SAXTON NUCLEAR EXPERIMENTAL CORPORATION

DOCKET NO. 50-146
LICENSE DPR-4

Amendment No. 1 to Change Report No. 16

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1. On November 13, 1968, Applicant submitted Change Report No. 16 describing modifications made to the safety injection system and the installation of an automatic, long-term coolant recirculation system. The section, "Safety Considerations", has been revised and this revision is being submitted as Amendment No. 1 to Change Report No. 16.

SAXTON NUCLEAR EXPERIMENTAL CORPORATION

By /s/ R. E. Neidig
R. E. Neidig, President

July 8, 1969

Docket No. 50-146
DPR-4
Change Report No. 16

Amendment No. 1

CHANGE REPORT FOR INSTALLATION OF LONG-TERM RECIRCULATION SYSTEM AND INJECTION SYSTEM CIRCUITRY

Safety Injection System

Each of the two safety injection lines feeding the reactor vessel is supplied with a flow indication channel mounted on the main control board. The logic in the existing circuit for detecting a rupture of one of the safety injection lines and closing the associated isolation valve is based on a two to one flow ratio in the two injection lines. If the flow ratio exceeds two to one, the isolation valve in the line with the higher flow is automatically closed. To preclude isolation of an intact line, in the event the isolation valve in the remaining line should fail to open, the circuit will be modified to require indication of an open flow path in line with the lower flow prior to closing of the isolation valve in the line with higher flow. The modification will include a position signal indicating the valve is in an open position to ensure that the flow path is open as shown in Figure 4.

The safety injection actuation circuitry has been analyzed from the standpoint of an active component failure preventing automatic operation. Failure of the master actuation relay, operating coil, or its fuse could prevent automatic safety injection. With coil or fuse failure the operator would trip the relay manually. Mechanical failure of the relay would require the operator to manually start the pumps and operate the valves. To increase the reliability for automatic initiation, the circuit will be modified by addition of separate relay, operating coil, and fuse in parallel as shown in Figures 5 and 6.

Purpose of Change

The purpose of this change is to enhance the safety characteristics of the Saxton Reactor (as described in the previously submitted Saxton - Loss of Coolant Accident Prevention and Protection Report) by providing long-term cooling for decay heat removal, increasing the reliability of the Safety Injection System and adding redundancy to the actuation circuitry.

Safety Considerations

The design, fabrication and erection of the recirculation system piping was made in accordance with USAS B31.1 - 1967 Edition.

A schematic of the system is shown in Figure 1. The recirculation reservoir is a stainless steel tank provided to insure a source of clean water for periodic testing of the system. The recirculation pumps are designed and installed to operate, immersed in borated water. The motor operated isolation valves are located in the piping so that they will not be immersed. The valves are, however, designed to operate in a 40 psig, 280°F, saturated steam environment. The system piping from the reservoir to the check valves (VR7 and VR8) downstream of the pumps is designed for 150 psig and 280°F. That part of the system from the check valves to the connection to the safety injection piping is designed for 2500 psia and 650°F. Two new check valves (3V251A and 3V253A), designed for 2500 psia and 650°F, have been installed in the safety injection piping as a part of the recirculation system.

The integrity of the recirculation and safety injection system was assured by conforming to the following Code requirements:

1. Welders and weld procedures were qualified in accordance with ASME Boiler and Pressure Vessel Code, Section IX.
2. Root and final pass of all welds were liquid penetrant inspected and all butt welds were 100% radiographically inspected. The procedures and acceptance standards were in accordance with ASME Boiler and Pressure Vessel Code, Section I.

Paragraph 137.1 of B31.1 requires that all piping systems designed, fabricated and erected under the Code demonstrate leak tightness, which must be met by a hydrostatic test prior to initial operation. Where a hydrostatic test is not practicable an initial service leak test, a vacuum test or 100% radiography of all welded joints in an all welded system may be substituted. Paragraph 137.4.1(b) further specifies that the hydrostatic test, if performed, shall be conducted at a test pressure of 1.5 x design pressure unless a lesser pressure is indicated by Paragraph 137.4.1(a). Paragraph 137.4.1(a) specifies that the test pressure shall not exceed the maximum test pressure of any vessel or components in the piping system. Reference to Figure 1 shows that in order to hydrostatically test the new piping, the reactor coolant system will be subjected to the same hydrostatic pressure. Therefore, the practicability of conducting such a test is limited by the maximum pressure capability of the reactor coolant system.

In determining the maximum pressure capability of the reactor coolant system the following conditions were considered:

1. Pressure retaining components in the reactor coolant system include austenitic stainless steel piping and fittings, and low alloy steel.
2. NDT shift and thermal stress considerations for the low alloy steel in the reactor vessel limit minimum system temperature to 520°F for approximately system design pressure.

The allowable stress for austenitic stainless steel in both the ASME Boiler and Pressure Vessel Code and USAS B31.1 recognizes the work-hardening characteristics of these materials by permitting the allowable stress at elevated temperature to reach 90% of the minimum 0.2% offset yield strength at the specific design temperature. A footnote to Tables A-1 and A-2 of USAS B31.1 cautions that allowable stress is 90% of yield strength, and for some loading conditions undesirable plastic deformation could occur. Section III of the ASME Boiler and Pressure Vessel Code provides a more quantitative warning by limiting any test pressure to the lesser of 1.25 x design pressure or that which produces a stress equal to 90% of the material yield strength at the test temperature. Therefore, the limiting pressure for the reactor coolant system at a temperature of 520°F is set by the ausenitic stainless steel piping and fittings in the system.

The reactor coolant system piping (centrifugally cast) and the reactor coolant system fittings (static cast) were designed, fabricated and erected in accordance with USAS B31.1 - 1955 Edition, and nuclear piping Cases N-9 and N-10* respectively. The material property data curves are the same for both components; therefore, the allowable stresses as set forth in Cases N-9 and N-10 are identical. The maximum allowable stresses for the system design temperature and the leak test temperature are:

For a design temperature of 650°F, S_a = 15,000 psi

For a leak test temperature of 520°F, S_a = 15,720 psi

* Cases N-9 and N-10 are attached

Thus, the maximum leak test pressure to which the reactor coolant system may be subjected to stay within the 90% yield strength limit is:

$$\frac{15,720}{15,000} \times 2485 = 2604 \text{ psig}$$

where: 2485 psig is reactor coolant system design pressure.

In view of the quality control exercised during fabrication and erection, and the use of radiographic and liquid penetrant examinations to verify the structural adequacy, the use of 2604 psig is an unnecessarily high pressure to demonstrate leak tightness of the recirculation and safety injection systems. Therefore, the systems will be leak tested at a pressure of 2500 psia (system design pressure), while the reactor coolant system is maintained at a slightly higher pressure of 2575 psia.

Construction quality control for the electrical and instrumentation installations will be assured by integrating permanently assigned Westinghouse technicians with the contractor personnel. Further the overall installation will be continuously monitored by an NPS I&C engineer or the Westinghouse site resident engineer.

The National Fire Protection Association, National Electrical Code, Manufacturers recommended installation instructions, Westinghouse handbook for Inspection and Test of Electrical Equipment, Westinghouse Wiring Checklist, and Westinghouse Electrical Equipment Test Records will all be used as a guide to assure proper installation.

A comprehensive functional test procedure has been defined for nuclear power plant systems by Westinghouse. This test procedure is to be conducted by Westinghouse and the Saxton Nuclear Experimental Corporation as part of the acceptance testing.

To demonstrate the availability of the Recirculation System and to ensure satisfactory operation of system components, pump relays and automatic actuation circuitry, the Recirculation System will be tested monthly in conjunction with the routine test of the Safety Injection System.