PSNH

SEABROOK STATION
Engineering Office

Public Service of New Hampshire

New Hampshire Yankee Division

March 20, 1986

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United States Nuclear Regulatory Commission
Washington, DC 20555

Attention: Mr. Vincent S. Noonan, Project Director
PWR Project Directorate No. 5

References:
(a) Construction Permits CPPR-135 and CPPR-136, Docket Nos. 50-443 and 50-444
(b) USNRC Letter, dated February 14, 1986, "Seismic Qualification Review of Equipment," V. Nerses to R. J. Harrison

Subject: Seismic Qualification Review of Equipment

Dear Sir:

Enclosed please find, as Attachment 1, revised excerpts of FSAR Section 3.9(B) which addresses the concerns raised in Reference (b). The enclosed will be incorporated into the FSAR by a future amendment.

Very truly yours,

John DeVincentis, Director
Engineering and Licensing

Enclosures

cc: Atomic Safety and Licensing Board Service List

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ATTACHMENT 1

Revised Excerpts FSAR Sections 3.9(B).3.2 and 3.9(B).3.3

Seabrook Station

condition by assuring that: (1) the deflection of the pump impeller shaft will not exceed the clearance between the impeller and impeller casing and (2) the bearing will not be subjected to excessive loads imposed by deflection of rotating assembly and by differential movement of the coupling between the pump and pump driver shaft. The pump supports, including the base frame and anchor bolts, are analyzed for dead weight, nozzle loads, operating loads and seismic loads. The stress limits for the supports are those of AISC Manual of Steel Construction, and are described in Table 3.9(B)-10.

The lowest natural frequency of all active pumps, except the service water pumps, is demonstrated by test or analysis to be greater than 33 Hz. The service water pump is a long deep well pump with a natural frequency of 9.61 Hz. The operability of this pump is assured by dynamic analysis. Pumps having a natural frequency above 33 Hz, are considered to be rigid, and the problems with amplification between the component and structure are avoided. 56

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To avoid damage during the faulted plant condition, three areas of analysis are performed on the motor: the supports, the rotor assembly, and the motor stator frame. The supports, bolts, and the stator frame are analyzed for deadweight, operating loads, and seismic loads and the stress limits are those of the AISC Manual of Steel Construction. Deflection of the rotor shaft was compared to the clearance between the stator and the rotor, to ensure that rubbing - type failure will not occur. The angular and parallel shaft deflections at the coupling were calculated and compared to the allowables for the coupling. Rotor shaft stresses and bearing loads were evaluated and compared to allowables for the faulted plant conditions.

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b. Valve Operability Assurance Program

The operability assurance program for seismic Category I active valves of all pipe sizes is comprised of tests and analysis. This program provides assurance that these valves will perform their mechanical function in conjunction with a design basis accident during a seismic event. The active valves are subjected to several tests prior to installation; namely, a shell hydrostatic test to ASME Section III requirements, seat and disc hydrostatic tests, and functional tests. After installation, preoperational tests are performed. Periodic in-service inspections and periodic in-service testing further verify and assure the functional ability of the safety-related active valves. 56

The valve body and other pressure retaining parts of active valves are designed and analyzed by considering operating loads and seismic induced nozzle loads. For valves with extended structures, an analysis of the extended structure is performed applying static, equivalent seismic loads of 3g for each of the three principal axes acting at the center of gravity of the extended structures. The maximum allowable stress limits applied in these analyses demonstrates structural integrity and compliance with the limits specified by the ASME Section III Code for the particular ASME Class of valve analyzed. Stress limits for all loading combinations are presented in Table 3.9(B)-11 for Class 2 and 3 safety-related active valves and Table 3.9(B)-11a for Class 1 safety-related active valves. Table 3.9(B)-25 lists all AE-supplied active valves. 56

The valve body for active and non-active valves are qualified by analysis and account for the interface loading imposed by the actuators.

The valve actuators for active and non-active valves are qualified by tests in accordance with IEEE 323-1974 and IEEE 344-1971. However, a 1.5 factor is applied to the sinusoidal input motion and, therefore, compliance with IEEE 344-1975 is achieved. 48

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In addition to the above functional tests and analyses, representative active valves of each design type with overhanging structures are tested to verify operability during simulated seismic events by demonstrating operational capabilities within the specified limits.

Functional specifications for active valve assemblies are not prepared, but the requirements of R.G. 1.148 are contained within the design specifications and system specifications. The requirements of ANSI B16.41 are not part of a specific test program but all of the individual tests defined, except for the vibration endurance tests, are performed as part of the series of tests comprised of vendor hydro tests and seismic tests and plant start-up testing. The valve(s) chosen for the parent valve(s) for vendor seismic testing generally complies with the size extension limitations of 200 percent to 50 percent except as follows:

(1) Posi-Seal butterfly valves, Class 2 and 3, 150 lb. carbon steel body with matrix operator, sizes 14 to 36 inches, are qualified by tests performed on a 30-inch valve.

(2) Walworth gate valves, Class 2 and 3, 150 lb. carbon steel body with Limitorque operator, sizes 3 to 16 inches, are qualified by tests performed on 8 and 16 inch valves. Although the 3-inch valve is below the 50% criteria, evaluation of the valve dimensions indicate sufficient conservatism so that operability is assured. 56

d. Operability Assurance Program Results for Active Valves

The results of seismic tests and analysis on active valves are provided in our document entitled, "Public Service Company of New Hampshire, Seabrook Station Units 1 & 2, Seismic Qualification Review Team (SQRT) Equipment List," which was forwarded to Mr. Frank J. Miraglia, Chief Licensing Branch #3, Division of Licensing, under cover of PSNH's letter, dated May 27, 1982. 45

3.9(B).3.3 Design and Installation Details for Mounting of Pressure Relief Devices

The installation and design of pressure relief devices comply with the rules of ASME III, Paragraph NB-7000, and NRC Regulatory Guide 1.67.

a. Overpressure Protection for Reactor Coolant Pressure Boundary (RCPB).

The pressurizer in the reactor coolant system is provided with three safety valves and two power-operated relief valves for overpressure protection. These valves discharge through a closed piping system to the pressurizer relief tank, where the steam is condensed and cooled by mixing with water. The piping system and supports are designed to satisfy the following design criteria.

1. Stress limits for load combinations listed in Table 3.9(B)-6 for safety Class 1 piping from the pressurizer to the safety and relief valves.
2. Stress limits for load combinations listed in Table 3.9(B)-7 for non-safety class piping downstream of the safety and relief valves to the pressurizer relief tank.
3. Load limits on pressurizer vessel nozzles as established by the manufacturer of the pressurizer vessel.
4. Load limits on valve connections as established by the manufacturer of the valves.

The three safety valves are mounted on the pressurizer nozzles with the short inlet pipe and elbow necessary to position the valves vertically. The total length of pipe, elbow and weld-neck flange is approximately 24 inches and is as short as possible to minimize the pressure drop on the inlet side of the valve.

When the valves open, the dynamic effects from the flow of water and steam are included in the design analysis.

These transient load effects on the piping system, upstream and downstream of the safety and relief valves, have been evaluated 56 45

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using the RELAP 5 computer code, Ref. (1), to generate thermal-hydraulic characteristics of the flow along the piping system, from which tables of the wave force versus time for each leg have been derived. To evaluate piping stresses and support loads, the maximum force for each leg has been selected and applied statically to the piping system in the most conservative fashion. To account for the effect of the suddenly applied load, dynamic load factors (DLF) have been applied to the reaction forces. DLF's have been based on the valve opening time and the system dynamic characteristics, or DLF of 2.0 has been used in accordance with NRC Regulatory Guide 1.67. The developed stresses and loads on nozzles were combined with the other applicable loads from Tables 3.9(B)-6 and 3.9(B)-7. These were compared with the allowable stresses and allowable nozzle loads. The simultaneous discharge from all valves has been assumed in the thrust analyses. 45

b. Overpressure Protection for the Secondary (Main Steam) System

A multiple-valve installation, comprised of five safety valves, is provided in each of the four main steam lines. The valves are installed on main steam piping headers, outside of the containment building in a piping chase between the containment penetration and the main steam isolation valves. The safety valve discharge side is configured so as to minimize reaction forces at the valve branch/main header intersection point. The vertical branch line from the main steam piping header to each individual valve has a forged flange and sweepolet welded to the header. Safety valves are bolted directly to the flanges. 56

The effect of the valve discharge transient was obtained by static application of an assumed discharge force, as obtained from the valve manufacturer, with a dynamic load factor DLF = 2.0. It has been assumed that all five valves discharge simultaneously. The system of piping supports and rigid restraints limits both dynamic and static loadings to the piping system to code allowable stresses for the load combinations listed in Table 3.9(B)-7.

c. Safety and Relief Valves for Various Auxiliary Systems

Mounting of safety and relief valves on auxiliary piping systems utilizes standard piping components: flanges, buttwelded or socketwelded tees, weldolets and sockolets for pipe branches to the valves. The valves and valve discharge piping utilize flanged joints, buttwelded and socketwelded connections. Branch connections are qualified using code standard calculations for tees with proper intensification factor (ASME III, Table NB-3682.21 or NC-3652-4). The alternative method for branch qualification is the Bijlaard method utilizing the SPHNOZ/CYLNOZ computer program. The load combination for calculating stresses is according to Table 3.9(B)-7. These were compared with the allowable stresses.

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The pump has two lateral restraints which maintain lateral displacements within the limits of the available clearances. Additionally, all stresses are limited to 1.5 S, thereby assuring that the pump operability is maintained in the faulted loading conditions.

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All motor stresses are limited to the region of elastic deformation of the material stress-strain relationship and thereby provides assurance that operability is maintained in the faulted condition.

INSERT C

The response of equipment at the resonant frequency at 5% damping for a continuous sinusoidal input is amplified approximately ten (10) times, compared with an amplification of three (3) times for a random motion input. By applying a factor of 1.5 to the sinusoidal input, the comparative response is $\frac{10}{3} \times 1.5 = 5$ to 1, which is conservative.

in the following manner:

1. Safety Valve Piping System

   A static analysis was performed for the safety valve piping system in which the peak transient loads obtained from a RELAP 5 analysis and multiplied by a dynamic load factor (DLF) were applied. The pressurrizer safety valve piping system contains no water seals nor is subjected to water slugs.

2. Pressurizer Relief Valve Piping System

   A static analysis was performed for the pressurizer relief valve piping system in which the peak transient loads obtained from a RELAP 5 analysis and multiplied by a dynamic load factor were applied. Although the pressurizer relief valve piping system contains water seals and is subjected to water slugs, the effects of these two items were fully accounted for in the RELAP 5 analysis.

In each of the above analyses, the RELAP 5 computer code, Ref. (1), was used to generate thermal hydraulic characteristics of the flow along the piping system, from which tables of the wave force versus time for each leg have been derived. To evaluate piping stresses and support loads, the maximum force for each leg has been selected and applied statically to the piping system in the most conservative fashion using a dynamic load factor (DLF) based on the valve opening time and the system dynamic characteristics or a DLF of 2.0 was used. The developed stresses and loads on nozzles were combined with the other applicable loads from Tables 3.9(B)-6 and 3.9(B)-7. These were compared with the allowable stresses and allowable nozzle loads. The simultaneous discharge from all valves has been assumed in the thrust analyses.