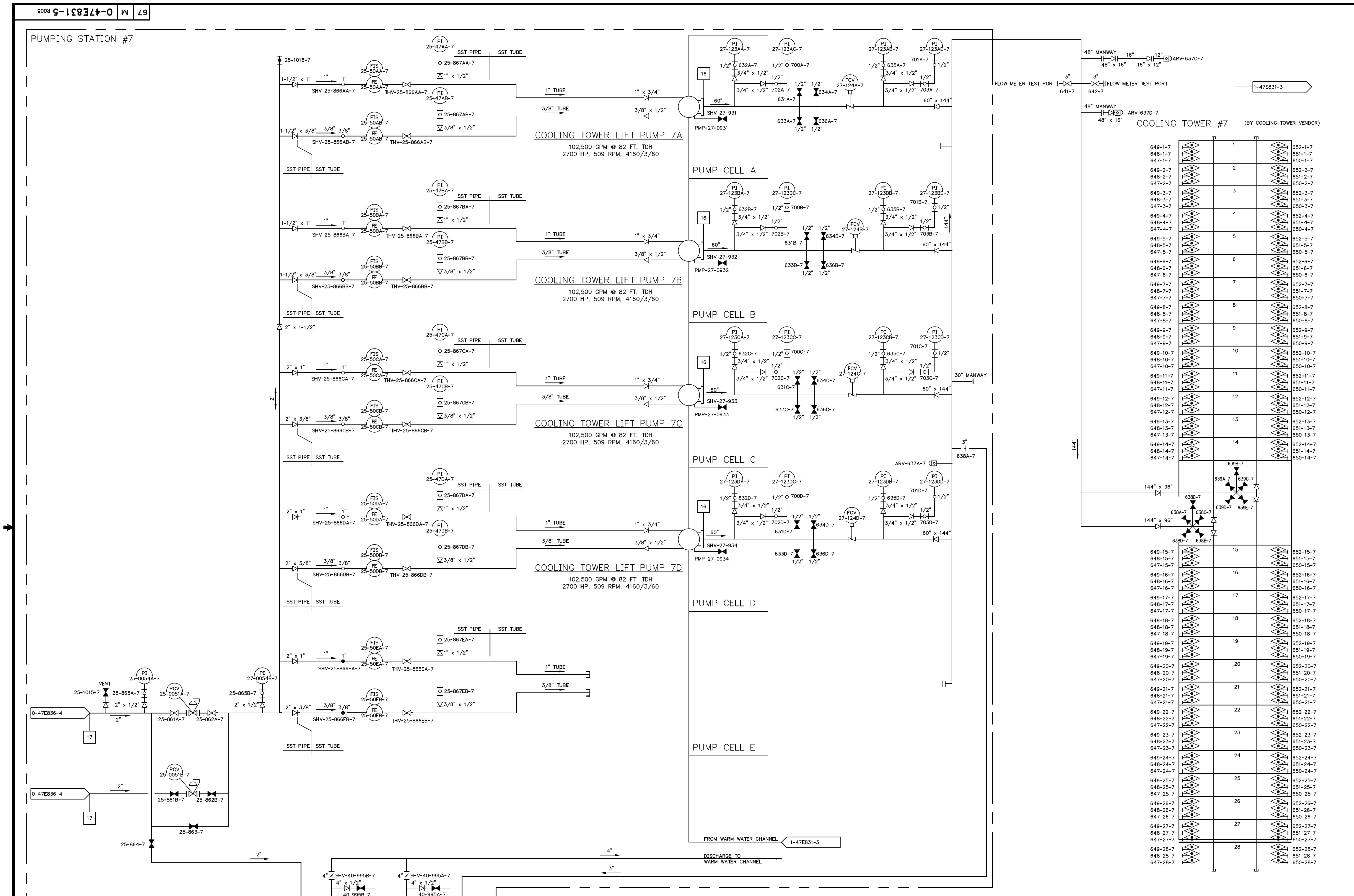
COMPANION DRAWINGS:
1-47E831-2,-3,-4
1-47E831-3-1
2-47E831-1,-2,-3,-4
3-47E831-1,-2,-3,-4
0-47E831-5

GENERAL
UNITS 1 & 0

BROWNS FERRY NUCLEAR PLANT
FINAL SAFETY ANALYSIS REPORT

CONDENSATE CIRCULATING WATER
FLOW DIAGRAM

FIGURE 11.6-5



NOTES:

1. FOR GENERAL NOTES AND REFERENCE DRAWINGS SEE 1-47E831-1.

2. ALL INSTRUMENTS ARE PREFIXED BY UNIT 0 UNLESS OTHERWISE NOTED. ALL OTHER UNIDS ARE PREFIXED UNIT 0 AND SYSTEM 27 UNLESS OTHERWISE NOTED.

3. SEE MEL FOR INSTRUMENT RANGE AND SET POINT INFORMATION.

4. UNIDS ON DRAWINGS ARE FOR REFERENCE ONLY AND ARE ABBREVIATED TO MEET SPACE CONSTRAINTS. REFER TO MEL FOR COMPLETE UNIDS.

5. 16 & 17 SEE DRAWING 1-47E831-1 NOTE 6.

NOTES CONT:

6. UP TO A TOTAL OF TWELVE (12) LIFT PUMPS MAY BE PUT IN SERVICE IN ANY COMBINATION FROM COOLING TOWERS 1 THROUGH 7 WITHOUT RESTRICTIONS OR ADDITIONAL MONITORING. ALTERNATELY, IF ALL FOUR OF THE LIFT PUMPS IN COOLING TOWER 7 ARE IN SERVICE, UP TO NINE OF THE PUMPS IN COOLING TOWERS 1 THROUGH 6 MAY BE IN SERVICE. THIS IS ACCEPTABLE BECAUSE THE FLOW CAPACITY OF THE FOUR LIFT PUMPS IN COOLING TOWER 7 IS EQUAL TO THE FLOW CAPACITY OF THREE LIFT PUMPS IN COOLING TOWERS 1 THROUGH 6. ADDITIONAL LIFT PUMPS MAY BE PUT IN SERVICE, ONE AT A TIME, AT INTERVALS NOT LESS THAN 1 HOUR, PROVIDED THE RESULTING STEADY STATE WATER SURFACE ELEVATION UPSTREAM AT GATE STRUCTURE NO. 2 IS MONITORED, VISUALLY AS A MINIMUM, AND DOES NOT EXCEED 562'-8" (4" BELOW THE TOP OF THE SIDEWALK LOCATED ON TOP OF THE SHEET PILES ON GATE STRUCTURE NO. 2). THE WATER ELEVATION AT GATE STRUCTURE NO. 2 SHALL NOT EXCEED 562'-8" DURING TRANSITION FROM HELPER MODE TO OPEN MODE. WHEN MORE THAN 12 LIFT PUMPS ARE IN SERVICE, THE LIFT PUMPS SHALL BE REMOVED FROM SERVICE ONE AT A TIME, AT INTERVALS NOT LESS THAN ONE HOUR. IF A RAINFALL IN EXCESS OF 4" PER HOUR IS FORECAST, NO MORE THAN 12 LIFT PUMPS IN ANY COMBINATION FROM COOLING TOWERS 1 THROUGH 7 MAY BE IN SERVICE WITHIN 1 HOUR AFTER INITIATION OF THE RAINFALL.

AMENDMENT 28

YARD PIPING
UNIT 0

BROWNS FERRY NUCLEAR PLANT
FINAL SAFETY ANALYSIS REPORT

FLOW DIAGRAM
PUMPING STATION #7 AND
COOLING TOWER #7

FIGURE 11.6-6

11.7 CONDENSATE FILTER-DEMINERALIZER SYSTEM

11.7.1 Power Generation Objective

The objective of the Condensate Filter-Demineralizer System is to treat the flow of condensate from the condenser hotwell to remove dissolved and suspended solids which result from corrosion in the condenser and associated piping systems and from leakage of cooling water into the condenser.

11.7.2 Power Generation Design Basis

1. The system will be capable of processing the full flow of condensate under normal operating conditions.

2. The system will be capable of handling, at less than full flow, the high concentrations of dissolved and particulate material present in the condensate during startup and restart operations.

3. The system will be capable of handling some inleakage of condenser cooling water with only a minimal increase in effluent conductivity.

11.7.3 System Description

The Condensate Filter-Demineralizer System for each reactor unit consists of ten filter-demineralizer units, a backwash system, a precoat system, and a bodycoat system (Figures 11.7-1, 11.7-2, and 11.7-3).

Nine filter-demineralizer units are located in individual concrete cells. No valves or other equipment with moving parts are located within the cells. Holding pumps, which serve to keep the precoat in place while their associated units are out of service, are located in a pump and valve room adjacent to the demineralizer units.

The tenth filter-deminizeralizer unit is located in an area adjacent to the nine filter-demineralizers. It is enclosed by a radiological shield. There are no valves or other equipment with moving parts located within the shield.

The filter-demineralizer units, arranged in parallel, are supplied by the condensate pumps via an inlet header. An outlet header collects the effluent from the individual filter demineralizer. When the unit is shut down for refueling, one or more filter-demineralizer units may be used to polish condensate for filling the reactor well and dryer-separator pit. The fill water is normally supplied from condensate storage to the reactor via the condenser hotwell and the condensate and feedwater lines or via the Core Spray System. At the end of the refueling period, filter-demineralizer units may be used to treat water drained from the reactor well and dryer-separator pit before it is returned to condensate storage.

The filter-demineralizer system effluent water should meet the following minimum expected quality criteria during power operation:

Loading	Effluent
Specific conductivity	Less than 0.1 micromho/cm
Total iron	Less than 10 ppb
Total copper	Less than 2 ppb

The filter-demineralizer vessels are vertical cylinders with dished heads. They are 6 feet in diameter by 6 feet 6 inches straight side height or as described in the vendor manual. The tenth filter-demineralizer vessel is a segmented vertical cylinder with a flat head. It is 6 feet in diameter by 8 feet 8 inches high. Each vessel contains 302 filter elements which are removable for inspection or replacement. The normal flow rate is 32,685 gpm with nine filter-demineralizers in service. Flow rates are approximately equal through each filter-demineralizer unit.

The filter-demineralizer filter elements are coated with a mixture of cation and anion exchange resins in hydrogen and hydroxyl forms, respectively. The coating is applied to the filter elements in thicknesses of up to about 1/4 inch. This coating serves the dual functions of filtration and ion exchange.

A filter-demineralizer unit may be removed from service when its pressure drop exceeds operational requirements or when the effluent conductivity increases above water chemistry specification. The exhausted unit is backwashed to remove the spent resin, which is flushed to a backwash receiver tank. Fresh resin slurry is prepared as required and pumped to the unit, where the resin particles are deposited on the filter elements. Backwash and precoating operations are normally performed automatically but may be performed manually. After precoating is completed, flow produced by the holding pump keeps the resin coating in place on the filter elements until the unit is placed in service. Backwash receiver tank contents are pumped to one of the condensate phase separator tanks in the Radwaste Building.

A strainer which serves as a resin trap is located in the effluent line from each filter-demineralizer unit. The resin trap is designed to stop particulates that might leak through in the event of a failure of one or more filter support elements. Instrumentation and controls are provided to perform the following functions:

a. Measure electrical conductivity of water in the influent header, effluent line of each filter-demineralizer, and effluent header. Alarms are provided for each of the effluent points.

b. Measure pressure drop across each filter-demineralizer, and alarm on high differential pressure.

c. Measure pressure differential between influent and effluent headers, and open the system bypass valve on system high-differential signal.

d. Measure flow rates.

e. Start holding pump when flow rate through any filter-demineralizer unit decreases to a preset setpoint.

f. Alarm high-pressure drop across resin traps.

Controls and local instrumentation for the system are mounted on a panel located near the precoat system. Recorders [Unit 1 only] / Monitors [Units 2 and 3] and alarms are on this panel for Unit 2 only. For Units 1 and 3, alarms and monitors are provided on the panel. In the Main Control Room, an alarm indicates trouble in the condensate demineralizer system. A hand switch which operates the system bypass valve is also located in the Main Control Room. Recorders and alarms for conductivity are also located in the analytical laboratory.

Decontamination of filter-demineralizer units can be performed using the precoat system to make up and circulate decontaminating solutions.

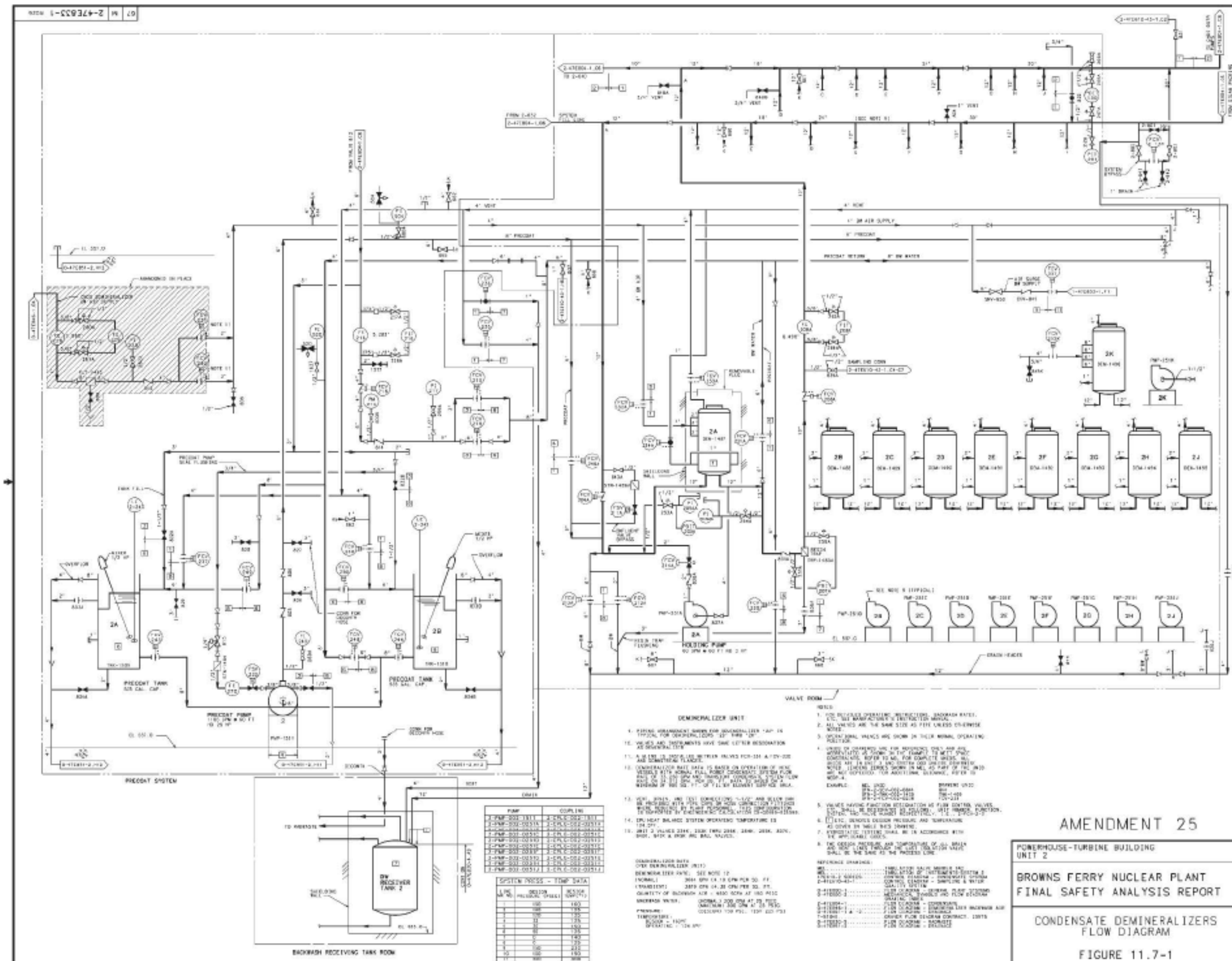
11.7.4 Power Generation Evaluation

In the event of a complete power failure, the condensate pumps stop, and flow through the filter-demineralizers ceases. The holding pumps are not supplied with emergency power, so that they are unable to maintain a minimum flow. Under no-flow conditions, the coating on the filter elements tends to fall to the bottom of the vessel. Before the filter-demineralizers are returned to service, after power is restored, they should be backwashed and precoated.

11.7.5 Inspection and Testing

The filter-demineralizer system is used extensively during preoperational testing and during startup operations. This use provides thorough testing of the system.

Filter-demineralizer elements are replaced by high differential pressure across a filter demineralizer unit or due to resin leakage. Other equipment in the system receives routine maintenance.



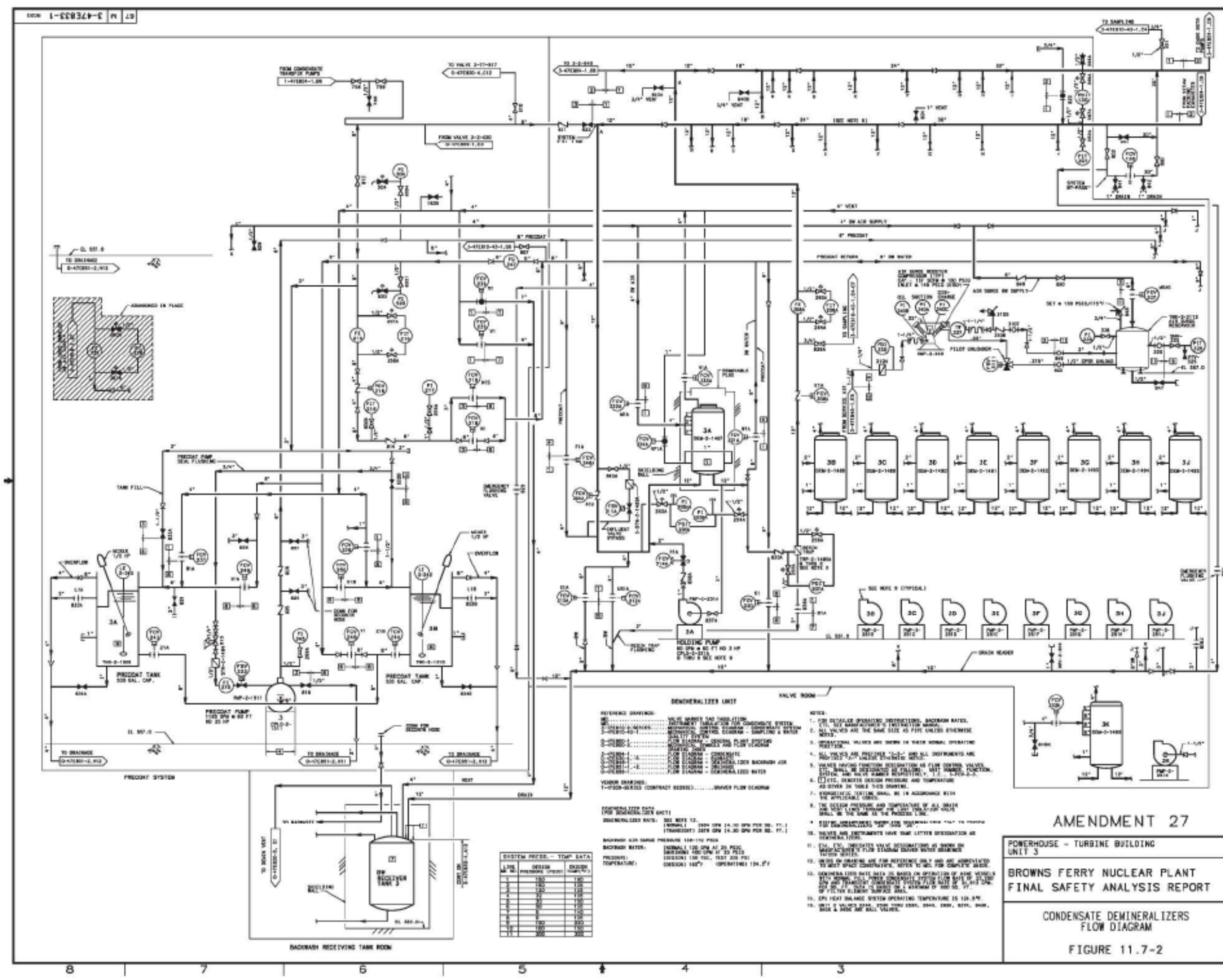
AMENDMENT 25

POWERHOUSE-TURBINE BUILDING
UNIT 2

BROWNS FERRY NUCLEAR PLANT
FINAL SAFETY ANALYSIS REPORT

CONDENSATE DEMINERALIZERS
FLOW DIAGRAM

FIGURE 11.7-1

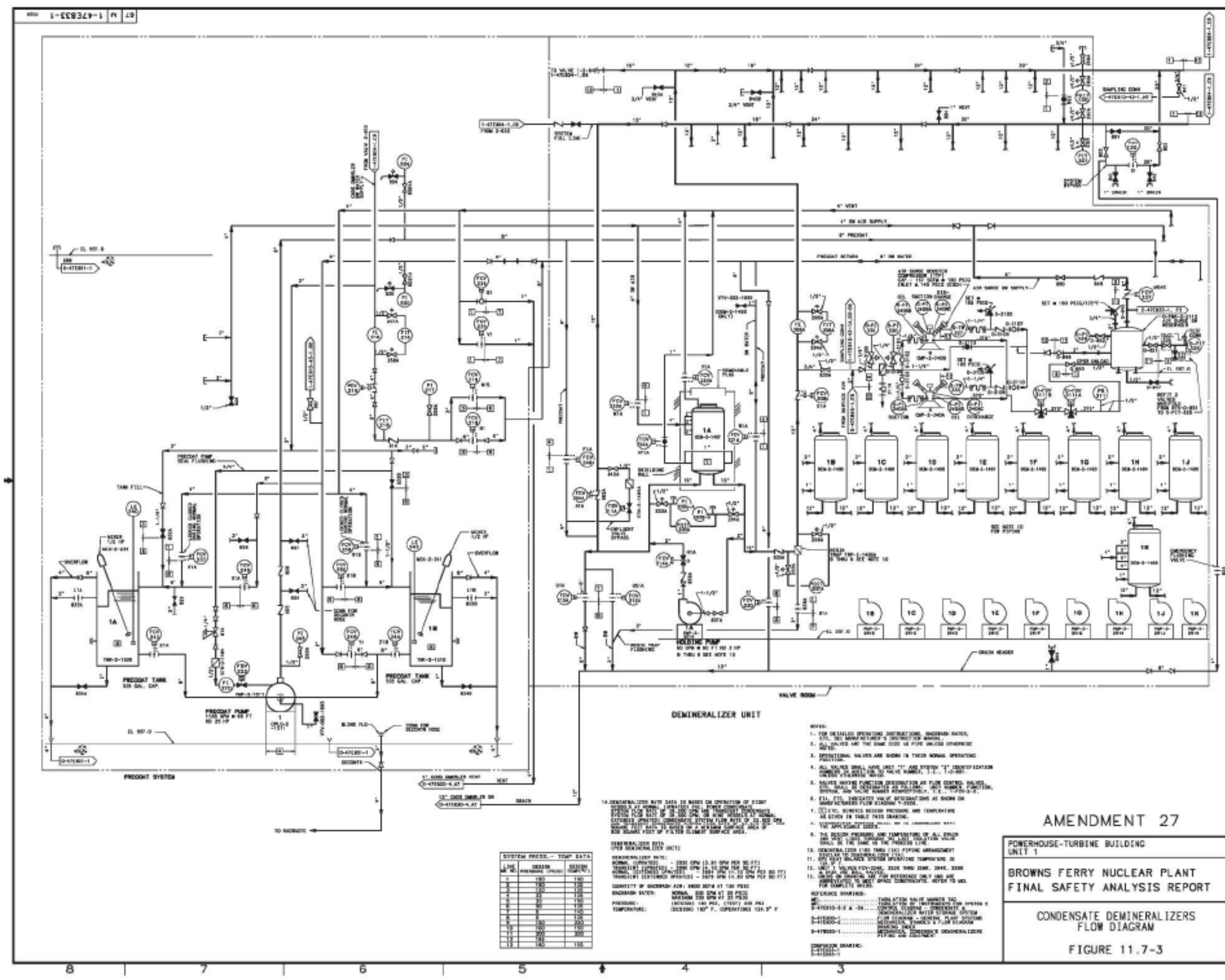


POWERHOUSE - TURBINE BUILDING
UNIT 3

BROWNS FERRY NUCLEAR PLANT
FINAL SAFETY ANALYSIS REPORT

CONDENSATE DEMINERALIZERS
FLOW DIAGRAM

FIGURE 11.7-2



AMENDMENT 27

POWERHOUSE-TURBINE BUILDING
UNIT 1

BROWNS FERRY NUCLEAR PLANT
FINAL SAFETY ANALYSIS REPORT

CONDENSATE DEMINERALIZERS
FLOW DIAGRAM

FIGURE 11.7-3

11.8 CONDENSATE AND REACTOR FEEDWATER SYSTEMS

11.8.1 Power Generation Objective

The objective of the Condensate and Reactor Feedwater Systems is to provide feedwater to the reactor to maintain a constant reactor water level.

11.8.2 Power Generation Design Basis

The Condensate and Reactor Feedwater Systems shall provide adequate feedwater to the reactor vessel during power operation.

11.8.3 System Description

The Condensate and Reactor Feedwater Systems take suction from the main condensers and deliver demineralized water to the reactor vessel at an elevated temperature and pressure. Refer to Figures 11.8-1 sheets 1, 2, 3, 4, 5, and 6, 11.9-1a, 11.9-1b sheets 1, 2, and 3, 11.9-4, and 11.9-5 for system flow paths.

The Condensate and Reactor Feedwater System is designed to provide water to the reactor vessel under main turbine control valves wide-open conditions.

Feedwater heaters are designed in accordance with the Heat Exchange Institute (HEI) Standards for Closed Feedwater Heaters. Portions of the Condensate and Reactor Feedwater Systems are Class II systems, with associated piping designed in accordance with USAS B31.1, 1967. The Class II boundaries of the systems extend from the secondary containment boundary up to the half wall anchor in the steam vault (Reactor Feedwater). The major system components are described below.

11.8.3.1 Condensate and Reactor Feedwater Pumps

Three vertical, centrifugal, motor-driven condensate pumps; three horizontal, centrifugal, motor-driven condensate booster pumps; and three horizontal, centrifugal, single-stage reactor feedwater pumps with variable-speed steam turbines are provided for these systems. In the event one condensate pump, one condensate booster pump, and one reactor feedwater pump are out of service, reactor power operation can be continued at 100% power by the remaining condensate pumps, condensate booster pumps, and reactor feedwater pumps. The feedwater pumps utilize water from the injection water system for sealing and cooling. A differential pressure indicator exists upstream of the feedwater pumps. This decreases the possibility of a loss of feedwater transient caused by inadequate cooling flow to the feedwater pump due to a clogged strainer.

11.8.3.2 Feedwater Heaters

Three parallel strings of heaters, each consisting of three low-pressure feedwater heaters and two high-pressure feedwater heaters, are provided. The feedwater heaters may be taken out of service in various combinations without plant interruption but at a reduced generator output. Analyses show that operation with final feedwater temperature reduced by up to 55 degrees Fahrenheit, at rated conditions, can be accommodated within the licensing basis.

The lowest-pressure heaters have separate drain coolers. All others have integral drain coolers. The two sets of lowest-pressure heaters, along with the separate drain coolers, are located horizontally in the condenser necks.

The remaining three sets of feedwater heaters are vertical. All heaters are of the two-pass, U-tube type. The separate drain coolers are of the one-pass, straight-tube type.

All tubes are stainless steel, rolled, and welded to the tube sheets. Stainless steel baffles are provided at entering steam and drain connections.

Condensate drainage from the drain coolers of each feedwater heater flows to the next lower-pressure heater by means of pressure differential between successive heaters. Condensate drainage exiting from the separate drain cooler of the lowest-pressure heater is returned to the condenser.

11.8.3.3 Condensate Filter/Demineralizer System

A complete full-flow demineralizing system is provided in the condensate system to ensure that required water quality to the reactor vessel is maintained. A description of this system is included in Subsection 11.7.

11.8.3.4 Steam Jet Air Ejector (SJAE) Inter-Condensers

Condensate leaving the condensate pumps is divided and directed through SJAE inter-condensers, offgas condenser, and the steam-packing exhauster. A description of the air removal equipment is included in Subsection 11.4.

11.8.3.5 Steam-Packing Exhauster

The steam-packing exhauster is arranged in parallel with the SJAE to minimize the pressure loss in the condensate system. Description of the exhauster system is included in Subsection 11.4.

11.8.3.6 Offgas Condenser

The offgas condenser is also arranged in parallel with the SJAE. A description of the offgas condenser is included in Subsection 9.5. To further minimize the pressure loss, a butterfly valve is provided to permit part of the condensate to bypass the parallel heat exchangers when flow is adequate to satisfy all performance requirements of the heat exchangers. The condensate side of the offgas condensers is equipped with flow measuring devices. A pressure tap is located at each end of the piping, leading from the condenser to other process systems. These pressure taps are connected to differential pressure indicators which constitute the flow measuring devices. These devices are strategically placed to avoid areas of moisture concentration whenever possible.

11.8.3.7 Feedwater Control

Feedwater flow is normally controlled by varying the speed of the reactor feedwater pump turbine drives. However, during startup, feedwater flow is controlled by startup level control valves (see Subsection 7.10).

11.8.3.8 Condensate and Reactor Feedwater System Minimum Flow Bypasses

The condensate system is provided with minimum flow bypass valves located downstream of the condensate booster pumps. The bypass valves receive their operating signal from a flow device located in the condensate pump discharge line. The purpose of this bypass is to protect the condensate system pumps, and to provide cooling water (condensate) flow to the SJAE condensers, offgas condenser, and steam-packing exhauster at all times.

The reactor feedwater system has a minimum flow bypass line located downstream of each feedwater pump to permit direct recirculation of condensate to the main condensers. The bypass control valve in each line opens on a low-flow signal from a flow-measuring device located downstream of each pump and thereby protects the pumps from damage due to insufficient flow.

11.8.3.9 Condensate Oxygen Injection System

The condensate system is provided with means to inject oxygen gas into the condensate in order to minimize corrosion in the condensate and feedwater system piping. A program of feedwater dissolved oxygen control minimizes corrosion product input into the reactor, thereby decreasing radiolytic activation products, pipe wall thinning, plate-out, and fouling of heat transfer surfaces. The non-safety, non-seismic oxygen injection system is located in the turbine building in an area where no safety-related equipment is located. (See Figures 11.9-1a, 11.9-4, and 11.9-5).

The Unit 2 and Unit 3 injection system consists of supply tanks with regulators supplying oxygen gas to a flow control panel equipped with a manual flow regulator, flow indicator, pressure indicator and manual isolation valves. In addition, a tubing connection from the oxygen tank farm piping is connected downstream of the flow regulator to provide a continuous oxygen supply to the condensate pumps. The injection tubing connects to each of the three condensate pumps' suction. The manually operated injection system design provides features to limit excess oxygen flow into the condensate/feedwater system. An excess flow check valve protects against excess gas flow due to regulator failure or injection tube break. The tubing and panel are protected from over pressure with a relief valve, and check valves prevent backflow of condensate into the oxygen injection system.

The Unit 1 injection consists of manual isolation valves. A tubing connection from the oxygen tank farm piping provides a continuous oxygen supply to the condensate pumps. The injection tubing connects to each of the three condensate pumps' suction. The manually operated injection system design provides features to limit excess oxygen flow into the condensate/feedwater system. Check valves prevent backflow of condensate into the oxygen injection system.

11.8.3.10 Zinc Injection Skid

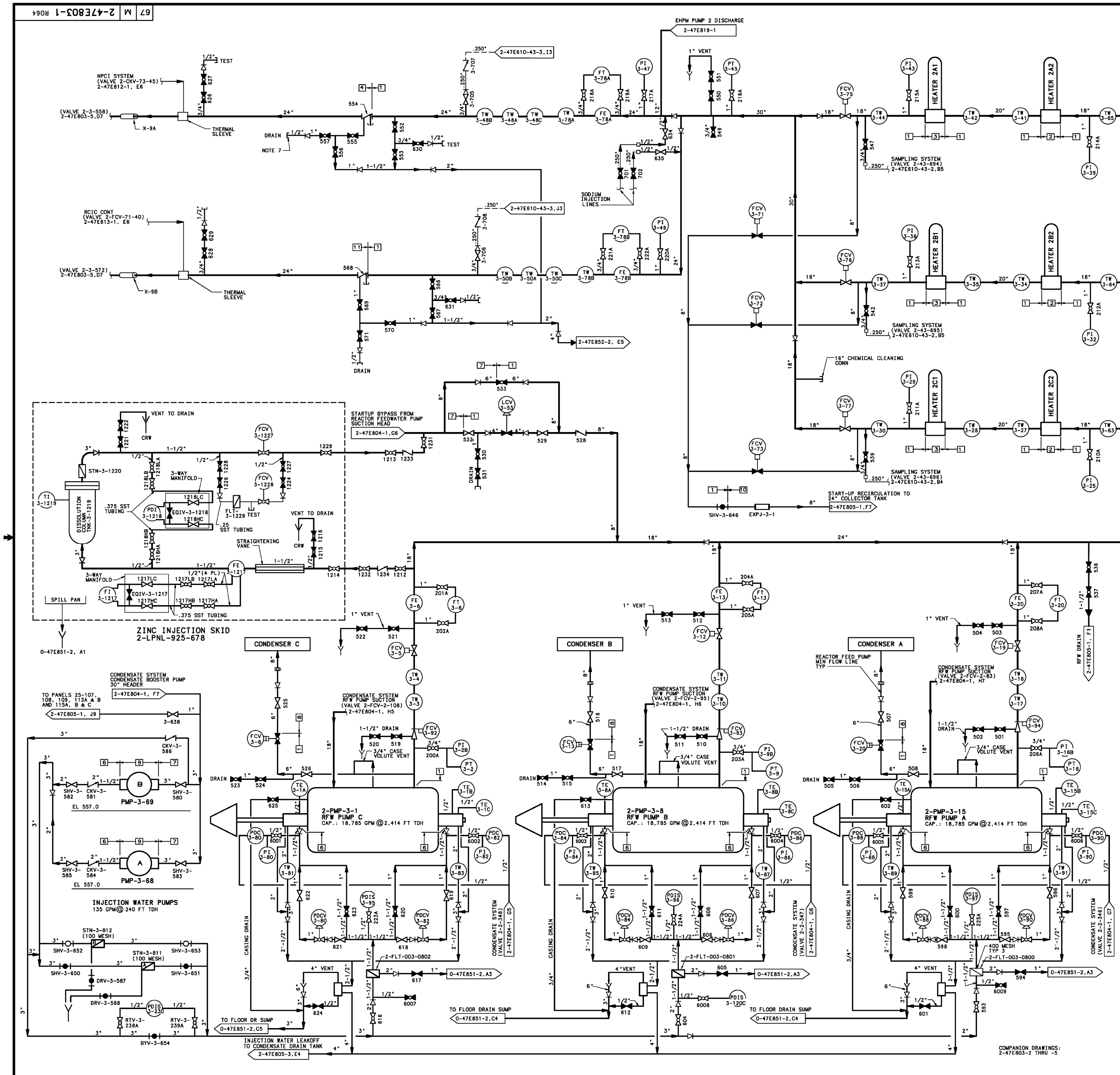
The Feedwater System is provided with a passive Zinc Injection System. The system consists of a simple recirculation loop around the feedwater pumps which injects (dissolves) small amounts of zinc oxide into the reactor feedwater. The presence of trace quantities of zinc reduces occupational radiation exposure to plant personnel by promoting the formation of a thin oxide layer on stainless steel piping and components. This thin oxide layer results in reduced soluble Co-60 buildup and is a primary factor in reducing shutdown dose rates on piping and components (see Figures 11.8-1 sheets 1, 3, and 5).

11.8.4 Inspection and Testing

Test and inspection of system components and equipment are conducted to ensure functional performance as required for continued safe operation, and to provide maximum protection for operating personnel.

The initial factory acceptance testing of the condensate and reactor feedwater pumps, and the shell and tube sides of the feedwater heaters, consists of hydrostatic testing at 1-1/2 times the design pressure.

Condensate and reactor feedwater pumps received shop tests verifying pump head, capacity, efficiency, and BHP requirements over the entire flow range. Certified pump curves are on record and final pump data have been incorporated into system design.



SYSTEM PRESS.- TEMP DATA		
LINE MK NO.	DESIGN PRESSURE (PSIG)	DESIGN TEMP(°F)
1	1250	400
2	1350	360
3	1350	410
4	1375	545
6	625	301
7	525	301
8	130	330
9	625	200
10	125	350
11	1375	545

NOTES:
1. ALL VALVES ARE SAME SIZE AS PIPING, UNLESS OTHERWISE NOTED.
2. ALL VALVES ARE PREFIXED BY UNIT NUMBER 2- AND SYSTEM NUMBER 3-, UNLESS OTHERWISE INDICATED.
3. ALL VENTS AND DRAINS SHOWN , INDICATES CLOSED SYSTEM, (CRW); VENTS AND DRAINS SHOWN , INDICATES OPEN SYSTEM, (DRW).
4. $\boxed{1}$ ETC, DENOTES DESIGN PRESSURE AND TEMPERATURE AS GIVEN IN TABLE THIS DRAWING.
5. HYDROSTATIC TESTING SHALL BE IN ACCORDANCE WITH THE APPLICABLE CODES.
6. THE DESIGN PRESSURE AND TEMPERATURE OF ALL DRAIN AND VENT LINES THROUGH THE LAST ISOLATION VALVE SHALL BE THE SAME AS THE PROCESS LINE.
7. CAP IS OPTIONAL
8. VENT, DRAIN, AND TEST CONNECTIONS 1-1/2" AND BELOW CAN BE PROVIDED WITH PIPE CAPS OR HOSE CONNECTION FITTINGS WHERE REQUIRED BY PLANT PERSONNEL. THIS CONFIGURATION IS SUPPORTED BY ENGINEERING CALCULATION CD-Q0999-923399.
9. DELETED.
10. FOR OPERATIONAL RESTRICTIONS AND LIMITATIONS ON THE REACTOR FEEDWATER PUMPS SEE 2-47E800-3.

REFERENCE DRAWINGS:

2-45E612-1, -2 & -3...WIRING DIAGRAM-REACTOR FEED PUMP TURBINES SCHEMATIC DIAGRAM
MEL...................VALVE MARKER TAG TABULATION
MEL...................INSTRUMENT TABULATION FOR FEEDWATER SYSTEM
47W415-1 SERIES.......REACTOR FEEDWATER PIPING
47W420 SERIES.........PHYSICAL PIPING DRAWING
47W545 SERIES.........PHYSICAL PIPING DRAWING
2-47E610-3 SERIES.....MECHANICAL CONTROL DIAGRAM-REACTOR FEEDWATER SYSTEM
2-47E610-43-1,-2......MECHANICAL CONTROL DIAGRAM-SAMPLING & WATER QUALITY
2-47E610-46-1.........MECHANICAL CONTROL DIAGRAM-FEEDWATER CONTROL SYSTEM
0-47E800-1............MECHANICAL FLOW DIAGRAM-GENERAL PLANT SYSTEMS
0-47E800-2............MECHANICAL FLOW DIAGRAM-MECHANICAL SYMBOLS & FLOW DIAGRAM DRAWING INDEX
2-47E801-2............MECHANICAL FLOW DIAGRAM-MAIN STEAM
1-47E803-1............MECHANICAL FLOW DIAGRAM-REACTOR FEEDWATER SYSTEM
3-47E803-1............MECHANICAL FLOW DIAGRAM-REACTOR FEEDWATER SYSTEM
2-47E803-2 THRU -4....MECHANICAL FLOW DIAGRAM-REACTOR FEEDWATER SYSTEM
2-47E804-1............MECHANICAL FLOW DIAGRAM-CONDENSATE
2-47E805-1,-3.........MECHANICAL FLOW DIAGRAM-HEATER DRAINS AND VENTS AND MISCELLANEOUS PIPING
2-47E810-1............MECHANICAL FLOW DIAGRAM-REACTOR WATER CLEANUP SYSTEM
2-47E812-1............MECHANICAL FLOW DIAGRAM-HIGH PRESSURE COOLANT INJECTION SYSTEM
2-47E813-1............MECHANICAL FLOW DIAGRAM-REACTOR CORE ISOLATION COOLING SYSTEM
2-47E816-1............MECHANICAL FLOW DIAGRAM-LUBRICATING OIL SYSTEM
2-47E817-1............MECHANICAL FLOW DIAGRAM-NUCLEAR BOILER
2-47E820-2............MECHANICAL FLOW DIAGRAM-CONTROL ROD DRIVE HYDRAULIC SYSTEM
2-47E841-1............FLOW DIAGRAM-GLAND SEAL WATER
2-47E852-2............MECHANICAL FLOW DIAGRAM-CLEAN RADWASTE AND DECON DRAINAGE
2-509E624CD-1,-2,-3...WIRING ARRANGEMENT
2-509E603AD...........CONTROLS DIAGRAM
K-15542...............GENERAL TURBINE DATA

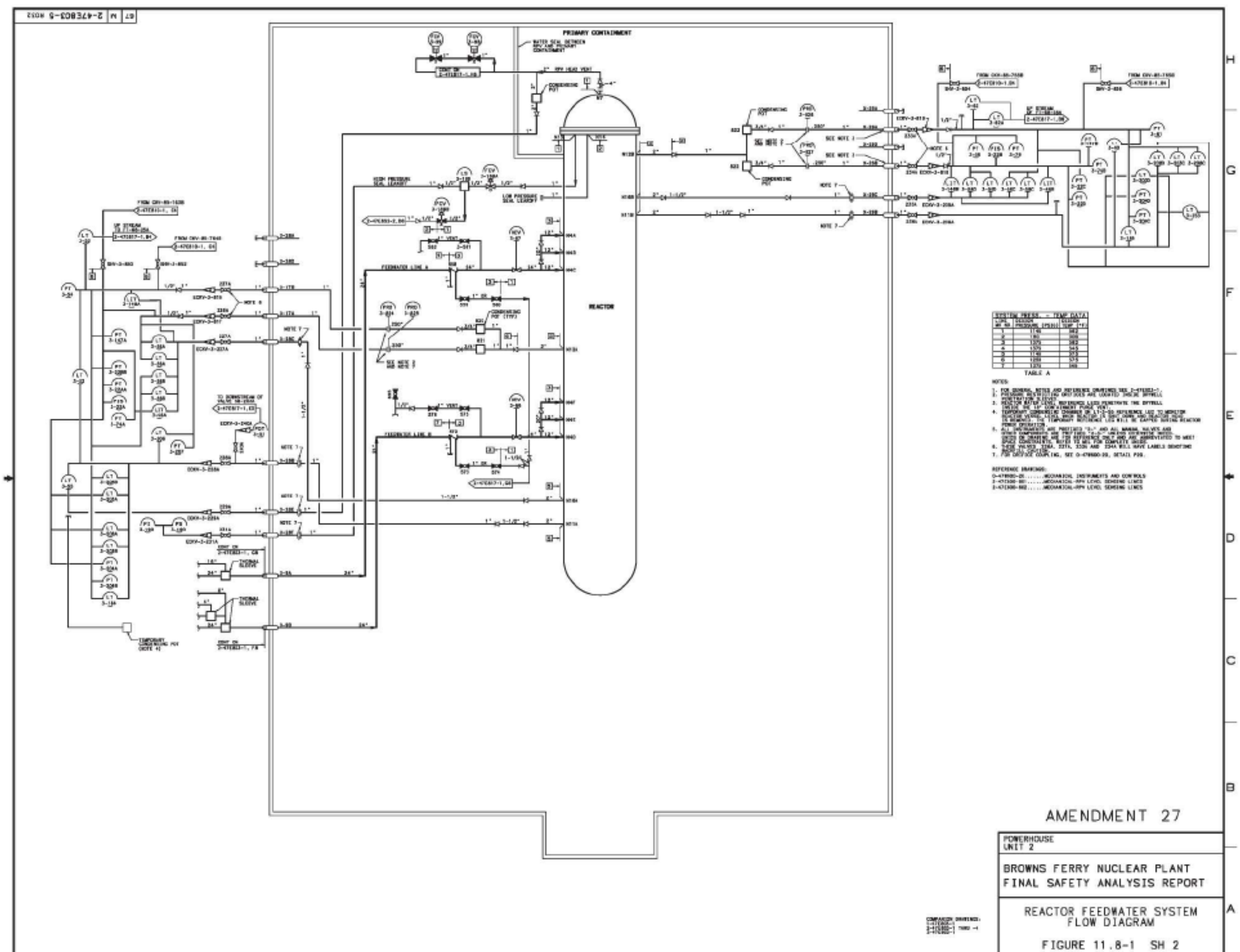
AMENDMENT 28

POWERHOUSE
UNIT 2

BROWNS FERRY NUCLEAR PLANT
FINAL SAFETY ANALYSIS REPORT

REACTOR FEEDWATER
FLOW DIAGRAM

FIGURE 11.8-1 SH 1

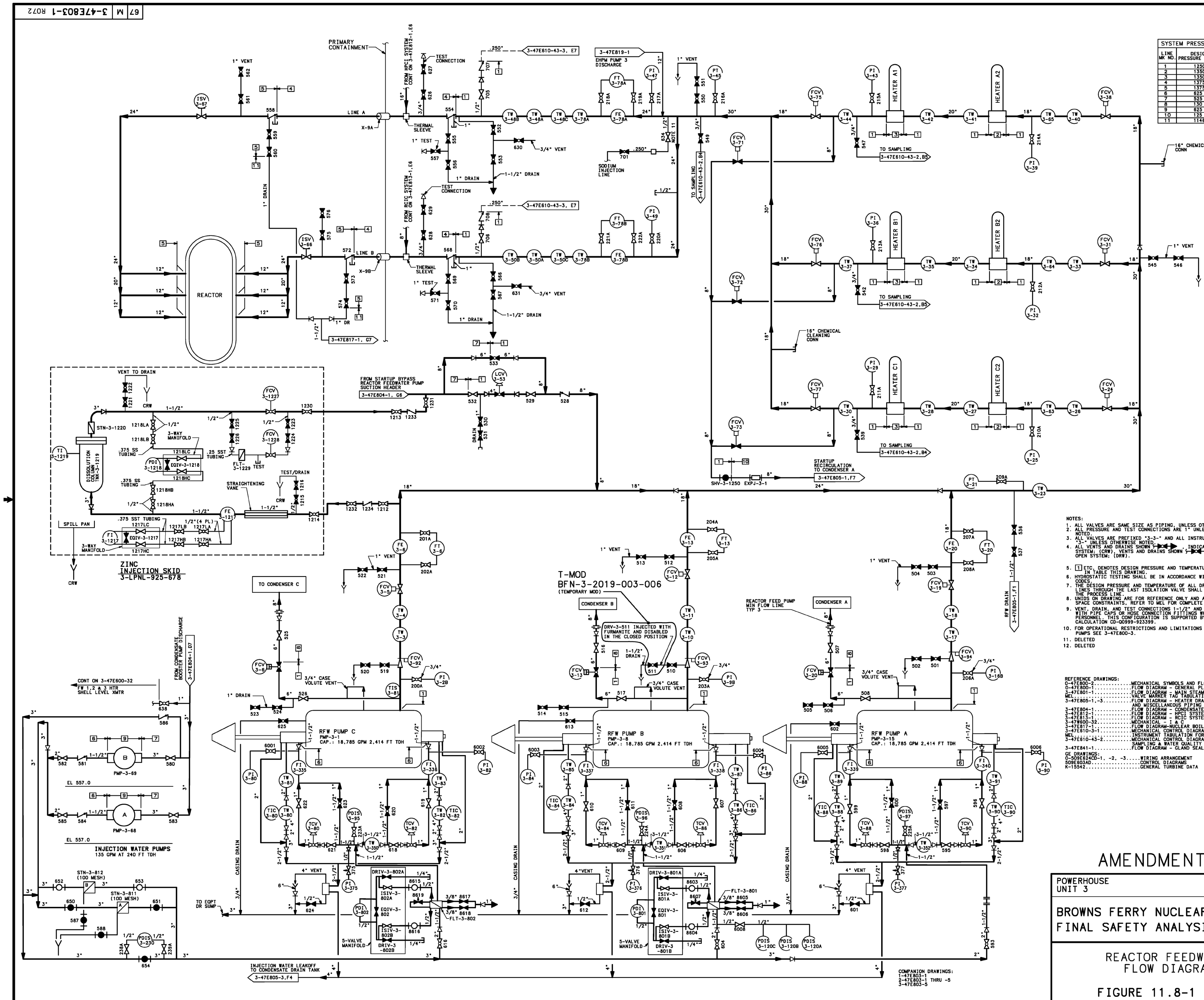


POWERHOUSE
UNIT 2

BROWNS FERRY NUCLEAR PLANT
FINAL SAFETY ANALYSIS REPORT

REACTOR FEEDWATER SYSTEM
FLOW DIAGRAM

FIGURE 11.8-1 SH 2



SYSTEM PRESS.- TEMP DATA		
LINE MK NO.	DESIGN PRESSURE (PSIG)	DESIGN TEMP(°F)
1	1250	400
2	1350	360
3	1350	410
4	1375	545
5	1375	562
6	625	301
7	525	301
8	130	330
9	625	200
10	125	350
11	1146	562

NOTES:

1. ALL VALVES ARE SAME SIZE AS PIPING, UNLESS OTHERWISE NOTED.
2. ALL PRESSURE AND TEST CONNECTIONS ARE 1" UNLESS OTHERWISE NOTED.
3. ALL VALVES ARE PREFIXED "3-3-" AND ALL INSTRUMENTS ARE PREFIXED "3-" UNLESS OTHERWISE NOTED.
4. ALL VENTS AND DRAINS SHOWN , INDICATES CLOSED SYSTEM; (CRW), VENTS AND DRAINS SHOWN , INDICATES OPEN SYSTEM; (DRW).
5. 1 ETC, DENOTES DESIGN PRESSURE AND TEMPERATURE AS GIVEN IN TABLE THIS DRAWING.
6. HYDROSTATIC TESTING SHALL BE IN ACCORDANCE WITH THE APPLICABLE CODES.
7. THE DESIGN PRESSURE AND TEMPERATURE OF ALL DRAIN AND VENT LINES THROUGH THE LAST ISOLATION VALVE SHALL BE THE SAME AS THE PROCESS LINE.
8. UNIDS ON DRAWING ARE FOR REFERENCE ONLY AND ARE ABBREVIATED TO MEET SPACE CONSTRAINTS, REFER TO MEL FOR COMPLETE UNIDS.
9. VENT, DRAIN, AND TEST CONNECTIONS 1-1/2" AND BELOW CAN BE PROVIDED WITH PIPE CAPS OR HOSE CONNECTION FITTINGS WHERE REQUIRED BY PLANT PERSONNEL. THIS CONFIGURATION IS SUPPORTED BY ENGINEERING CALCULATION CD-Q0999-923399.
10. FOR OPERATIONAL RESTRICTIONS AND LIMITATIONS ON THE REACTOR FEEDWATER PUMPS SEE 3-47E800-3.
11. DELETED
12. DELETED

REFERENCE DRAWINGS:
0-47E800-2.............MECHANICAL SYMBOLS AND FLOW DIAGRAM DRAWING INDEX
0-47E800-1.............FLOW DIAGRAM - GENERAL PLANT SYSTEMS
3-47E801-1.............FLOW DIAGRAM - MAIN STEAM
MEL....................VALVE MARKER TAG TABULATION
3-47E805-1,-3..........FLOW DIAGRAM - HEATER DRAINS & VENTS AND MISCELLANEOUS PIPING
3-47E804-1.............FLOW DIAGRAM - CONDENSATE
3-47E812-1.............FLOW DIAGRAM - HPCI SYSTEM
3-47E813-1.............FLOW DIAGRAM - RCIC SYSTEM
3-47W600-32............MECHANICAL - I & C
3-47E817-1.............FLOW DIAGRAM-NUCLEAR BOILER
3-47E610-3-1...........MECHANICAL CONTROL DIAGRAM - FEEDWATER
MEL....................INSTRUMENT TABULATION FOR FEEDWATER SYSTEM
3-47E610-43-2..........MECHANICAL CONTROL DIAGRAM - SAMPLING & WATER QUALITY
3-47E841-1.............FLOW DIAGRAM - GLAND SEAL WATER

GE DRAWINGS:
0-509E624CD-1, -2, -3.....WIRING ARRANGEMENT
509E603AD.................CONTROL DIAGRAMS
K-15542...................GENERAL TURBINE DATA

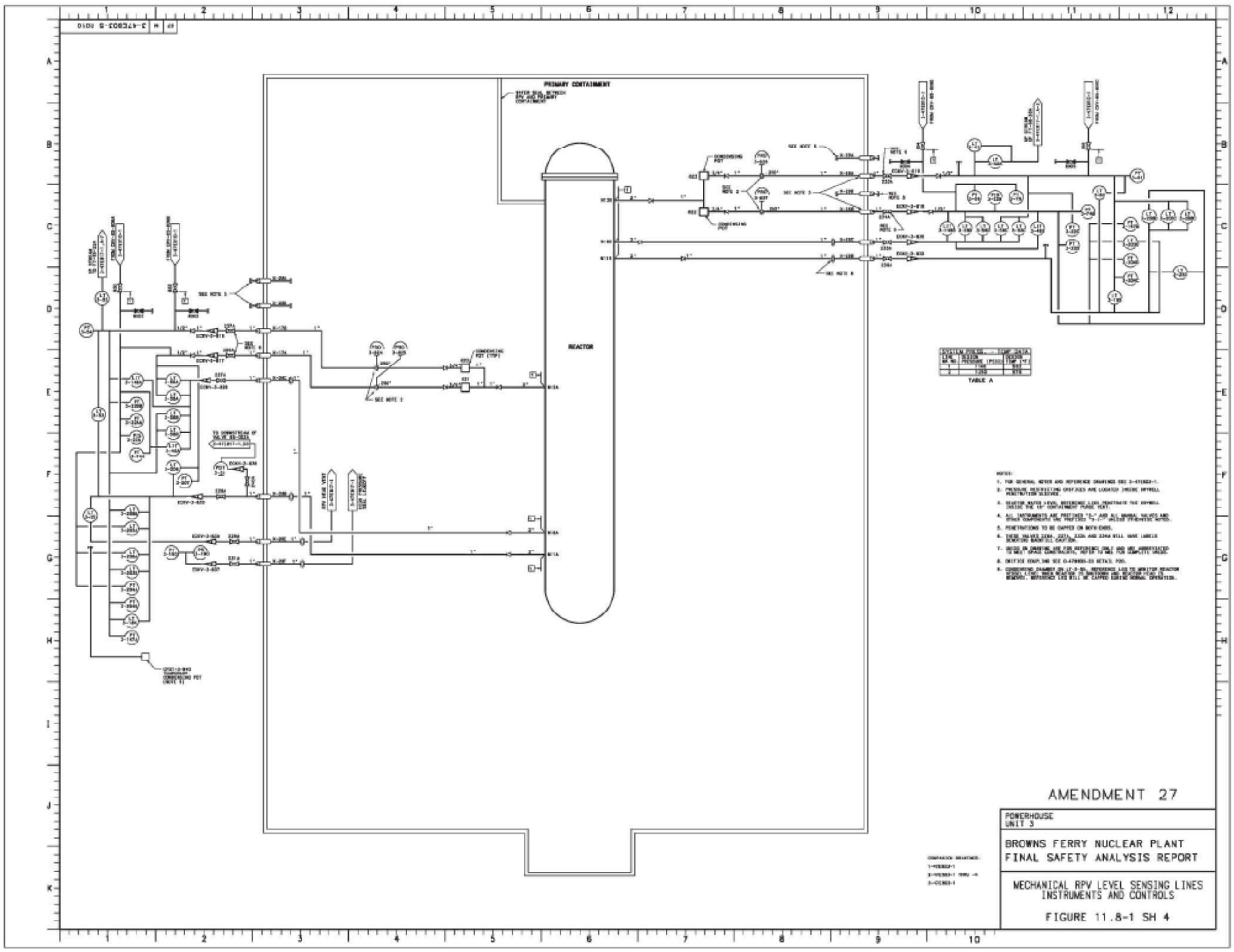
AMENDMENT 28

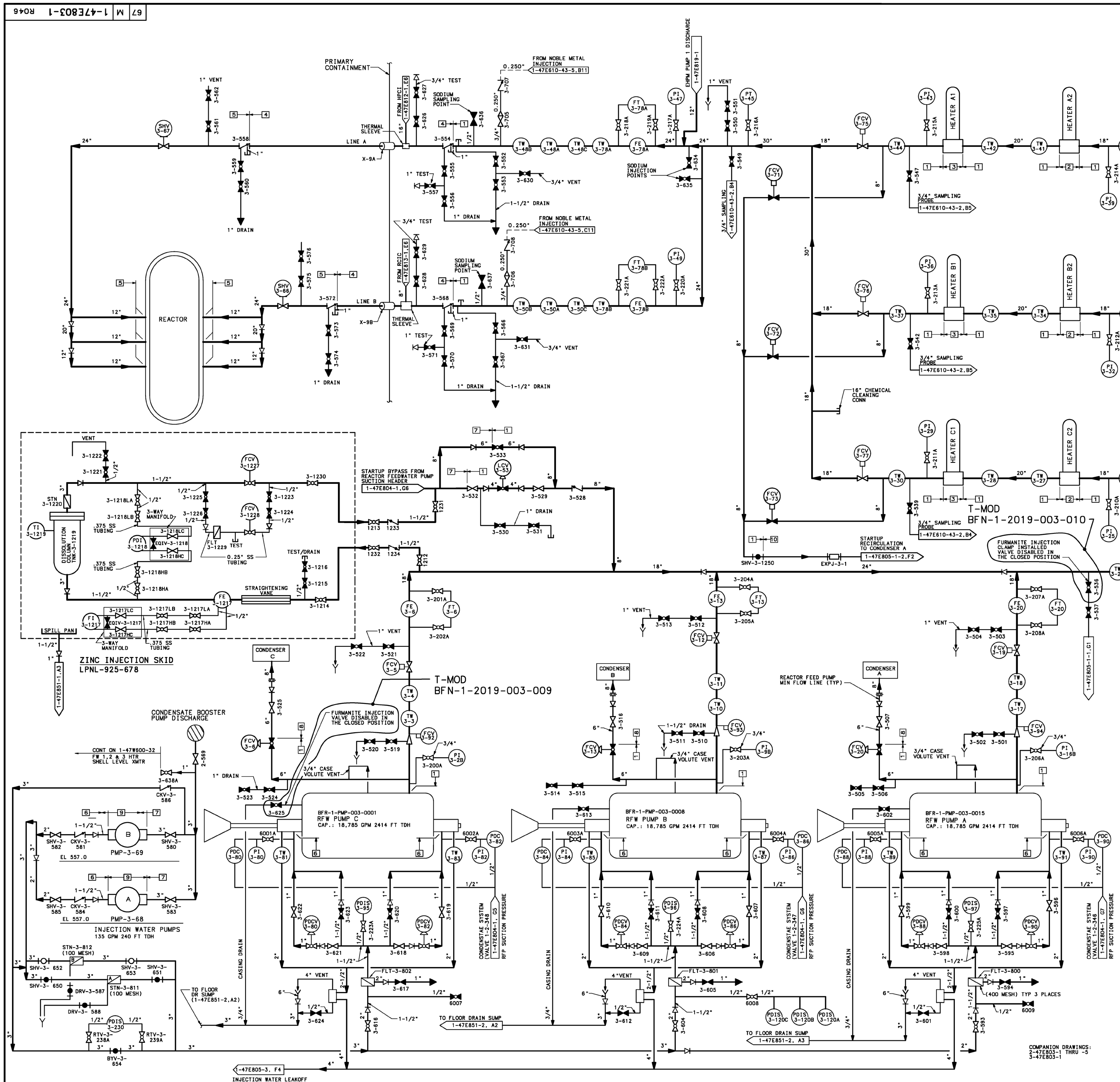
POWERHOUSE
UNIT 3

BROWNS FERRY NUCLEAR PLANT
FINAL SAFETY ANALYSIS REPORT

REACTOR FEEDWATER
FLOW DIAGRAM

FIGURE 11.8-1 SH 3


PRIMARY CONTAINMENT
REACTOR
TABLE A
AMENDMENT 27
POWERHOUSE
UNIT 3
BROWNS FERRY NUCLEAR PLANT
FINAL SAFETY ANALYSIS REPORT
MECHANICAL RPV LEVEL SENSING LINES
INSTRUMENTS AND CONTROLS
FIGURE 11.8-1 SH 4



SYSTEM PRESS.- TEMP DATA		
LINE MK NO.	DESIGN PRESSURE (PSIG)	DESIGN TEMP(°F)
1	1250	400
2	1350	360
3	1350	410
4	1375	545
5	1375	562
6	520	301
7	450	301
8	130	330
9	530	200
10	125	350

NOTES:

1. ALL VALVES ARE SAME SIZE AS PIPING, UNLESS OTHERWISE NOTED.
2. ALL PRESSURE AND TEST CONNECTIONS ARE 1" UNLESS OTHERWISE NOTED.
3. ALL VALVES SHALL BE TAGGED. VALVE NUMBERS SHALL BE PREFIXED WITH THE UNIT NUMBER, AND SYSTEM NUMBER, I.E. 1-3-501.
4. ALL VENTS AND DRAINS SHOWN , INDICATES CLOSED SYSTEM; (CRW), VENTS AND DRAINS SHOWN , INDICATES OPEN SYSTEM; (DRW).
5. 1 ETC, DENOTES DESIGN PRESSURE AND TEMPERATURE AS GIVEN IN TABLE THIS DRAWING.
6. HYDROSTATIC TESTING SHALL BE IN ACCORDANCE WITH THE APPLICABLE CODES.
7. THE DESIGN PRESSURE AND TEMPERATURE OF ALL DRAIN AND VENT LINES THROUGH THE LAST ISOLATION VALVE SHALL BE THE SAME AS THE PROCESS LINE.
8. VENT, DRAIN AND TEST CONNECTION 1-1/2" AND BELOW CAN BE PROVIDED WITH PIPE CAPS OR HOSE CONNECTION FITTINGS WHERE REQUIRED BY PLANT PERSONNEL. THIS CONFIGURATION IS SUPPORTED BY ENGINEERING CALCULATION CD-Q0999-923399.
9. UNIDS ON DRAWINGS ARE FOR REFERENCE ONLY AND ARE ABBREVIATED TO MEET SPACE CONSTRAINTS, REFER TO MEL FOR COMPLETE UNIDS.
10. FOR OPERATIONAL RESTRICTIONS AND LIMITATIONS ON THE REACTOR FEEDWATER PUMPS SEE 1-47E800-3.

REFERENCE DRAWINGS:

0-47E800-1.............FLOW DIAGRAM - GENERAL PLANT SYSTEMS
1-47E801-1.............FLOW DIAGRAM - MAIN STEAM
MEL....................TABULATION OF VALVE MARKER TAGS
1-47E804-1.............FLOW DIAGRAM - CONDENSATE
1-47E812-1.............FLOW DIAGRAM - HPCI SYSTEM
1-47E813-1.............FLOW DIAGRAM - RCIC SYSTEM
1-47W600-32............MECHANICAL - I & C
1-47E610-3-1...........CONTROL DIAGRAM - REACTOR FEEDWATER
1-47E817-1.............FLOW DIAGRAM - NUCLEAR BOILER
MEL....................INSTRUMENT TABULATION FOR FEEDWATER SYSTEM
1-47E610-46-1..........CONTROL DIAGRAM - FEEDWATER SYSTEM
0-47E800-2.............MECHANICAL SYMBOLS AND FLOW DIAGRAM DRAWING INDEX
1-47E805-3.............FLOW DIAGRAM - HEATER DRAINS & VENTS & MISC PIPING
1-47E610-43-2..........CONTROL DIAGRAM - SAMPLING & WATER QUALITY

GE DRAWINGS:

509E215RE.........WIRING ARRANGEMENT
509E253BA.........CONTROL DIAGRAMS

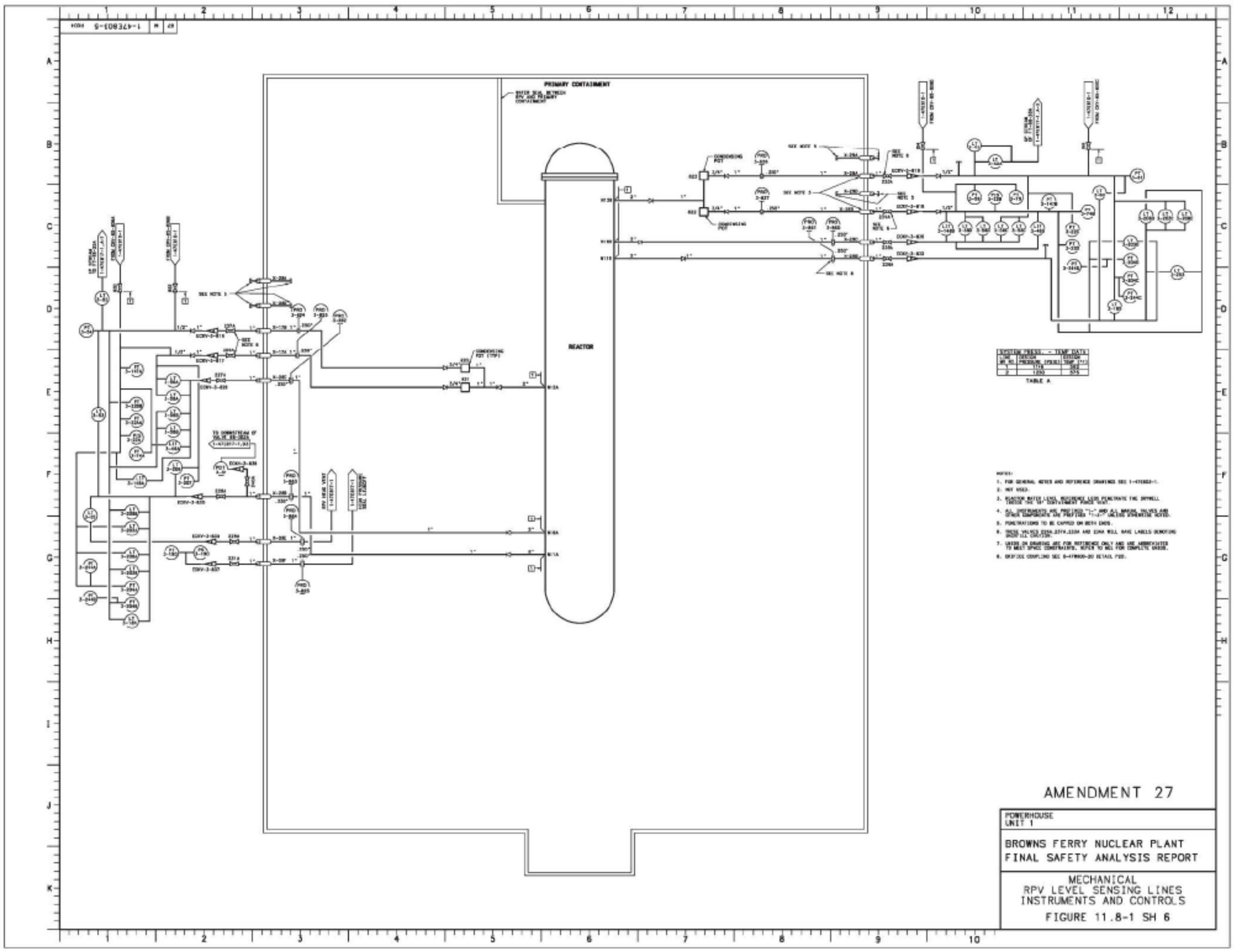
AMENDMENT 28

POWERHOUSE
UNIT 1

BROWNS FERRY NUCLEAR PLANT
FINAL SAFETY ANALYSIS REPORT

REACTOR FEEDWATER
FLOW DIAGRAM

FIGURE 11.8-1 SH 5


PRIMARY CONTAINMENT
REACTOR
TABLE A
AMENDMENT 27
POWERHOUSE
UNIT 1
BROWNS FERRY NUCLEAR PLANT
FINAL SAFETY ANALYSIS REPORT
MECHANICAL
RPV LEVEL SENSING LINES
INSTRUMENTS AND CONTROLS
FIGURE 11.8-1 SH 6

11.9 CONDENSATE STORAGE AND TRANSFER SYSTEMS

11.9.1 Power Generation Objective

The power generation objectives of the Condensate Storage and Transfer Systems are to deliver condensate to other systems at the flow rates and pressures required, and to receive inputs of water of condensate quality from other systems.

11.9.2 Power Generation Design Basis

The Condensate Storage System, including the supply-return headers, shall be capable of supplying makeup water to the hotwells of the main condensers, and water to the suctions of the control rod drive pumps and the condensate transfer pumps; for test purposes, to the headers in the basement of each Reactor Building which supply the core spray, RHR, RCIC, and HPCI pumps.

1. The Condensate Storage System, including headers, shall be capable of receiving inputs of water from the Radioactive Liquid Waste System, condenser hotwell high-level reject water, and water returned during tests of the RCIC and HPCI pumps.

2. The Condensate Transfer System shall provide water under pressure for such purposes as backwashing filters and demineralizers, makeup to the spent-fuel pools, cooling water flow for dry cask annulus flushing, annulus quenching, alternate cooling operations, decontamination of reactor well, dryer-separator pit, and spent fuel shipping cask.

3. The Condensate Transfer System shall be capable of transferring water from one condensate storage tank to another.

4. The Condensate Storage System shall provide a reserve supply of condensate to serve as the preferred source of water for the operation of the HPCI and RCIC Systems.

5. The Condensate Storage System, including the associated supply-return headers, shall be sized such that while it is supplying normal requirements for condensate at maximum demand, the system shall be capable of supplying the added demand created by a design basis accident.

11.9.3 System Description

Flow diagrams of the Condensate Storage and Transfer Systems are shown in Figures 11.9-1b sheets 1, 2, and 3.

11.9.3.1 Condensate Storage System

Condensate normally meeting the quality requirements given in Table 11.9-1 is stored in three 375,000-gallon tanks. The tanks are located out-of-doors. They are constructed of steel, and are painted inside with a phenolic-epoxy protective coating. Makeup water is supplied from demineralized water storage.

Two supply return lines per unit, one 20 inches (steel on Unit 1, aluminum on Units 2 and 3), and one 24 inches (aluminum) in diameter, interconnect the storage tanks and lead to the Turbine Building, from which branch lines lead to points of use. The 20-inch lines terminate in standpipes within the tanks. These standpipes prevent the level in the individual tanks from being drawn below the 135,000-gallon level via the 20-inch pipe. The 24-inch header terminates in a 20-inch line near the bottom of the tanks. The valves between the tanks and the 20- and 24-inch lines are normally closed to prevent crossload, resulting in a unitized system.

The 20-inch line normally supplies water for non safety related uses. The line connects directly to the condensate transfer pump suctions and to the condenser hotwells for makeup. The transfer pumps supply water to the following:

Condensate, cleanup, and fuel pool filter-demineralizers for backwashing,

Reactor Building operating floor for cooling water flow during dry cask annulus flushing, annulus quenching, alternate cooling operations, decontaminating spent-fuel shipping casks and walls of reactor wells and dryer-separator pits, and for
makeup to the fuel pools,

RHR and core spray systems flush and fill, and

Floor drain and waste filters and waste demineralizer for backwashing.

The 20-inch line receives return flows from HPCI and RCIC pump tests. The 24-inch line receives return flow from the high-level reject from the condenser hotwells. The latter includes water drained from the reactor well and dryer-separator pit following the refueling, and reactor water released via the Reactor Water Cleanup System during startup.

The 24-inch supply-return header, which has access to the entire volume of the storage tanks, is lined up to supply water to the condensate header in the basement of each Reactor Building, which, in turn, is the primary supply of water to the HPCI and RCIC pumps. The 24-inch supply-return header also provides water to the control rod drive pumps.

Water recovered in the radwaste system is returned to condensate storage via the Unit 1 20-inch line.

The three storage tanks and the two supply-return headers for each unit are not designed to Class I seismic requirements.

The condensate ring header and branch lines from the ring header that supply condensate to the RHR, CS, HPCI, and RCIC Systems are designed to seismic Class I requirements.

In addition to the three tanks described above, two 500,000-gallon condensate storage tanks are available for the storage of condensate or for the storage of torus and reactor vessel cavity water during outages.

11.9.3.2 Condensate Transfer System

The Condensate Transfer System includes two centrifugal pumps rated at 1,000 gpm each at 200 feet head. A 10,000-gallon head tank is connected into the pump discharge line. The tank is located on the roof of the Reactor Building, approximately 150 feet above the pump. Normally, one pump is used at a time. The transfer system operates such that small quantities of water are supplied from the head tank, while larger quantities are supplied by the operating pump. The head tank sets the system pressure. When large quantities of water are required, the head tank is valved off from the rest of the system, and both pumps are placed on manual operation.

If one of the condensate storage tanks is to be taken out of service, the water in it can be transferred to the other storage tanks, using the transfer pumps. Valves are set so that the 20-inch supply-return header is connected to the bottom of the tank to be emptied. The valves in the 24-inch supply-return header are closed to the tank being emptied and open to the tanks being filled. The transfer pump is set to take suction via the 20-inch line and discharge through the 24-inch line. Should an accident occur during the transfer, all of the water in the tanks being filled, and some in the tank being emptied, is available to the safety related systems. The only operator action required is to open the valve in the 24-inch line and to stop the transfer pumps before the suction is lost from the tank being emptied.

11.9.3.3 Instrumentation and Controls

Figure 11.9-2 is a control diagram of the systems. Instruments and controls for the condensate storage tanks and the condensate transfer pumps are located in the Unit 1 control room. Included on the Unit 1 panel 9-22 are the following:

Level indicator for each of the three condensate storage tanks, Control switch for each of the six motor-operated valves in the two supply-return headers, with position-indicating lights,

Control switch for each of the two condensate transfer pumps, with status lights, and

Control switch for air-operated valve which isolates the condensate head tank from the condensate transfer pump discharge line, with position-indicating lights.

Annunciators mounted on the Unit 1 Main Control Room panel 9-22 are actuated by the following signals:

High level in a condensate storage tank,
Low level in a condensate storage tank,
High-high level in condensate head tank, and
Low-low level in condensate head tank.

The high-level alarm on the condensate storage tank, located just below the overflow, informs the operator that inputs to the tanks must be stopped to avoid overflow. The low-level alarm is located just above the 135,000-gallon level, and informs the operator that the level is approaching the point at which outflow into the 20-inch header will cease.

Controls on the condensate head tank start the selected condensate transfer pump at low-tank level, and stop the pump at high level. Should the demand exceed the capacity of one pump, the alternate pump is started at low-low level. Simultaneously, the low-low level alarm is actuated. Should the cutoff switch at the high level fail to stop the pump, the second cutoff switch at the high-high level stops it. The high-high level alarm is actuated simultaneously.

In addition to the Unit 1 controls and indications, level indicators are locally mounted on each of the condensate storage tanks. Unit specific condensate storage tank level indications and annunciators are located on the Units 2 and 3 Main Control Room panels 9-6.

11.9.4 Power Generation Evaluation

The Condensate Storage and Transfer System, as described in paragraph 11.9.3, is capable of meeting the requirements listed under paragraph 11.9.2.

The Condensate Storage System is designed such that each of the three storage tanks contains a reserve supply of 135,000 gallons. The only normal water requirements drawn from the reserve volume consists of an essentially continuous flow requirement for control rod drive cooling water and short-term flow requirements for periodic testing of the HPCI and RCIC System pumps. The control rod drive cooling water is a minor demand of approximately 65 gpm per operating BFN unit. The periodic testing of the HPCI and RCIC System pumps is normally in a closed-loop flow path which returns the water to the Condensate Storage System. Therefore, periodic testing of the HPCI and RCIC System pumps does not reduce the amount of water in the reserve volume.

Standard operating practice is to maintain a reserve of 135,000 gallons per operating reactor. This reserve is the preferred source of cooling water for any kind of accident condition that requires operation of the HPCI and RCIC pumps to supply water to the reactor. If the tanks or headers were destroyed, as by an earthquake or tornado, the HPCI pumps would automatically take suction from the pressure suppression chamber. This action is initiated by redundant level switches located in the line leading from the supply-return headers to the header in the Reactor Building basement. The switches respond to a low-level signal which indicates that the 24-inch supply-return header is not delivering water. The basement header contains sufficient water to supply the pumps while the transfer to the pressure suppression chamber is being made.

Only one tank normally supplies water to each unit. However, if it becomes necessary to remove a condensate storage tank on one unit from service, one of the other unit's condensate storage tanks can furnish the needed water by opening the appropriate valves separating the three-unit supply and return lines. It is possible to provide all the water for all three units from one unit's tank by opening all the valves.

If it becomes necessary to remove all three storage tanks from service, the plant will be shut down.

The 20- and 24-inch supply-return headers are of adequate size that, while carrying maximum normal flows, they can accommodate the added flows occasioned by an accident on one of the units and provide adequate NPSH to the safety related system pumps. When both lines are in service, maximum normal flows include tests of safety related pumps.

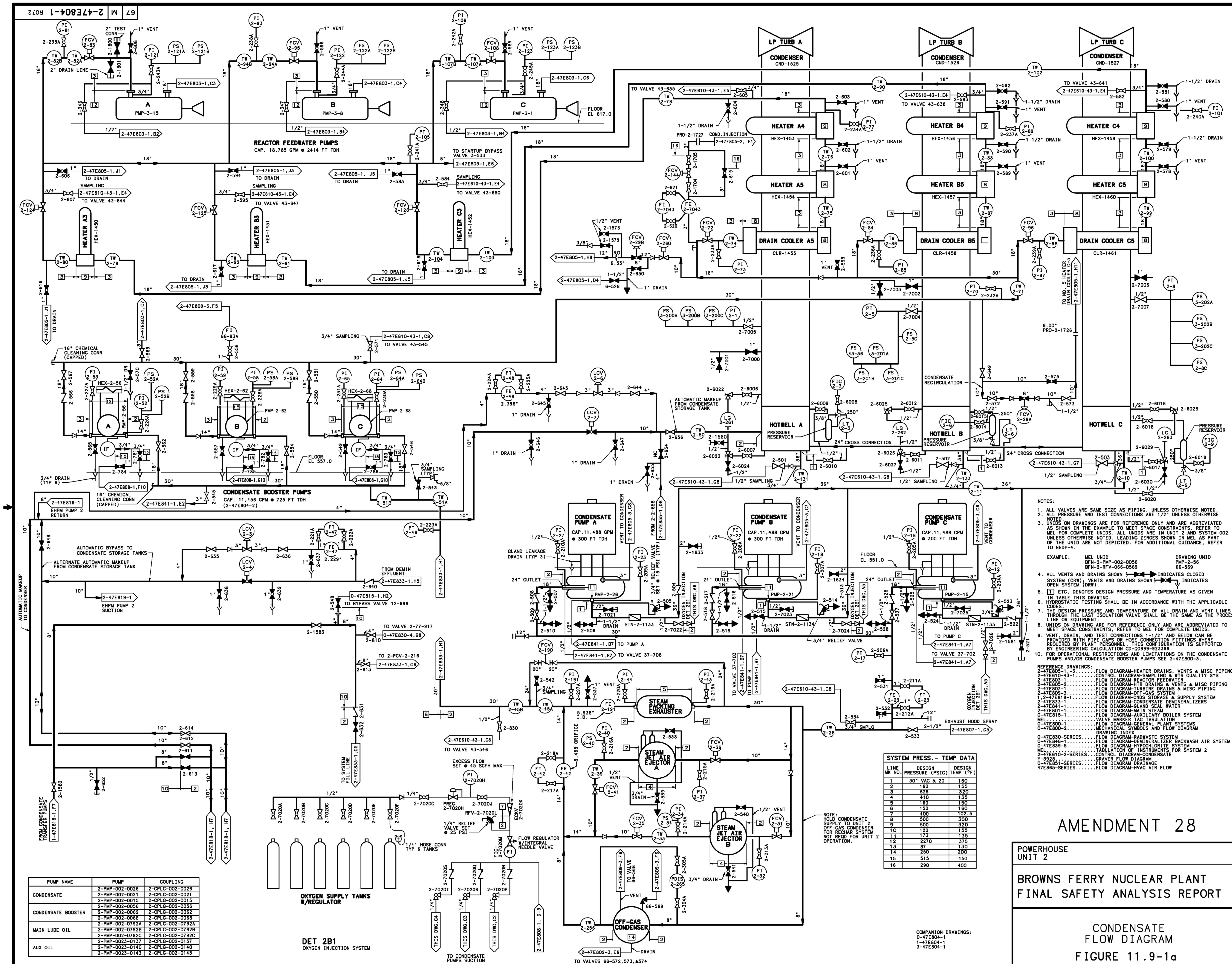
11.9.5 Inspection and Testing

The condensate storage tanks are inspected at appropriate intervals to ascertain the condition of the protective coating, and routine inspection and maintenance are performed on valves, pumps, and piping. No special tests of the Condensate Storage and Transfer System are required.

TABLE 11.9-1

QUALITY REQUIREMENTS FOR CONDENSATE IN STORAGE

Specific Conductivity μmho/cm	≤ 1.0
Silica (as SiO_2), ppm	≤ 0.05
Chloride (as Cl), ppm	≤ 0.05
Filterable Iron ppm,	≤ 0.2



NOTES:

1. ALL VALVES ARE SAME SIZE AS PIPING, UNLESS OTHERWISE NOTED.
2. ALL PRESSURE AND TEST CONNECTIONS ARE 1/2" UNLESS OTHERWISE NOTED.
3. UNIDS ON DRAWINGS ARE FOR REFERENCE ONLY AND ARE ABBREVIATED AS SHOWN IN THE EXAMPLE TO MEET SPACE CONSTRAINTS. REFER TO MEL FOR COMPLETE UNIDS. ALL UNIDS ARE IN UNIT 2 AND SYSTEM 002 UNLESS OTHERWISE NOTED. LEADING ZEROES SHOWN IN MEL AS PART OF THE UNID ARE NOT DEPICTED. FOR ADDITIONAL GUIDANCE, REFER TO NEDP-4.

EXAMPLE:	MEL UNID	DRAWING UNID
	BFN-2-PMP-002-0056	PMP-2-56
	BFN-2-RFV-066-0569	66-569

4. ALL VENTS AND DRAINS SHOWN INDICATES CLOSED SYSTEM (CRW); VENTS AND DRAINS SHOWN INDICATES OPEN SYSTEM (DRW).
5. 1 ETC, DENOTES DESIGN PRESSURE AND TEMPERATURE AS GIVEN IN TABLE THIS DRAWING.
6. HYDROSTATIC TESTING SHALL BE IN ACCORDANCE WITH THE APPLICABLE CODES.
7. THE DESIGN PRESSURE AND TEMPERATURE OF ALL DRAIN AND VENT LINES THROUGH THE LAST ISOLATION VALVE SHALL BE THE SAME AS THE PROCESS LINE OR EQUIPMENT.
8. UNIDS ON DRAWING ARE FOR REFERENCE ONLY AND ARE ABBREVIATED TO MEET SPACE CONSTRAINTS, REFER TO MEL FOR COMPLETE UNIDS.
9. VENT, DRAIN, AND TEST CONNECTIONS 1-1/2" AND BELOW CAN BE PROVIDED WITH PIPE CAPS OR HOSE CONNECTION FITTINGS WHERE REQUIRED BY PLANT PERSONNEL. THIS CONFIGURATION IS SUPPORTED BY ENGINEERING CALCULATION CD-Q0999-923399.
10. FOR OPERATIONAL RESTRICTIONS AND LIMITATIONS ON THE CONDENSATE PUMPS AND/OR CONDENSATE BOOSTER PUMPS SEE 2-47E800-3.

REFERENCE DRAWINGS:
2-47E805-1,-3.......FLOW DIAGRAM-HEATER DRAINS, VENTS & MISC PIPING
2-47E610-43-1.......CONTROL DIAGRAM-SAMPLING & WTR QUALITY SYS
2-47E803-1..........FLOW DIAGRAM-REACTOR FEEDWATER
2-47E805-2..........FLOW DIAGRAM-HTR DRAINS & VENTS & MISC PIPING
2-47E807-1..........FLOW DIAGRAM-TURBINE DRAINS & MISC PIPING
2-47E809-3..........FLOW DIAGRAM-OFF-GAS SYSTEM
1,2-47E818-1........FLOW DIAGRAM-CNDS STORAGE & SUPPLY SYSTEM
2-47E833-1..........FLOW DIAGRAM-CONDENSATE DEMINERALIZERS
2-47E841-1..........FLOW DIAGRAM-GLAND SEAL WATER
2-47E801-1..........FLOW DIAGRAM-MAIN STEAM
0-47E815-1..........FLOW DIAGRAM-AUXILIARY BOILER SYSTEM
MEL.................VALVE MARKER TAG TABULATION
0-47E800-1..........FLOW DIAGRAM-GENERAL PLANT SYSTEMS
0-47E800-2..........MECHANICAL SYMBOLS AND FLOW DIAGRAM DRAWING INDEX
0-47E830-SERIES.....FLOW DIAGRAM-RADWASTE SYSTEM
0-47E846-1..........FLOW DIAGRAM-DEMINERALIZER BACKWASH AIR SYSTEM
0-47E839-5..........FLOW DIAGRAM-HYPOCHLORITE SYSTEM
MEL.................TABULATION OF INSTRUMENTS FOR SYSTEM 2
2-47E610-2-SERIES...CONTROL DIAGRAM-CONDENSATE
Y-3928..............GRAVER FLOW DIAGRAM
0-47E851-SERIES.....FLOW DIAGRAM DRAINAGE
47E865-SERIES.......FLOW DIAGRAM-HVAC AIR FLOW

SYSTEM PRESS.- TEMP DATA

LINE MK NO.	DESIGN PRESSURE (PSIG)	DESIGN TEMP (°F)
1	30" VAC & 20	160
2	160	155
3	525	320
4	410	135
5	160	150
6	150	160
7	400	102.5
8	500	300
9	500	320
10	120	155
11	173	135
12	2270	375
13	87	130
14	250	200
15	515	150
16	290	400

PUMP NAME	PUMP	COUPLING
CONDENSATE	2-PMP-002-0026	2-CPLG-002-0026
	2-PMP-002-0021	2-CPLG-002-0021
	2-PMP-002-0015	2-CPLG-002-0015
CONDENSATE BOOSTER	2-PMP-002-0056	2-CPLG-002-0056
	2-PMP-002-0062	2-CPLG-002-0062
	2-PMP-002-0068	2-CPLG-002-0068
MAIN LUBE OIL	2-PMP-002-0792A	2-CPLG-002-0792A
	2-PMP-002-0792B	2-CPLG-002-0792B
	2-PMP-002-0792C	2-CPLG-002-0792C
AUX OIL	2-PMP-0023-0137	2-CPLG-002-0137
	2-PMP-0023-0140	2-CPLG-002-0140
	2-PMP-0023-0143	2-CPLG-002-0143

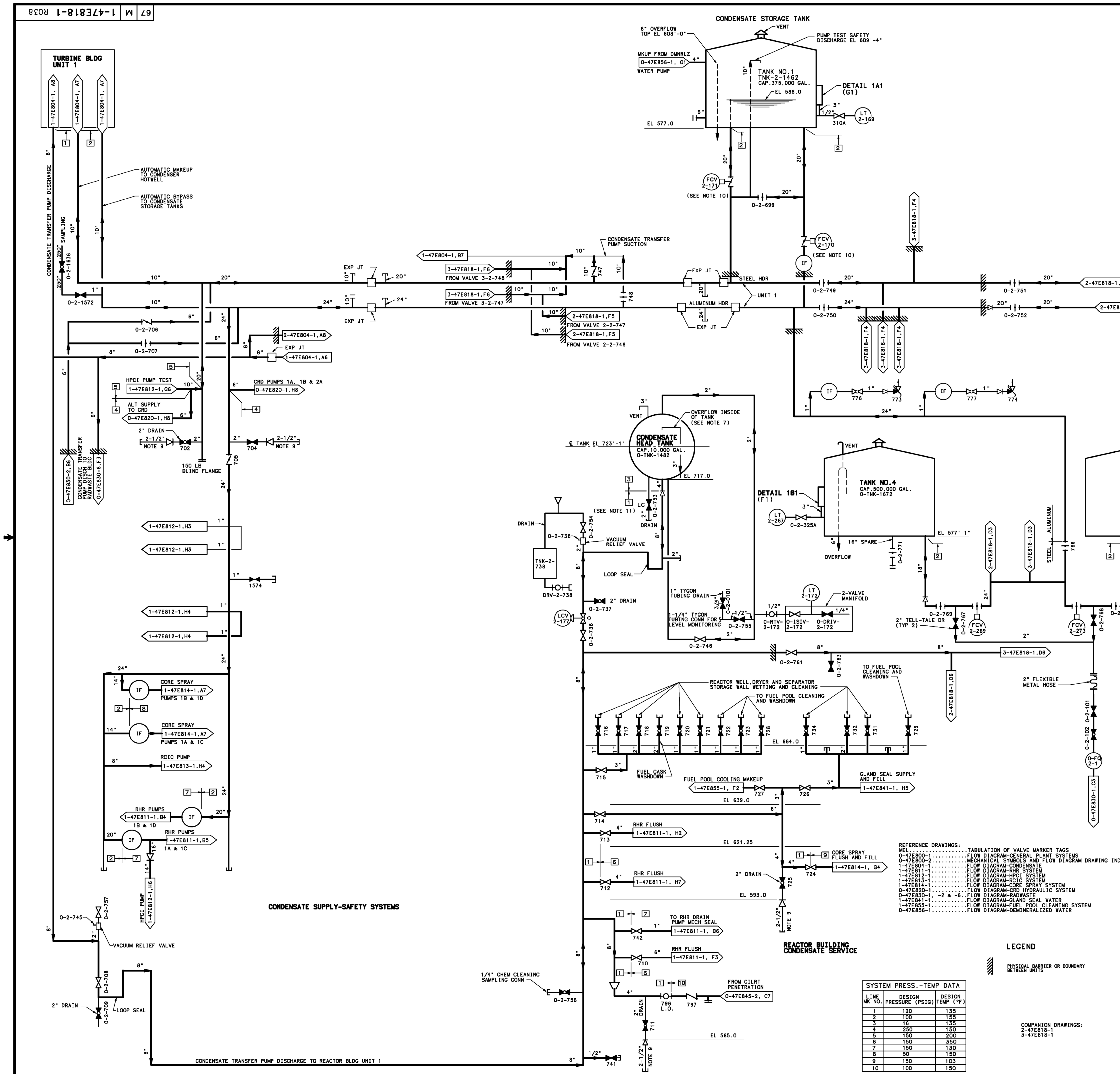
AMENDMENT 28

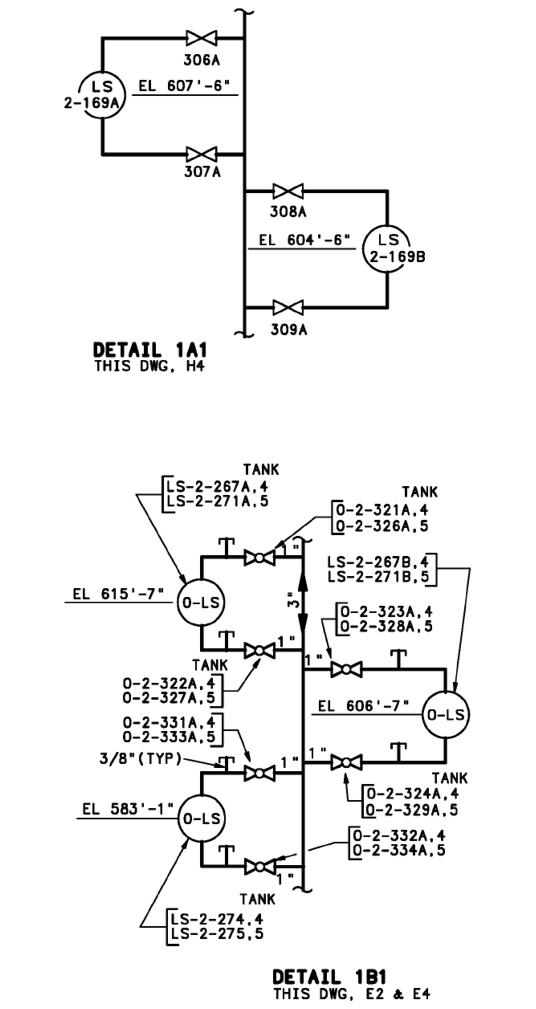
POWERHOUSE
UNIT 2

BROWNS FERRY NUCLEAR PLANT
FINAL SAFETY ANALYSIS REPORT

CONDENSATE
FLOW DIAGRAM

FIGURE 11.9-1a





NOTES:

1. ALL VALVES ARE SAME SIZE AS PIPING, UNLESS OTHERWISE NOTED.
2. ALL PRESSURE AND TEST CONNECTIONS ARE 1/2", UNLESS OTHERWISE NOTED.
3. UNIDS ON DRAWINGS ARE FOR REFERENCE ONLY AND ARE ABBREVIATED AS SHOWN IN THE EXAMPLE TO MEET SPACE CONSTRAINTS. REFER TO MEL FOR COMPLETE UNIDS. ALL UNIDS ARE IN UNIT 1 AND SYSTEM 002 UNLESS OTHERWISE NOTED. LEADING ZEROES SHOWN IN MEL AS PART OF THE UNID ARE NOT DEPICTED. FOR ADDITIONAL GUIDANCE, REFER TO NEDP-4.

EXAMPLE: MEL UNID	DRAWING UNID
BFN-0-TNK-002-1673	0-TNK-1673
BFN-0-LT-002-0271	0-LT-2-271
BFN-1-SCV-002-0720	720

4. 1 ETC. DENOTES DESIGN PRESSURE AND TEMPERATURE AS GIVEN IN TABLE THIS DRAWING.
5. HYDROSTATIC TESTING SHALL BE IN ACCORDANCE WITH APPLICABLE CODES.
6. THE DESIGN PRESSURE AND TEMPERATURE OF ALL DRAIN AND VENT LINES THROUGH THE LAST ISOLATION VALVE SHALL BE THE SAME AS THE PROCESS LINE.
7. THE CONDENSATE HEAD TANK MAYBE USED TO SERVE RHR AND CORE SPRAY DISCHARGE PIPING INSTEAD OF UNIT 1,2, OR 3 PRESSURE SUPPRESSION CHAMBER (PSC) HEAD TANK. WHEN UTILIZED FOR THIS PURPOSE, THE CONDENSATE HEAD TANK SHALL NOT BE REMOVED FROM SERVICE TO CALIBRATE LEVEL SWITCHES 0-LS-2-172 A,B,C, AND D. (REFER TO 1-47E818-1, D4)
8. VENT, DRAIN, AND TEST CONNECTIONS 1-1/2" AND BELOW CAN BE PROVIDED WITH PIPE CAPS OR HOSE CONNECTION FITTINGS WHERE REQUIRED BY PLANT PERSONNEL. THIS CONFIGURATION IS SUPPORTED BY ENGINEERING CALCULATION CD-Q0999-923399.
9. 2" DRAIN VALVES 702, 704, 711 AND 725 ARE EQUIPPED WITH NST FIRE HOSE CONNECTIONS TO SUPPORT MITIGATION STRATEGY REQUIREMENTS OF PROVIDING WATER VIA THE FIRE PROTECTION SYSTEM RING HEADER FOR HOTWELL MAKEUP AND DRYWELL INJECTION. REF: CIVIL CALCULATION CDQ0999207039.
10. VALVE SHALL REMAIN OPEN FOR NFPA 805 REQUIREMENTS EXCEPT WHEN REQUIRED FOR TESTING OR OPERATION.
11. DRAIN VALVE 0-2-753 LOCKED CLOSED.

REFERENCE DRAWINGS:

MEL....................TABULATION OF VALVE MARKER TAGS
0-47E800-1...........FLOW DIAGRAM-GENERAL PLANT SYSTEMS
0-47E800-2...........MECHANICAL SYMBOLS AND FLOW DIAGRAM DRAWING INDEX
1-47E804-1...........FLOW DIAGRAM-CONDENSATE
1-47E811-1...........FLOW DIAGRAM-RHR SYSTEM
1-47E812-1...........FLOW DIAGRAM-HPCI SYSTEM
1-47E813-1...........FLOW DIAGRAM-RCIC SYSTEM
1-47E814-1...........FLOW DIAGRAM-CORE SPRAY SYSTEM
0-47E820-1...........FLOW DIAGRAM-CRD HYDRAULIC SYSTEM
0-47E830-1, -2 & -6..FLOW DIAGRAM-RADWASTE
1-47E841-1...........FLOW DIAGRAM-GLAND SEAL WATER
1-47E855-1...........FLOW DIAGRAM-FUEL POOL CLEANING SYSTEM
0-47E856-1...........FLOW DIAGRAM-DEMINERALIZED WATER

LEGEND

PHYSICAL BARRIER OR BOUNDARY BETWEEN UNITS

COMPANION DRAWINGS:
2-47E818-1
3-47E818-1

SYSTEM PRESS.-TEMP DATA

LINE MK NO.	DESIGN PRESSURE (PSIG)	DESIGN TEMP (°F)
1	120	135
2	100	155
3	16	135
4	250	150
5	150	200
6	150	350
7	150	130
8	50	150
9	150	103
10	100	150

AMENDMENT 28

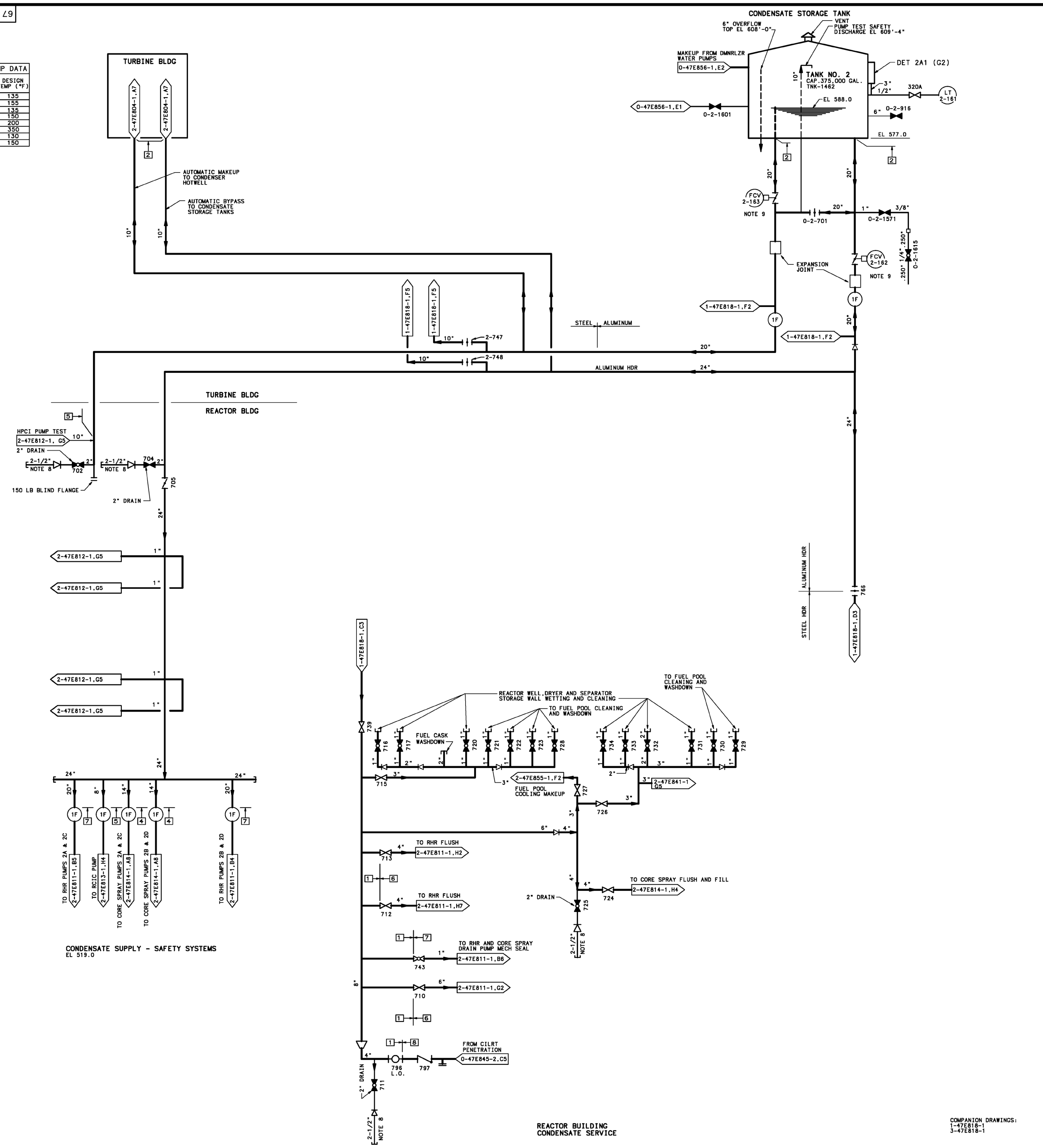
REACTOR BUILDING & YARD
UNITS 1 & 0

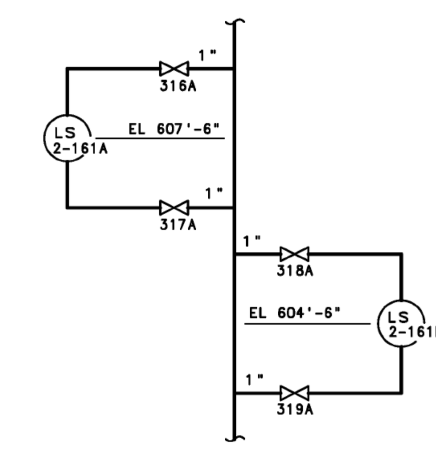
BROWNS FERRY NUCLEAR PLANT
FINAL SAFETY ANALYSIS REPORT

CONDENSATE STORAGE
AND SUPPLY SYSTEM
FLOW DIAGRAM
FIGURE 11.9-1b SH 1

2-47E818-1 R028 | M | 67

SYSTEM PRESS.- TEMP DATA		
LINE MK NO.	DESIGN PRESSURE (PSIG)	DESIGN TEMP (°F)
1	120	135
2	100	155
3	16	135
4	50	150
5	150	200
6	150	350
7	150	130
8	100	150





NOTES:

1. ALL VALVES ARE SAME SIZE AS PIPING, UNLESS OTHERWISE NOTED.
2. UNIDS ON DRAWINGS ARE FOR REFERENCE ONLY AND ARE ABBREVIATED AS SHOWN IN THE EXAMPLE TO MEET SPACE CONSTRAINTS. REFER TO MEL FOR COMPLETE UNIDS. ALL UNIDS ARE IN UNIT 2 AND SYSTEM 002 UNLESS OTHERWISE NOTED. LEADING ZEROES SHOWN IN MEL AS PART OF THE UNID ARE NOT DEPICTED. FOR ADDITIONAL GUIDANCE, REFER TO NEDP-4.

EXAMPLE: MEL UNID	DRAWING UNID
BFN-0-SHV-002-0747	2-747
BFN-0-SHV-002-0701	0-2-701
BFN-2-FCV-002-0162	FCV-2-162

3. 1 ETC, DENOTES DESIGN PRESSURE AND TEMPERATURE AS GIVEN IN TABLE THIS DRAWING.
4. DELETED
5. THE DESIGN PRESSURE AND TEMPERATURE OF ALL DRAIN AND VENT LINES THROUGH THE LAST ISOLATION VALVE SHALL BE THE SAME AS THE PROCESS LINE.
6. DELETED
7. VENT, DRAIN, AND TEST CONNECTIONS 1-1/2" AND BELOW CAN BE PROVIDED WITH PIPE CAPS OR HOSE CONNECTION FITTINGS WHERE REQUIRED BY PLANT PERSONNEL. THIS CONFIGURATION IS SUPPORTED BY ENGINEERING CALCULATION CD-Q0999-923399.
8. 2" DRAIN VALVES 702, 704, 711 AND 725 ARE EQUIPPED WITH NST FIRE HOSE CONNECTIONS TO SUPPORT MITIGATION STRATEGY REQUIREMENTS OF PROVIDING WATER VIA THE FIRE PROTECTION SYSTEM RING HEADER FOR HOTWELL MAKEUP AND DRYWELL INJECTION. REF: CIVIL CALCULATION CDQ099920070039.
9. VALVE SHALL REMAIN OPEN FOR NFPA 805 REQUIREMENTS EXCEPT WHEN REQUIRED FOR TESTING OR OPERATION.

REFERENCE DRAWINGS:

MEL....................TABULATION OF VALVE MARKER TAGS

0-47E800-1.............FLOW DIAGRAM-GENERAL PLANT SYSTEMS
0-47E800-2.............MECHANICAL-SYMBOLS AND FLOW DIAGRAM DRAWING INDEX
2-47E804-1.............FLOW DIAGRAM-CONDENSATE
2-47E811-1.............FLOW DIAGRAM-RHR SYSTEM
2-47E812-1.............FLOW DIAGRAM-HPCI SYSTEM
2-47E813-1.............FLOW DIAGRAM-RCIC SYSTEM
2-47E814-1.............FLOW DIAGRAM-CORE SPRAY SYSTEM
0-47E820-1.............FLOW DIAGRAM-CRD HYDRAULIC SYSTEM
2-47E820-2.............FLOW DIAGRAM-CRD HYDRAULIC SYSTEM
0-47E830-1.............FLOW DIAGRAM-RADWASTE
2-47E841-1.............FLOW DIAGRAM-GLAND SEAL WATER
2-47E855-1.............FLOW DIAGRAM-FUEL POOL CLEANING SYSTEM
0-47E856-1.............FLOW DIAGRAM-DEMINERALIZED WATER

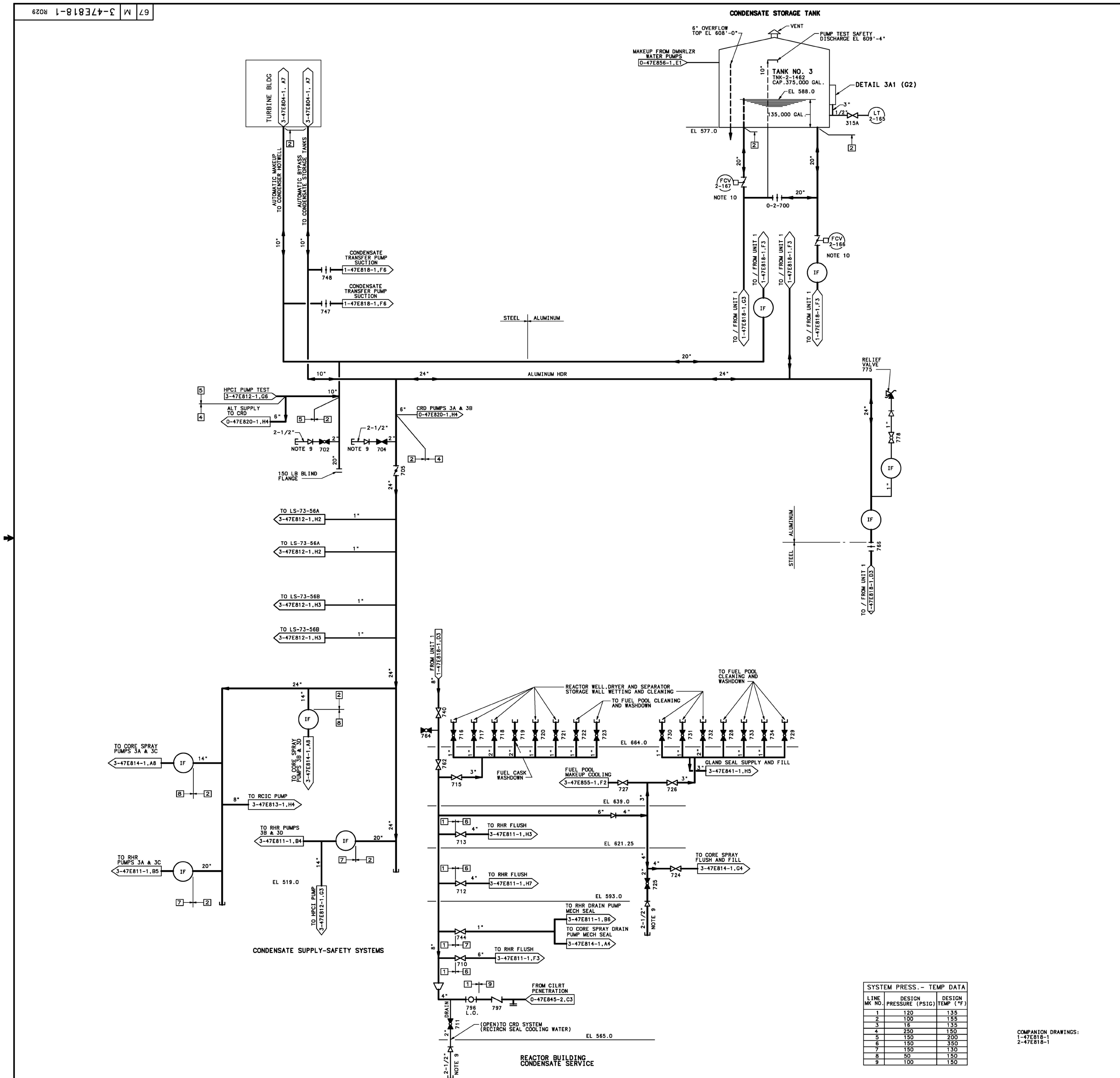
AMENDMENT 28

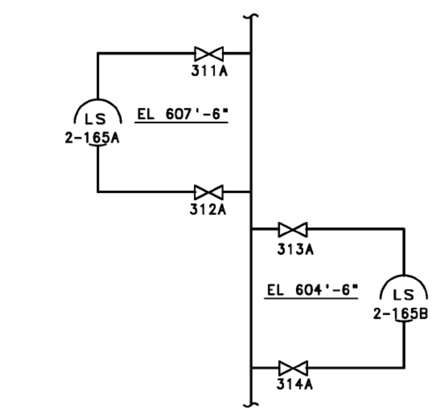
REACTOR BUILDING & YARD
UNIT 2

BROWNS FERRY NUCLEAR PLANT
FINAL SAFETY ANALYSIS REPORT

CONDENSATE STORAGE
AND SUPPLY SYSTEM
FLOW DIAGRAM
FIGURE 11.9-1b SH 2

67 M 3-47E818-1 R029





DETAIL 3A1
THIS DRAWING, H4

NOTES:

1. ALL VALVES ARE SAME SIZE AS PIPING, UNLESS OTHERWISE NOTED.
2. ALL PRESSURE AND TEST CONNECTIONS ARE 1/2", UNLESS OTHERWISE NOTED.
3. UNIDS ON DRAWINGS ARE FOR REFERENCE ONLY AND ARE ABBREVIATED AS SHOWN IN THE EXAMPLE TO MEET SPACE CONSTRAINTS. REFER TO MEL FOR COMPLETE UNIDS. ALL UNIDS ARE IN UNIT 3 AND SYSTEM 002 UNLESS OTHERWISE NOTED. LEADING ZEROES SHOWN IN MEL AS PART OF THE UNID ARE NOT DEPICTED. FOR ADDITIONAL GUIDANCE, REFER TO NEDP-4.

EXAMPLE:	MEL UNID	DRAWING UNID
	BFN-0-SCV-002-0730	730
	BFN-0-SHV-002-0700	0-2-700
	BFN-3-FCV-002-0167	FCV-2-167

4. 1 ETC, DENOTES DESIGN PRESSURE AND TEMPERATURE AS GIVEN IN TABLE THIS DRAWING.
5. DELETED
6. THE DESIGN PRESSURE AND TEMPERATURE OF ALL DRAIN AND VENT LINES THROUGH THE LAST ISOLATION VALVE SHALL BE THE SAME AS THE PROCESS LINE.
7. DELETED
8. VENT, DRAIN, AND TEST CONNECTIONS 1-1/2" AND BELOW CAN BE PROVIDED WITH PIPE CAPS OR HOSE CONNECTION FITTINGS WHERE REQUIRED BY PLANT PERSONNEL. THIS CONFIGURATION IS SUPPORTED BY ENGINEERING CALCULATION CD-Q0999-923399.
9. 2" DRAIN VALVES 702, 704, 711 AND 725 ARE EQUIPPED WITH NST FIRE HOSE CONNECTIONS TO SUPPORT MITIGATION STRATEGY REQUIREMENTS OF PROVIDING WATER VIA THE FIRE PROTECTION SYSTEM RING HEADER FOR HOTWELL MAKEUP AND DRYWELL INJECTION. REF: CIVIL CALCULATION CDQ09992007039.
10. VALVE SHALL REMAIN OPEN FOR NFPA 805 REQUIREMENTS EXCEPT WHEN REQUIRED FOR TESTING OR OPERATION.

REFERENCE DRAWINGS:

MEL ....MECHANICAL VALVE MARKER TAG TABULATION
3-47E610-73-1..........MECHANICAL CONTROL DIAGRAM - HPCI SYSTEM
3-47E610-2 SERIES......MECHANICAL CONTROL DIAGRAM - CONDENSATE SYSTEM
3-47E804-1.............FLOW DIAGRAM - CONDENSATE
3-47E811-1.............FLOW DIAGRAM - RHR SYSTEM
3-47E812-1.............FLOW DIAGRAM - HPCI SYSTEM
3-47E813-1.............FLOW DIAGRAM - RCIC SYSTEM
3-47E814-1.............FLOW DIAGRAM - CORE SPRAY SYSTEM
1-47E818-1.............FLOW DIAGRAM - CONDENSATE STORAGE AND SUPPLY SYSTEM
0-47E820-1.............FLOW DIAGRAM - CRD HYDRAULIC SYSTEM
3-47E841-1.............FLOW DIAGRAM - GLAND SEAL WATER
3-47E855-1.............FLOW DIAGRAM - FUEL POOL CLEANING SYSTEM
0-47E856-1.............FLOW DIAGRAM - DEMINERALIZED WATER
0-47E800-2.............MECHANICAL SYMBOLS & FLOW DIAGRAM DRAWING INDEX
0-47E800-1.............FLOW DIAGRAM - GENERAL PLANT SYSTEMS

SYSTEM PRESS.- TEMP DATA

LINE MK NO.	DESIGN PRESSURE (PSIG)	DESIGN TEMP (°F)
1	120	135
2	100	155
3	16	135
4	250	150
5	150	200
6	150	350
7	150	130
8	50	150
9	100	150

COMPANION DRAWINGS:
1-47E818-1
2-47E818-1

AMENDMENT 28

REACTOR BUILDING & YARD
UNIT 3

BROWNS FERRY NUCLEAR PLANT
FINAL SAFETY ANALYSIS REPORT

CONDENSATE STORAGE
AND SUPPLY SYSTEM
FLOW DIAGRAM
FIGURE 11.9-1b SH 3

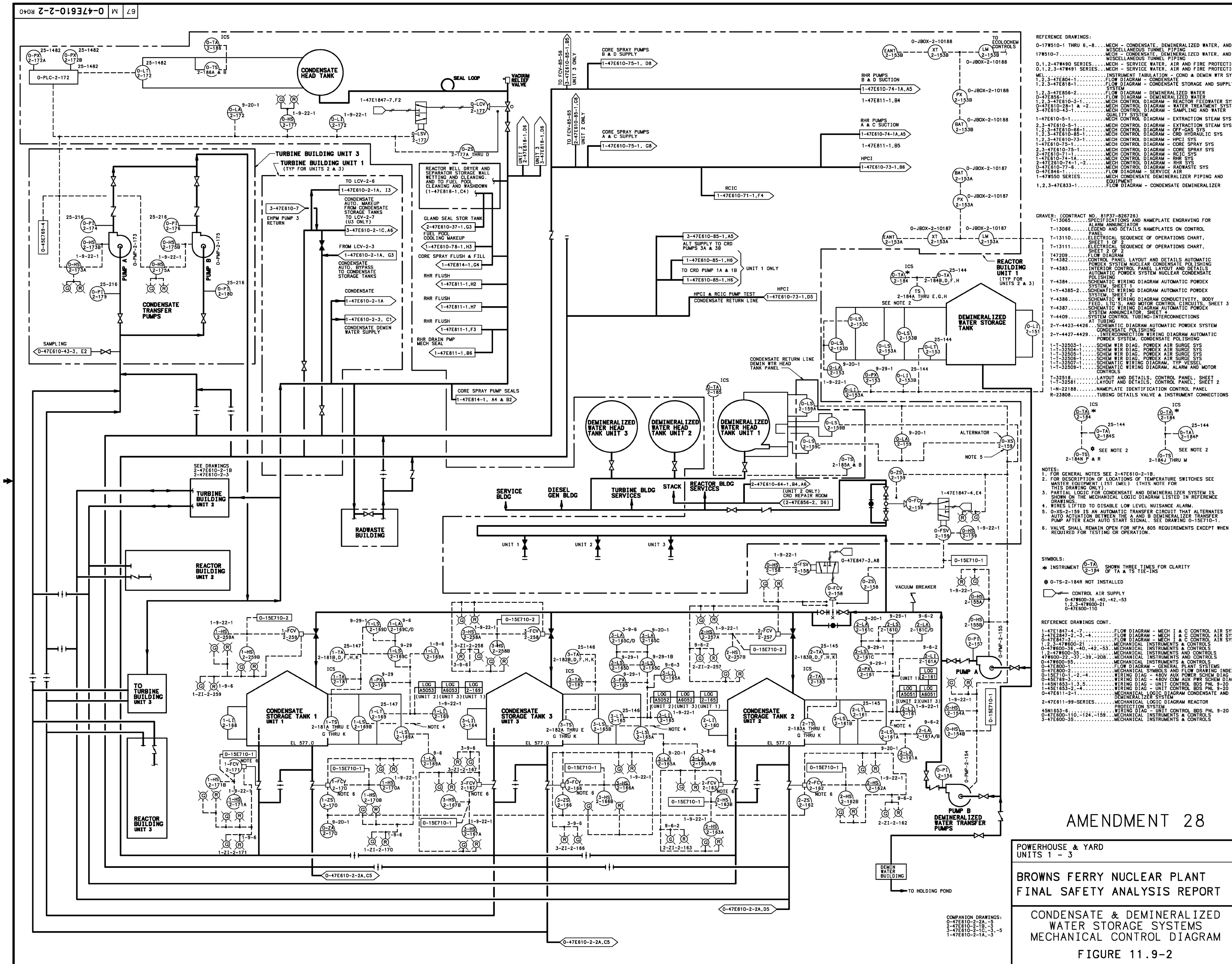
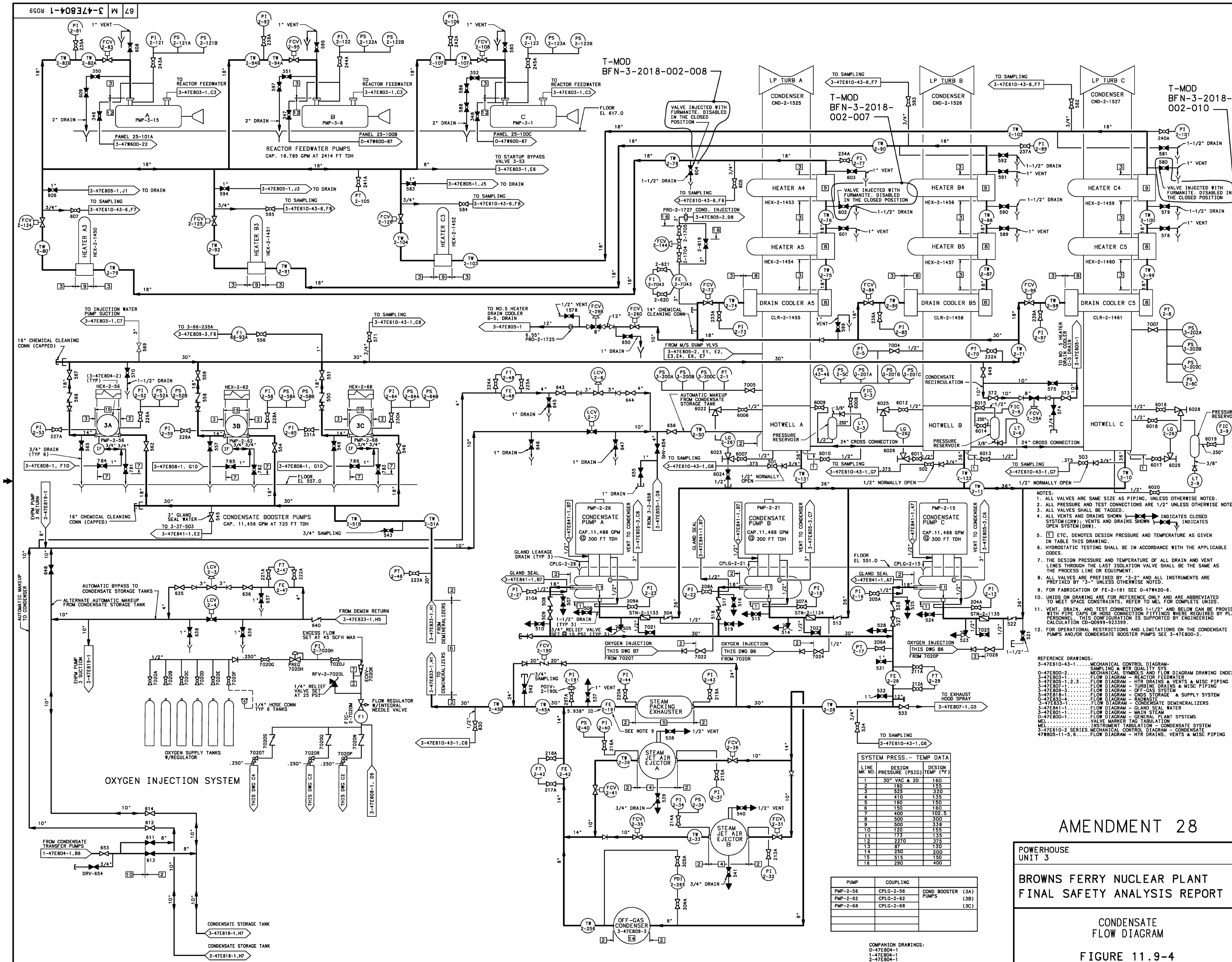

0-47E610-2-2 R040
CONDENSATE HEAD TANK
SEAL LOOP
VACUUM RELIEF VALVE
TURBINE BUILDING UNIT 3
TURBINE BUILDING UNIT 1 (TYP FOR UNITS 2 & 3)
CONDENSATE TRANSFER PUMPS
PUMP A
PUMP B
SAMPLING
REACTOR WELL DRYER AND SEPARATOR STORAGE WALL WETTING AND CLEANING. AND TO FUEL POOL CLEANING AND WASHDOWN (1-47E818-1,C4)
GLAND SEAL STOR TANK
FUEL POOL COOLING MAKEUP
CORE SPRAY FLUSH & FILL
RHR FLUSH
RHR DRAIN PMP MECH SEAL
CORE SPRAY PUMP SEALS
CORE SPRAY PUMPS B & D SUPPLY
CORE SPRAY PUMPS A & C SUPPLY
RHR PUMPS B & D SUCTION
RHR PUMPS A & C SUCTION
HPCI
RCIC
ALT SUPPLY TO CRD PUMPS 3A & 3B
TO CRD PUMP 1A & 1B
UNIT 1 ONLY
HPCI & RCIC PUMP TEST CONDENSATE RETURN LINE
REACTOR BUILDING UNIT 1 (TYP FOR UNITS 2 & 3)
DEMINERALIZED WATER STORAGE TANK
CONDENSATE RETURN LINE DEMIN WTR HEAD TANK PANEL
DEMINERALIZED WATER HEAD TANK UNIT 3
DEMINERALIZED WATER HEAD TANK UNIT 2
DEMINERALIZED WATER HEAD TANK UNIT 1
ALTERNATOR
SERVICE BLDG
DIESEL GEN BLDG
TURBINE BLDG SERVICES
STACK
REACTOR BLDG SERVICES
(UNIT 2 ONLY) CRD REPAIR ROOM
TURBINE BUILDING UNIT 2
RADWASTE BUILDING
REACTOR BUILDING UNIT 2
TO TURBINE BUILDING UNIT 3
REACTOR BUILDING UNIT 3
VACUUM BREAKER
CONDENSATE STORAGE TANK 1 UNIT 1
CONDENSATE STORAGE TANK 3 UNIT 3
CONDENSATE STORAGE TANK 2 UNIT 2
EL 577.0
PUMP B DEMINERALIZED WATER TRANSFER PUMPS
DEMIN WATER BUILDING
TO HOLDING POND
COMPANION DRAWINGS:
NOTES:
1. FOR GENERAL NOTES SEE 2-47E610-2-1B.
2. FOR DESCRIPTION OF LOCATIONS OF TEMPERATURE SWITCHES SEE MASTER EQUIPMENT LIST (MEL) (THIS NOTE FOR THIS DRAWING ONLY).
3. PARTIAL LOGIC FOR CONDENSATE AND DEMINERALIZER SYSTEM IS SHOWN ON THE MECHANICAL LOGIC DIAGRAM LISTED IN REFERENCE DRAWINGS.
4. WIRES LIFTED TO DISABLE LOW LEVEL NUISANCE ALARM.
5. 0-XS-2-159 IS AN AUTOMATIC TRANSFER CIRCUIT THAT ALTERNATES AUTO ACTUATION BETWEEN THE A AND B DEMINERALIZER TRANSFER PUMP AFTER EACH AUTO START SIGNAL. SEE DRAWING 0-15E710-1.
6. VALVE SHALL REMAIN OPEN FOR NFPA 805 REQUIREMENTS EXCEPT WHEN REQUIRED FOR TESTING OR OPERATION.
REFERENCE DRAWINGS:
GRAVER: (CONTRACT NO. 81P37-826726)
SYMBOLS:
REFERENCE DRAWINGS CONT.
AMENDMENT 28
POWERHOUSE & YARD
UNITS 1 - 3
BROWNS FERRY NUCLEAR PLANT
FINAL SAFETY ANALYSIS REPORT
CONDENSATE & DEMINERALIZED WATER STORAGE SYSTEMS MECHANICAL CONTROL DIAGRAM

FIGURE 11.9-2

Figure 11.9-3
(Deleted by Amendment 22)



NOTES:

1. ALL VALVES ARE SAME SIZE AS PIPING, UNLESS OTHERWISE NOTED.
2. ALL PRESSURE AND TEST CONNECTIONS ARE 1/2" UNLESS OTHERWISE NOTED.
3. ALL VALVES SHALL BE TAGGED.
4. ALL VENTS AND DRAINS SHOWN INDICATES CLOSED SYSTEM (CRW); VENTS AND DRAINS SHOWN INDICATES OPEN SYSTEM (DRW).
5. $\boxed{1}$ ETC, DENOTES DESIGN PRESSURE AND TEMPERATURE AS GIVEN IN TABLE THIS DRAWING.
6. HYDROSTATIC TESTING SHALL BE IN ACCORDANCE WITH THE APPLICABLE CODES.
7. THE DESIGN PRESSURE AND TEMPERATURE OF ALL DRAIN AND VENT LINES THROUGH THE LAST ISOLATION VALVE SHALL BE THE SAME AS THE PROCESS LINE OR EQUIPMENT.
8. ALL VALVES ARE PREFIXED BY "3-2" AND ALL INSTRUMENTS ARE PREFIXED BY "3-" UNLESS OTHERWISE NOTED.
9. FOR FABRICATION OF FE-2-191 SEE 0-47W420-6.
10. UNIDS ON DRAWING ARE FOR REFERENCE ONLY AND ARE ABBREVIATED TO MEET SPACE CONSTRAINTS, REFER TO MEL FOR COMPLETE UNIDS.
11. VENT, DRAIN, AND TEST CONNECTIONS 1-1/2" AND BELOW CAN BE PROVIDED WITH PIPE CAPS OR HOSE CONNECTION FITTINGS WHERE REQUIRED BY PLANT PERSONNEL. THIS CONFIGURATION IS SUPPORTED BY ENGINEERING CALCULATION CD-Q0999-923399.
12. FOR OPERATIONAL RESTRICTIONS AND LIMITATIONS ON THE CONDENSATE PUMPS AND/OR CONDENSATE BOOSTER PUMPS SEE 3-47E800-3.

REFERENCE DRAWINGS:

3-47E610-43-1.....MECHANICAL CONTROL DIAGRAM- SAMPLING & WTR QUALITY SYS
0-47E800-2........MECHANICAL SYMBOLS AND FLOW DIAGRAM DRAWING INDEX
3-47E803-1........FLOW DIAGRAM - REACTOR FEEDWATER
3-47E805-1,2,3....FLOW DIAGRAM - HTR DRAINS & VENTS & MISC PIPING
3-47E807-1........FLOW DIAGRAM - TURBINE DRAINS & MISC PIPING
3-47E809-3........FLOW DIAGRAM - OFF-GAS SYSTEM
3-47E818-1........FLOW DIAGRAM - CNDS STORAGE & SUPPLY SYSTEM
0-47E830-4........FLOW DIAGRAM - RADWASTE
3-47E833-1........FLOW DIAGRAM - CONDENSATE DEMINERALIZERS
3-47E841-1........FLOW DIAGRAM - GLAND SEAL WATER
3-47E801-1........FLOW DIAGRAM - MAIN STEAM
0-47E800-1........FLOW DIAGRAM - GENERAL PLANT SYSTEMS
MEL...............VALVE MARKER TAG TABULATION
MEL...............INSTRUMENT TABULATION - CONDENSATE SYSTEM
3-47E610-2 SERIES.MECHANICAL CONTROL DIAGRAM - CONDENSATE
47W805-11-5,6.....FLOW DIAGRAM - HTR DRAINS, VENTS & MISC PIPING

SYSTEM PRESS.- TEMP DATA

LINE MK NO.	DESIGN PRESSURE (PSIG)	DESIGN TEMP (°F)
1	30" VAC & 20	160
2	160	155
3	525	320
4	410	135
5	160	150
6	150	160
7	400	102.5
8	500	300
9	500	338
10	120	155
11	173	135
12	2270	375
13	87	130
14	250	200
15	515	150
16	290	400

PUMP	COUPLING	
PMP-2-56	CPLG-2-56	COND BOOSTER PUMPS (3A)
PMP-2-62	CPLG-2-62	(3B)
PMP-2-68	CPLG-2-68	(3C)

COMPANION DRAWINGS:
0-47E804-1
1-47E804-1
2-47E804-1

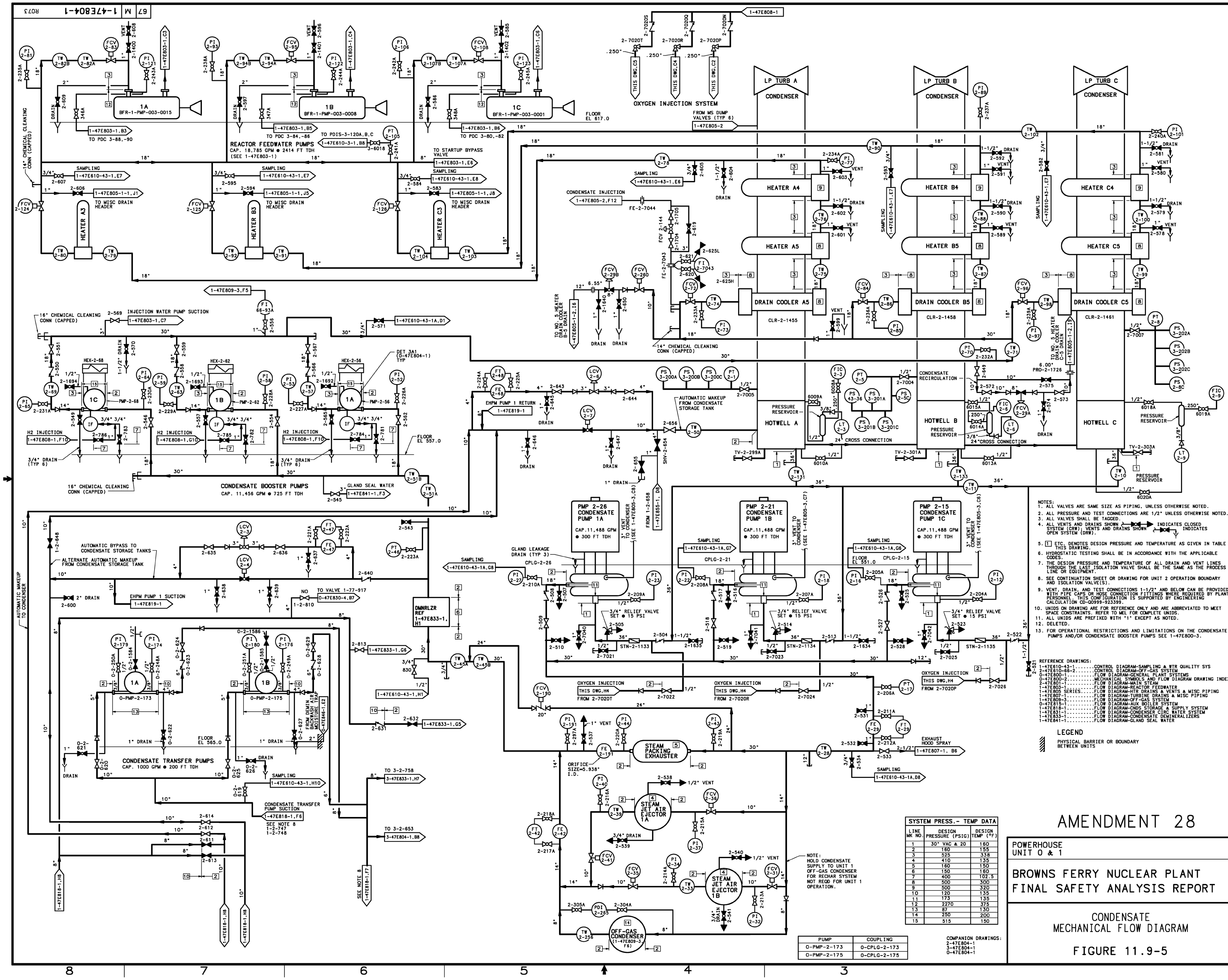
AMENDMENT 28

POWERHOUSE
UNIT 3

BROWNS FERRY NUCLEAR PLANT
FINAL SAFETY ANALYSIS REPORT

CONDENSATE
FLOW DIAGRAM

FIGURE 11.9-4



SYSTEM PRESS.- TEMP DATA

LINE MK NO.	DESIGN PRESSURE (PSIG)	DESIGN TEMP (°F)
1	30" VAC & 20	160
2	160	155
3	525	338
4	410	135
5	160	150
6	150	160
7	400	102.5
8	500	300
9	500	320
10	120	135
11	173	135
12	2270	375
13	87	130
14	250	200
15	515	150

PUMP	COUPLING
0-PMP-2-173	0-CPLG-2-173
0-PMP-2-175	0-CPLG-2-175