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Public Service of New Hampshire

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SBN-476
T.F. B7.1.2

United States Nuclear Regulatory Commission
Washington, D. C. 20555

Attention: Mr. George W. Knighton, Chief
Licensing Branch No. 3
Division of Licensing

References: (a) Construction Permits CPPR-135 and CPPR-136, Docket Nos. 50-443 and 50-444

Subject: Open Item Response, RAI 440.132; (SRP 5.2.2, Reactor Systems Branch)

Dear Sir:

We have enclosed a response to the subject Request for Additional Information regarding Low Temperature Overpressure Protection.

The enclosed response will be incorporated in OL Application Amendment 49.

Very truly yours,

YANKEE ATOMIC ELECTRIC COMPANY

Allen J. Legendre Jr.

for: J. DeVincentis
Project Manager

ALL/fsf

cc: Atomic Safety and Licensing Board Service List

B001

440.132 The staff is concerned that your proposed Low Temperature Overpressure Protection (LTOP) System does not adequately protect the reactor vessel during transient events where the vessel wall temperature lags behind the temperature used in the variable setpoint calculator. For example, starting an RCP in a loop with a hot steam generator when the RCS is water solid causes the RCS pressure and temperature to rise. Your LTOP System would automatically raise the PORV setpoint as a function of auctioneered cold or hot leg temperature, but the vessel wall will not be heated in this transient at the same rate. Thus, due to the LTOP System auctioneering scheme, the part of the RCS most vulnerable to brittle fracture will be protected to a higher pressure than its temperature allows.

If, during a cooldown, the cold leg temperature detector downstream of the generator(s) being used failed, and a mass input event ocurred, your proposed LTOP System may not protect the coldest location in the vessel since the setpoint would not be based on the coldest fluid temperature.

Address the above concerns by addressing the following questions:

(1) Show that for all normal events and events in which the RCS fluid temperature is changing, your proposed system suitably protects the reactor vessel at its coldest location.

(2) Show data to justify the RCS temperature transients assumed in (1) above.

(3) Include in your analyses the most limiting single failure, and justify the choice.

(4) Include in your analyses the effects of system and component response times, including:

(a) Temperature detectors,

(b) Pressure detectors,

(c) Logic circuitry, and

(d) PORV and its associated air system.

Show the response times that were assumed and the techniques, including surveillance requirements for ensuring their conservatism.

RESPONSE: (1) The Low Temperature Overpressurization Protection (LTOP) System is designed to protect the reactor vessel against overpressurization events including inadvertent mass additions or rapid temperature increases of the RCS with the RCS in a water-solid condition and the letdown system isolated.

Mass input calculations assumed the maximum flow rate from either one centrifugal charging pump or one safety injection pump. Mass additions from more than one charging or safety injection pump are precluded by Technical Specification requirements (see the response to RAI 440.105).

Rapid temperature increases, resulting from the startup of an idle RCP with a steam generator at a higher temperature than the RCS, were analyzed with steam generator/RCS ΔT's up to 50°F. Temperature differences in excess of 50°F would be difficult to achieve and would be obvious to the operators. RCP startup during water-solid operations with greater than a 50°F ΔT is also precluded by Technical Specifications.

The LTOP System utilizes auctioneered low temperature inputs from wide-range RTDs located in all four loops' T_{hot} and T_{cold} legs. These inputs generate pressure equivalent setpoints to which actual RCS pressure is continuously compared. Should actual pressure exceed the generated pressure setpoint, the pressurizer PORVs are opened to relieve the excessive pressure. The setpoint generation includes allowance for both pressure and temperature instrumentation error. Additionally, the setpoints have also included an allowance of 50°F to consider transient temperature changes associated with an RCP startup with a hot steam generator. This allowance is incorporated into the LTOP setpoint by assuming that the limiting regions of the reactor vessel are being exposed to coolant temperatures 50°F lower than the low auctioneered temperature input to the LTOP System. This 50°F allowance also provides protection for cold water mass addition transients. Fluid and thermal mixing tests simulating mass additions at various loop flows have shown that the injected mass and loop flow combine such that nearly complete mixing occurs. The 50°F allowance in the LTOP setpoints more than compensates for any reduction in vessel wall temperature due to cold mass addition incidents.

Thus, it can be seen that the Seabrook LTOP System, with its conservative setpoint generation, adequately protects the reactor vessel for all design basis low temperature overpressurization events.

(2) During the start of an idle RCP with a steam generator 50°F higher than the RCS, the loop RTDs will sense an increasing temperature as the warmer water coming out of the steam generators mixes with the cooler RCS water. However, because a 50°F allowance has been incorporated into the PORV setpoints, the setpoint value will always be conservative and PORV actuation will prevent exceeding 10CFR50, Appendix G limits.

(3) The most limiting single failure is considered to be the failure of one PORV to actuate. All setpoint determinations were performed assuming this single failure. Failure of all

T_{hot} or all T_{cold} RTDs and failure of various components and power supplies for the LTOP circuitry were evaluated with the results indicating that the loss of one PORV represented the most limiting failure. Responses to RAI 420.61 and 440.11 provide additional information and changes which have been incorporated into the LTOP System to address single failures.

(4) Response times for the pressure detectors, logic circuitry and PORV actuation were all considered in the analysis. Temperature detector response was not explicitly considered due to the relatively short duration of the event and the fact that the 50°F margin built into the setpoints more than adequately compensate for any temperature changes up to and beyond the maximum allowable heatup and cooldown rates. For example, at a 100°F/hr cooldown rate, with a temperature detector response time of 5 minutes (typical RTD response times are more than an order of magnitude faster), the setpoint would only be high by about 8°F. This is well within the 50°F allowance in the setpoints.

Actual response times utilized were:

(a) Pressure detectors - less than 1 second,

(b) Logic circuitry - 0.1 second, and

(c) PORV response time - see Note,

NOTE: PORV response times were based on the originally designed air-operated PORVs. The new PORVs will be solenoid-operated valves. The opening and closing times are presently being evaluated. Should the new valve characteristics be less conservative than previously assumed, the PORV setpoints will be adjusted to compensate for the difference.

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