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RECIP.NAME RECIPIENT AFFILIATION
EISENHUT,D.G. Division of Licensing

SUBJECT: Forwards info re thermal shock to reactor pressure vessels, in response to NRC 810821 request. Response addresses Questions 1,2 & 5 of subj ltr.

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TITLE: Thermal Shock to Reactor Vessel

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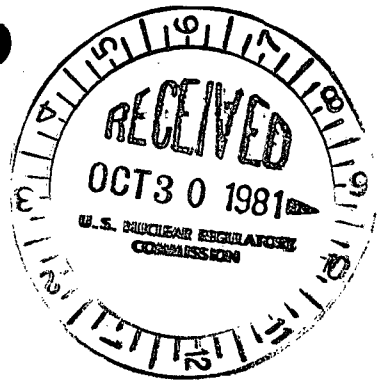

October 26, 1981

File: NG-3514(R)

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Mr. Darrell G. Eisenhut, Director
Division of Licensing
United States Nuclear Regulatory Commission
Washington, D. C. 20555

H. B. ROBINSON STEAM ELECTRIC PLANT, UNIT NO. 2
DOCKET NO. 50-261
LICENSE NO. DPR-23
THERMAL SHOCK TO REACTOR PRESSURE VESSELS

Dear Mr. Eisenhut:

This letter is in response to your letter of August 21, 1981, which requested information concerning thermal shock to reactor pressure vessels. This response addresses questions (1), (2) and (5) of the subject letter. As stated in our September 21, 1981 letter, response to questions (3) and (4) will be supplied by January 18, 1982 in our 150-day response. Carolina Power & Light Company's (CP&L) responses to questions (1), (2) and (5) are presented below:

NRC Question (1):

Provide the RT_{NDT} values of the critical welds and plates (or forgings) in your vessel for:

(a) Initial (as-built) conditions and location (e.g., ¼T), and

(b) Current conditions (include fluence level) at the RPV inside carbon steel surface.

NRC Question (2):

At what rate is RT_{NDT} increasing for these welds and plate material?

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CP&L RESPONSE (1) AND (2):

COMPONENT	PLATE/ SEAM	INITIAL RT_{NDT}	INNER SURFACE FLUENCE	INNER SURFACE RT_{NDT}**	¼ THICKNESS FLUENCE	¼ THICKNESS RT_{NDT}**	RATE OF INCREASE - RT_{NDT} NEXT 10 EFPY	RATE OF INCREASE - RT_{NDT} REMAINING LIFE
Nozzle Shell To Intermediate Shell Weld	10-273	0°F	$.562 \times 10^{19}$	188°F	3.39×10^{18}	160°F	7°F/EFPY	5°F/EFPY
Intermediate Shell-Longitudinal Weld	2-273C	0°F	1.30×10^{19}	<242°F*	7.84×10^{18}	<210°F*	7°F/EFPY	5°F/EFPY
Intermediate Shell to Lower Shell Weld	11-273	0°F	1.24×10^{19}	240°F	7.46×10^{18}	205°F	7°F/EFPY	5°/EFPY
Lower Shell Longitudinal Weld	3-273A	0°F	1.24×10^{19}	<240°F*	7.46×10^{18}	<205*°F	7°F/EFPY	5°F/EFPY
Intermediate Shell Plate	W10201-4	46°F(¼T)	1.42×10^{19}	124°F	8.55×10^{18}	113°F	-	45°F Total

*These values were derived based on high copper/high nickel weld materials. These welds actually contain low nickel. Empirical data has shown that low nickel content can lower the expected RT_{NDT} by 50°F. Empirical data for the level of copper contained in these welds is not available, therefore, credit has not been taken for low nickel content.

**These values of RT_{NDT} are based on ASTM trend curves.

NRC Question (5):

Provide a listing of operator actions which are required for your plant to prevent pressurized thermal shock and to ensure vessel integrity. Include a description of the circumstances in which these operator actions are required to be taken. Included in this summary should be the specific pressure, temperature and level values for: a) high pressure injection (HPI) termination criteria presently used at your facility, b) HPI throttling criteria and instruction presently used at your facility, and c) criteria for throttling feedwater presently used at your facility. For each required operator action, give the information available to the operator and the time available for his decision and the required action. State how each required operator action is incorporated in plant operating procedures and in training and requalification training programs.

CP&L Response (5):

Challenges to vessel integrity from pressurized thermal shock generally occur after rapid vessel cooldown caused by relatively cold water being injected into the vessel following accident or transient events. For H. B. Robinson (HBR2), as for other Westinghouse plants, the major events that could produce a rapid cooldown followed by repressurization are loss of coolant and steamline rupture. These conditions have been described in various submittals to the NRC by the Westinghouse Owners' Group (WOG).

Operator actions that are required to prevent overpressurization following thermal shock are mainly oriented toward securing high head safety injection (SI) to the vessel following recovery of core inventory and secondary heat sink during the above described accidents, as well as spurious SI initiation during heatup or cooldown, in which a pressurization prior to SI termination could violate heatup/cooldown curves. The controlling procedures for these events are EI-1, Incident Involving Reactor Coolant System (RCS) Depressurization, and AP-25, Spurious Safeguards Actuation.

In EI-1, the operator is instructed not to terminate high head SI until:

1. The RCS pressure is greater than 2000 psig and increasing, and
2. Pressurizer level is at no-load level and responding, and
3. The water level in at least one steam generator is on narrow range span or in the wide range span at a level sufficient to assure that the U-tubes are covered, and
4. At least $40^{\circ}F$ of subcooling exists in the primary system.

It should be noted that high head safety injection at HBR2 is provided by intermediate pressure pumps with a shutoff head capability of 1500 psi thus mitigating the potential for an overpressurization event.

The above criteria are precautions following any safety injection system actuation. If the event is diagnosed to be a loss of coolant accident, the SI termination criteria are identical to the ones set forth above. If the event is diagnosed to be a steamline or feedline rupture, the following termination criteria are applied:

1. - One wide range RCS T_h is less than 460°F, and

   - Wide range RCS pressure is greater than 700 psig and is stable or increasing, and

   - Pressurizer water level is greater than 20% and rising (heaters covered), and

   - RCS subcooling is greater than 40°F, and

   - Water level in at least one steam generator is in the narrow range span, or in the wide range span at a level sufficient to assure that the U-tubes are covered.

or

2. - All wide range RCS T_h indicators are greater than 460°F, and

   - RCS pressure is greater than 2000 psig and is stable or increasing, and

     NOTE: Observe the applicable reactor pressure vessel pressure-temperature limitations (Curves 3.3 or 3.4, Volume 15, Curve Book).

   - Water level in at least one steam generator is in the narrow range span, or in the wide range span at a level sufficient to assure that the U-tubes are covered, and

   - Pressurizer water level is greater than 50% of span, and

     NOTE: If Containment Vessel (C.V.) pressure, radiation level and sump level indications are in the normal (pre-event) range, than a pressurizer level of 20% is acceptable due to the absence of an adverse C.V. atmosphere effect on the pressurizer level transmitters.

   - The RCS subcooling is greater than 40°F.

In AP-25, Spurious Safeguards Actuation, the following precaution is provided relating to vessel integrity concerns:

"If the initiation is at other than normal temperature and pressure (i.e., during a cooldown or heatup), the conditions for safety injection termination as described in EI-1 should not be established if the heatup/cooldown curves would be violated. A safety injection initiation at other than normal temperature and pressure should be considered to reflect an actual condition requiring safety injection until careful observation of plant conditions verify the initiation to be spurious."

With regard to SI throttling criteria, none are used in the H. B. Robinson emergency procedures for these events. Safety injection is either on, flowing at maximum rate, or off, due to adequate inventory being restored to the primary system.

With regard to throttling of feedwater, in general, feedwater (main or auxiliary) is provided to maintain the levels in the steam generators within the narrow range or in the wide range sufficient to ensure that the U-tubes are covered. Under a steamline or feedline rupture event, auxiliary feedwater flow to the faulted steam generator is isolated, while flow to each of the remaining two generators is limited to 400 gpm or less. Similarly, feedwater flow to the faulted generator is isolated under a steam generator tube rupture event.

Information available to the operator upon which he can base his decisions for SI termination and feedwater throttling are:

Pressurizer Pressure
Pressurizer Level
Containment Pressure
Containment Radiation
Containment Sump Level
Wide Range RCS T_{hot}
Steamline Pressure
Steamline Flow
Steam Generator Water Level - Narrow and Wide Range
Charging Pump Flow
Auxiliary Feedwater Flow
Main Feedwater Flow
Saturation Meter

The time available for the operator to take action in terminating safety injection or throttling feedwater flow is very dependent on the specific characteristics of the accident. In general, though, operator action is not required prior to 10 minutes after an accident situation. High pressures due to SI system actuation will not occur, since the shutoff head of the SI pumps is 1500 psig.

In addition, Technical Specifications require the overpressurization protection system to be operable and the Safety Injection pump power supply breakers racked out whenever the RCS temperature is below 350°F and the RCS is not vented to the containment.

Training programs are established to address the procedural requirements for operator response during transient and accident situations and the basis for these requirements. These programs provide, through classroom review and simulator training and accident sequences, adequate opportunity for the operators to be cognizant of expected plant response throughout any of the accidents that could adversely affect vessel integrity.

CP&L trusts that the above information is responsive to your needs. CP&L believes that the above information reinforces our previous statements and those of the Westinghouse Owner's Group that adequate time is available for deliberate careful assessment of this issue and potential remedial actions. CP&L views pressurized thermal shock as a serious concern that must be examined in depth. CP&L does not believe that a simple arbitrary limit on RT_{NDT} is a viable answer to the concern. Any value of RT_{NDT} extracted from an analysis is only useful within the context of that analysis. CP&L will continue to provide you with the information requested but wishes to reiterate that the information is plant specific and is not useful as a generic limit.

If you have any questions on this item, please contact our staff.

Yours very truly,

E. E. Utley
Executive Vice President
Power Supply and
Engineering & Construction

E. E. Utley, having been first duly sworn, did depose and say that the information contained herein is true and correct to his own personal knowledge or based upon information and belief.

Franklin Murray
Notary (Seal)

FRANKLIN MURRAY
NOTARY PUBLIC
WAKE COUNTY, N. C.

My commission expires: Oct. 4, 1986

FMG/lr (030-426)

cc: V. Stello (NRC I&E)
W. Ross (NRC)