SAXTON NUCLEAR EXPERIMENTAL CORPORATION
GENERAL PUBLIC UTILITIES SYSTEM

JERSEY CENTRAL POWER & LIGHT COMPANY
NEW JERSEY POWER & LIGHT COMPANY
PENNSYLVANIA ELECTRIC COMPANY
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October 8, 19[illegible]

Docket No. 50-146
License DPR-4

Mr. R. L. Doan, Director
Division of Reactor Licensing
United States Atomic Energy Commission
Washington 25, D.C.

Dear Mr. Doan:

Three signed copies and nineteen conformed copies of Change Request No. 18 for a proposed change in the Saxton Technical Specifications are enclosed. This change pertains to a supercritical technology program to be conducted at the Saxton Reactor Plant.

Very truly yours,

W. H. Layman
General Manager

WHL:DS
Encl.

CC: G. F. Trowbridge, Esquire

1. Description of Change

Make the following addition to the Saxton Technical Specifications: Supplement No. 2 to Technical Specifications incorporating changes applicable to conduct of a Supercritical Technology Program in the Saxton Reactor Plant.

During the conduct of tests and experiments contained in the Supercritical Technology Program, the Technical Specifications shall be changed to the extent indicated below, when fuel is installed in the supercritical loop and the Saxton reactor is above 1 MWt. Except to the extent as changed, all of the remaining provisions of the Technical Specifications shall remain in effect.

A. SUPERCRITICAL FUEL ASSEMBLY

1. Enriched uranium dioxide (UO_2) shall be used for fuel, either sintered in the form of pellets or vibration compacted and swaged or vibration compacted and "pressure bonded."

2. The fuel pellets will have dished ends initially and a void will be provided in the upper end plug to accommodate fission gas build-up.

3. The fuel clad will be Type 16-20 stainless steel or Incoloy, with nominal wall thickness of 10.5 mils. The clad will rely upon the enclosed fuel for support against the coolant pressure.

4. Seven fuel rods form the fuel assembly. One rod is in the center with the other six surrounding it. The outer six rods are spiral wrapped with 0.05" O.D. wire, made of the same material as the clad which it is on.

5. The fuel assembly is bolted to the upper grid and bolts tack welded in place. The rods are slipped into the lower grid to allow axial expansion and restrict radial movement.

6. The rod cluster is contained within three form-fitting hexagonal fuel assembly baffles which are welded at the top of the upper grid. The inner baffle is also welded to the lower grid at the bottom. The outer baffles are dimpled for an interference fit, to center the fuel assembly.

7. The upper grid is then hung from the outer, of the three, fuel assembly baffles which is welded to the spring guide at the top of the baffles. The inner two baffles are free to expand axially at the top. These baffles separate inlet and outlet coolant flow.

8. The fuel assembly, complete with fuel assembly baffles and fuel assembly hanger baffles, is bolted to the pressure tube baffles and fitted into the pressure tube.

9. The Saxton fuel assembly, into which the pressure tube is to be inserted, has 21 rods removed from its center and is located in core position E-1. The center portion of it is designated experimental position N-4.

B. SUPERCRITICAL COOLANT SYSTEM

The supercritical coolant system consists of the pressure tube, pumps, heat exchangers, purification equipment, accumulator, specimen holders and necessary piping and valves. All equipment except the pressure tube shall be fabricated in accordance with the applicable ASME Boiler and Pressure Vessel Code or ASA Pressure Piping Code.

1. Pressure Tube

The pressure tube assembly shall be of the bayonet re-entry type. Coolant at pressures up to 4000 psig and temperatures to 1000°F enters the pressure tube through a lower jumper and flows downward through the annulus formed by the pressure tube baffles and the fuel assembly baffles. At the lower end of the pressure tube, the flow direction is reversed to pass upward through the fuel assembly and inner fuel assembly hanger baffles. The coolant leaves through the top jumper at temperatures up to 1000°F.

A Marman conoseal pipe joint serves to support the pressure tube assembly on the reactor head penetration.

The pressure tube assembly consists of five components: the connector body, pressure tube extension, head adaptor flange assembly (each three of AISI Type 316 stainless steel), a co-extruded transition joint between stainless steel and Zircaloy-4 and Zircaloy-4 pressure tube.

The pressure tube is designed for an internal working pressure of 4000 psig with no external pressure and externally 2200 psig with no internal pressure.

2. Pumps

Three electrically driven triplex positive displacement pumps are provided to supply coolant to the pressure tube. Two 2-speed loop pumps are rated at 15 gpm each at full speed and 5000 psig discharge pressure and 7.5 gpm each at half speed at the same pressure. A single speed standby pump is provided as a reserve which is rated at 5.3 gpm at the same discharge pressure. The second 2-speed loop pump is physically piped into the loop but is not connected electrically. In the event of failure of the first pump, the standby pump can be utilized while the wiring is changed to the second pump.

All parts in contact with the coolant are fabricated of austenitic stainless steel or equivalent corrosion resistant material.

3. Heat Exchangers

a. Heater - The heater, with a rated capacity of 650 KW, raises the coolant temperature to the required pressure tube inlet conditions. Forty-two individual heaters are provided in three parallel paths of austenitic stainless steel pipe. A saturable reactor is provided to vary heater voltage and current to establish constant pressure tube inlet temperature.

b. Interchanger - The interchanger is a regenerative heat exchanger utilizing three parallel paths of double pipe coils constructed of welded austenitic stainless steel and arranged concentrically about the vertical axis.

c. High Pressure Cooler - The high pressure cooler utilizes a vertically oriented double pipe coil to cool the tube side stream from the interchanger to permit pressure reduction without flashing. The inner pipe is made of austenitic stainless steel while the outer pipe, exposed to component cooling water, is carbon steel.

d. Low Pressure Cooler - The low pressure cooler is constructed in the same manner as the high pressure cooler to further cool the loop coolant to the deaerator conditions.

4. Purification Equipment

The purification equipment, consisting of a deaerator, a demineralizer, a filter and two condensate pumps, is designed for full loop flow.

a. Deaerator - the deaerator separates and removes dissolved and entrained gases from the loop coolant and provides coolant storage and net positive suction head for the condensate pumps. All wetted surfaces are austenitic stainless steel.

b. Condensate Pumps - Two canned-motor units are arranged to operate in series, although they are piped such that each can operate alone. Both pumps may be required if both the main loop pump and standby pump are running. All parts in contact with the coolant are fabricated of austenitic stainless steel or equivalent corrosion resistant material.

c. Radiation Monitor - An in-line radiation monitor is located downstream of the condensate pumps for continuous measurement of the loop radiation level.

d. Demineralizer - A flushable, refillable, mixed bed demineralizer is used to remove ionic impurities and corrosion products in the loop. All wetted parts are constructed of austenitic stainless steel. Local radiation shielding is used.

e. Filter - A cartridge type filter removes resin fines escaping from the demineralizer. Construction of the filter container is austenitic stainless steel. Local radiation shielding is provided for the unit.

5. Specimen Holders

Three specimen holders are provided to permit insertion of specimens in the coolant flow stream. One holder is located downstream of the heater and the other two on either side of the interchanger. All parts of the holder are fabricated of austenitic stainless steel.

6. Accumulator

An accumulator is provided to reduce pressure pulsations from the main coolant pumps. The accumulator is constructed of carbon steel whose interior is lined with a protective coating.

7. Piping and Valves

All supercritical loop coolant piping is austenitic stainless steel. Service piping for component cooling water and air is carbon steel or copper. Piping joints in the main coolant stream are welded except for remote disconnect couplings at the pressure tube and specimen holders.

Manually operated stop valves are provided to change flow circuitry, to permit venting, filling and draining components and permit isolation of certain components for maintenance.

Remotely operated stop valves are used to isolate loop equipment not in use, by-pass various portions of the loop and vent or drain components not accessible during loop operation or decontamination.

All valves containing radioactive fluids, except instrument valves, are provided with leakoffs or backseats to maintain essentially zero leakage. All valves in contact with the loop coolant are austenitic stainless steel.

C. AUXILIARY SYSTEMS

1. Component Cooling

Flow from the component cooling system of the Saxton reactor is used to cool the following pieces of equipment in the supercritical loop: high pressure cooler, low pressure cooler, sample coolers, recombiner condenser, and vacuum pump seal water cooler.

2. Shutdown Cooling

Shutdown cooling utilizes the high pressure and low pressure coolers. The circulation is provided by the condensate pumps. In addition, emergency cooling can be effected by using the emergency condenser.

3. Coolant Make-up

The loop is filled by gravity from the head tank to the pumps' suctions. The head tank is a vertical cylindrical vessel constructed of stainless steel and designed for a pressure of 150 psig or full vacuum of 312°F.

4. Safety Injection

During emergency conditions, i.e., loss of flow or loss of coolant, the supply of pressurized water held in the coolant reservoir is discharged automatically to the accumulator connection of the loop following loss of flow or to the pressure tube outlet line upon a loss of coolant upstream of the pressure tube.

a. Coolant Reservoir - The coolant reservoir is a 25-gallon vertical cylinder constructed of carbon steel designed for 5000 psig at 200°F. It contains demineralized water pressurized by a gas cylinder.

b. Reservoir Gas Cylinder - The reservoir gas cylinder holds the nitrogen used to drive the reservoir water into the loop. It is of all welded joint construction, carbon steel, and designed for 5000 psig.

c. Gas Compressor - A gas compressor is provided to charge the reservoir gas cylinder and maintain its pressure at a specified value. It is designed to discharge 5000 psig with a suction pressure of 200 to 2500 psig supplied by a commercial container.

d. Emergency Condenser - The emergency condenser consists of a pipe coil mounted in a vertical drum which is used to continue fuel cooling during an extended loss of coolant or a loss of flow accident. An intermittent flow of make-up water balances the losses as it is boiled off in the drum. It is fabricated of austenitic stainless steel, provided with an overflow and vacuum break and designed for 15 psig shell and 4400 psig at 1000°F tube side.

5. Pressure Relief

The supercritical loop is protected from overpressure by relief valves on:

a. Outlet line from the pressure tube,

b. Discharge side of the loop pumps and standby pump,

c. Discharge side of the gas compressor,

d. Demineralized water line supplying the coolant reservoir, and

e. Component cooling water line.

Two rupture discs are also supplied. One protects the low pressure cooler from overpressure in the inlet. A second protects the deaerator from overpressure. An automatic valve is located between the pressure tube inlet and outlet lines to protect the interchanger in the event of pressure tube blockage.

6. Sampling

Provision shall be made to sample the coolant for crud, gas and liquid samples.

7. Decontamination

The decontamination system consists of a feed tank for mixing and storing decontamination solutions. It is constructed of stainless steel and is open to the atmosphere.

8. Reactor Head Nozzle Cooling System

A bleed system for reactor coolant through the supercritical loop nozzle penetration of the reactor vessel is provided to limit reactor nozzle temperature to 650°F.

D. RADIOACTIVE WASTE DISPOSAL

Liquid wastes from the supercritical loop are drained to the Saxton Radioactive Waste Disposal Facility.

The supercritical loop gaseous waste disposal system consists of a vacuum pump which draws the gases from the deaerator and pumps them to the recombiner package and its seal water system. The residue, after recombination, flows to the Saxton Radioactive Waste Disposal Facility.

E. WATER TREATMENT

The supercritical loop is filled with demineralized water initially from the Saxton plant supply. Since the loop contains a full flow demineralizer and a deaerator, it is relatively insensitive to make-up water specifications.

The following operating limitations shall apply to the supercritical loop operation:

Maximum supercritical fuel assembly power level	136 KWt
Maximum loop pressure	4000 psig
Minimum loop pressure	2000 psig
Maximum supercritical pressure tube outlet temperature	1000°F
Minimum loop flow	5 gpm
Maximum 15-minute degassed gross activity of coolant	20 uc/cc
Maximum chloride concentration in loop coolant	0.1 ppm
Maximum temperature of reactor vessel head flange	650°F

If any of these limits are exceeded, action will be initiated to bring the condition back within limits.

In Supplement No. 1 to Technical Specifications, page 4, change section labeled "Change Item G. 3." to read:

Change Item G. 3.

The reactor shall be automatically scrammed under the following conditions:

Conditions	Set Point
Fast startup rate (maximum)	2 decades/min.
High power level at startup (maximum)	25% full power
High power level at power	
20 MWt operation (maximum)	24 MWt
23.5 MWt " "	27 MWt
Low main coolant pressure (minimum)	1600 psig
Low main coolant flow above 1 MWt(minimum)	2.2×10^6 lb/hr
Low water level in pressurizer (minimum)	8.3%
Loss of main coolant pump power	Contact on breakers, failure of power supply, or loss of variable frequency set clutch excitation when variable frequency set is supplying power for main coolant pump operation.
Main coolant temperature(hot leg)(maximum)	554°F

If the supercritical loop pressure tube is installed in the reactor and it is fueled:

Conditions	Set Point
Loss of supercritical loop flow (minimum)	50% of normal flow set point, exceeding a preset time delay
Loss of supercritical loop coolant	2000 psig
Loss of supercritical loop coolant	Pressure drop reversal across pressure tube

The scram signal conditions associated with the supercritical loop need be operational only if a fueled pressure tube is installed in the reactor.

2. Purpose of Change

The purpose of this change request is to allow the insertion of a fueled pressure tube, forming a part of the supercritical loop coolant system into the Saxton Reactor and permit the conduct of a Supercritical Technology Program.

3. Safety Considerations

In our opinion, the proposed change does not present significant hazards considerations not described or implicit in the Final Safeguards Report.

4. Health and Safety

It is our opinion that the health and safety of the public will not be endangered by this change.