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SUBJECT: Forwards response to RAI re TS change request to convert to improved standard TS for rev of overpressurization analysis.

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RNP File No: 13510HA
Serial: RNP-RA/97-0087

APR 25 1997

United States Nuclear Regulatory Commission
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H. B. ROBINSON STEAM ELECTRIC PLANT, UNIT NO. 2
DOCKET NO. 50-261/LICENSE NO. DPR-23
RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION
AND TRANSMITTAL OF SUPPLEMENT 3 REGARDING THE
TECHNICAL SPECIFICATION CHANGE REQUEST TO CONVERT
TO THE IMPROVED STANDARD TECHNICAL SPECIFICATIONS

Gentlemen:

This letter provides Carolina Power & Light (CP&L) Company responses to the NRC request for additional information (RAI) dated March 6, 1997, regarding the CP&L Improved Technical Specifications (ITS) conversion submittal of August 27, 1996. The responses pertain to the H. B. Robinson Steam Electric Plant (HBRSEP), Unit No. 2 overpressurization analysis. In order to support the NRC review schedule for this submittal, the NRC has requested that the response to their request be submitted within 30 days of receipt of their letter. In a telephone conversation conducted between CP&L and the NRC on April 10, 1997, the NRC agreed to extend the due date for the response to their request by two weeks (i.e., April 25, 1997).

On March 5, 1997, the HBRSEP, Unit No. 2 overpressurization analysis was discussed in a teleconference between the NRC and CP&L. During the discussion, it was identified that the margin between pressure overshoot from the postulated overpressure event and the pressure-temperature limits for the reactor vessel was higher than reported in the analysis submitted as Enclosure 5 to CP&L letter dated August 27, 1996, and discussed in the CP&L response to the NRC RAI, dated January 10, 1997. As a result, the overpressurization analysis has been recalculated and sufficient margin has been identified to remove previously proposed restrictions on the operation of reactor coolant pumps and charging pumps. Additionally, as stated in CP&L letter dated February 18, 1997, the instrument uncertainty assumed in the overpressurization analysis was based upon an evaluation conducted in 1993.

A001/1

This evaluation was performed prior to implementation of the current Company setpoint methodology procedure. As a result, a new calculation of instrument uncertainty was

performed that resulted in a total instrument uncertainty that is higher than that assumed in the previous overpressurization analysis (i.e., ±30 psi). The new instrument uncertainty of ± 45.9 psi has been incorporated into the overpressurization analysis calculations for the entire range of applicability for the Low Temperature Overpressure Protection (LTOP) System (i.e., ITS MODES 4, 5, 6 with the reactor vessel head on), and sufficient margin exists between the LTOP setpoint plus instrument uncertainty and the analytical limit (i.e., American Society of Mechanical Engineers (ASME) Boiler & Pressure Vessel (B&PV) Code, Appendix G limit, less pressure overshoot, less static head effects, and less dynamic head effects). Therefore, in order to assist the NRC in its review of the overpressurization analysis, this letter includes, in addition to responses to the NRC RAI dated March 6, 1997, attachments containing a revised overpressurization analysis, revised response to the NRC RAI dated January 10, 1997, an instrument uncertainty calculation, and Supplement 3 to the CP&L ITS submittal, which contains information in support of a revised ITS Limiting Condition for Operation (LCO) Section 3.4.12, "Low Temperature Overpressure Protection (LTOP) System." The revised information reflects the new analysis and calculated instrument uncertainty.

Attachment I provides an affidavit as required by 10 CFR 50.30(b).

Attachment II provides the responses to the NRC RAI dated March 5, 1997.

Attachment III provides the revised analysis summary of the LTOP System (Siemens Power Corporation Methodology).

Attachment IV provides the revised responses to questions 1 through 8 of the NRC RAI dated January 10, 1997.

Attachment V provides a calculation summary of the LTOP System (Westinghouse Methodology).

Attachment VI provides a calculation summary of the LTOP System instrument uncertainty.

Attachment VII contains Supplement 3 to the ITS conversion submittal dated August 27, 1997. The August 27, 1997, submittal was previously modified by errata submitted by letters dated December 18, 1996, and January 17, 1997, Supplement 1 submitted by letter dated March 27, 1997, and Supplement 2 submitted by letter dated April 6, 1997. This supplement includes revised information in support of converting the current Technical Specifications (CTS) to ITS LCO Section 3.4.12. The supplement includes instructions for insertion of pages into the submittal.

A review of the current analyses has identified the need for an additional analysis to determine the necessary Reactor Coolant System (RCS) vent size or charging pump configuration to support operation in MODES 5 and 6 with the reactor vessel head on and

allow the capability to fill the accumulators utilizing the Safety Injection (SI) system. Consequently, Attachment IV, Table 1, "Acceptable Configuration for RCPs, SI Pumps and Charging Pumps," contains "(later)" as the configuration for SI pumps in MODES 5 and 6 with the reactor vessel head on and vented. The results of this calculation and any changes to ITS LCO 3.4.12 will be submitted to the NRC by June 30, 1997.

In accordance with 10 CFR 50.91(b), CP&L is providing the State of South Carolina with a copy of this letter with the enclosure and attachment.

If you have any questions concerning this matter, please contact me or Mr. H. K. Chernoff of my staff at (803) 857-1437.

Very truly yours,

Terry M. Wilkerson

T. M. Wilkerson
Manager - Regulatory Affairs

ALG/alg
Attachments:

I. Affidavit
II. Response To Request For Additional Information Regarding The Technical Specifications Change Request To Convert To The Improved Standard Technical Specifications (NRC Letter Dated March 5, 1997)
III. Analysis Summary Of The Low Temperature-Overpressure Protection System (Siemens Power Corporation Methodology)_April 1997 (Revised)
IV. Response To Request For Additional Information Regarding The Technical Specifications Change Request To Convert To The Improved Standard Technical Specifications (NRC Letter Dated January 10, 1997) (Revised Response)
V. Analysis Summary Of The Low Temperature-Overpressure Protection System(Westinghouse Methodology)
VI. Calculation Summary Of The Low Temperature-Overpressure Protection System Instrument Uncertainty
VII. Supplement 3

c: Mr. M. K. Batavia, Chief, Bureau of Radiological Health (SC)
Mr. L. A. Reyes, Regional Administrator, USNRC, Region II
Ms. B. L. Mozafari, USNRC Project Manager, HBRSEP (4 copies)
Mr. B. B. Desai, USNRC Resident Inspector, HBRSEP
Attorney General (SC) (w/out Enclosures)
Lockheed Idaho Technology, Inc.

Affidavit

State of South Carolina
County of Darlington

C. S. Hinnant, having been first duly sworn, did depose and say that the information contained in letter RNP-RA/97-0087 is true and correct to the best of his information, knowledge and belief; and the sources of his information are officers, employees, contractors, and agents of Carolina Power & Light Company.

C S Hinnant

Sworn to and subscribed before me

this 25th day of April 1997

(Seal) Albert L. Garrison
Notary Public for South Carolina

My commission expires: March 22nd, 2005

H. B. ROBINSON STEAM ELECTRIC PLANT, UNIT NO. 2 RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION REGARDING THE TECHNICAL SPECIFICATION CHANGE REQUEST TO CONVERT TO THE IMPROVED STANDARD TECHNICAL SPECIFICATIONS

(NRC Letter Dated March 5, 1997)

Question 1

"The approval of ANF-RELAP was limited to the events listed in Table 2-1 of the March 16, 1992 letter. These included SRP Chapter 15 non-LOCA analyses. The approval stated, "Application of the methodology to events not listed in Table 2-1 should be justified." LTOP is not an SRP Chapter 15 event, rather it is SRP Section 5.2. Therefore, justify the use of the ANF-RELAP in the LTOP analysis."

Response

The ANF-RELAP methodology was approved by the NRC by letter dated March 16, 1992, specifically for non-Loss-of-Coolant Accidents (non-LOCA) events described in Standard Review Plan (SRP) Chapter 15 (Ref. 1). The letter provided a list of the transients for which the ANF-RELAP methodology would be used. The overpressurization analysis was not specifically addressed in the review. The analysis uses the ANF-RELAP code, which is a derivative of RELAP5/MOD2 (Ref. 2).

RELAP5/MOD2 was developed by Idaho National Engineering Laboratory (INEL) for use in evaluating LOCAs and operational transients for pressurized water reactors (PWRs) up to the point of fuel damage. The other use for which RELAP5/MOD2 was specifically identified was in "the analysis of the transient behavior of piping systems containing steam/water such as for estimating hydraulic loads on relief valve discharge lines."

The Siemens Power Corporation (SPC) ANF-RELAP methodology is applicable to a wide range of transients, including pressurization events on both primary and secondary transients. The specific limitations placed on ANF-RELAP relate to boron tracking analyses and analyses in the natural circulation flow regime that involve voiding in the upper head. Neither of these restrictions are applicable to the overpressurization analysis.

Although the Reactor Coolant System (RCS) pressures associated with most of the SRP Chapter 15 events is higher than the pressures applicable to the overpressurization analysis, the water properties in the range of pressures of the overpressurization analysis are the same. In addition, ANF-RELAP is approved for use in the analysis of SRP Section 15.1.5, "Steam System Piping Failures Inside And Outside Of Containment (PWR)" (i.e., Main Steam Line Break (MSLB)). The RCS pressures for the MSLB event can be significantly below normal operating pressure.

The events for which the use of ANF-RELAP is specifically approved include the Category 5 events which increase reactor inventory and can potentially produce a challenge to primary system pressure limits. In non-powered Modes of operation, this analysis can be similar to the overpressure analysis.

Based upon the approved methodologies for MSLB and for the SRP Chapter 15 non-LOCA events and on the applicability of RELAP5/MOD2, analysis of the Low Temperature Overpressure Protection (LTOP) System with ANF-RELAP is appropriate.

Question 2

"Explain the assumption of "No dynamic compensation for PORV operation." Also discuss and justify the change in assumption for PORV opening time from 2.5 seconds in the previous analysis to 2.4 seconds in the new analysis."

Response

Actuation of the Power Operated Relief Valve (PORV) can be based on a comparison of the setpoint to the measured pressure, without any anticipatory compensation of the signal. It can also involve anticipatory compensation, usually in the form of a lead/lag filter. The H. B. Robinson Steam Electric Plant (HBRSEP), Unit No. 2 LTOP System does not employ dynamic compensation in the LTOP signal. The overpressurization analysis used the measured pressure, as adjusted for instrument uncertainties, to compare to the setpoint. Use of dynamic compensation would result in an earlier trip and a lower peak pressure.

The overpressurization analysis performed in accordance with the Westinghouse Methodology is provided in Attachment V to this letter and utilizes a total PORV opening time of 2.5 seconds. In accordance with that methodology, a delay time of 20% of the total opening time is assumed. Hence the assumed total opening time is 2.5 seconds including an initial delay in opening of 0.5 seconds. The SPC overpressurization methodology, to be consistent with the Westinghouse Methodology, assumes a total opening time of 3.0 seconds including an initial delay in opening of 0.6 seconds.

Question 3

"Describe how instrument uncertainty is accounted for in the analysis. Specifically, address whether it is factored into the limit or input into the LTOP analysis. Discussions in the submittal (table specified limit of 570 psig) and the answer to Question 6 ("The resulting value of 430 psig is then input into the LTOP analysis...") seem to conflict."

Response

The SPC overpressurization methodology assumed the total instrument loop uncertainty (i.e., ± 45.9 psi) was added to the LTOP setpoint of 400 psig, resulting in a maximum setpoint of 445.9 psi. No additional uncertainties were applied. The limit from Appendix G of the American Society of Mechanical Engineers Boiler and Pressure Vessel Code for the lower circumferential weld was used as a limit for the maximum pressure in the vessel. For the temperature range of 160°F to 220°F, this value is 602.61 psig. Instrument uncertainty is added to the LTOP setpoint and therefore not factored into the Appendix G limit. The information provided in Carolina Power & Light Company letter dated February 18, 1997, with respect to instrument uncertainty, has been revised and is presented in Attachment III to this letter.

References

1. "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plant." NUREG-0800, LWR Edition, U. S. Nuclear Regulatory Commission, Office of Nuclear Reactor Regulation.

2. Ransom, V.H., et al, "RELAP5/MOD 2 Code Manual," NUREG/CR-4312, Rev. 2, Volumes 1 and 2, EG&G Idaho, Idaho Falls, ID, March 1987.

H. B. ROBINSON STEAM ELECTRIC PLANT, UNIT NO. 2 TECHNICAL SPECIFICATION CHANGE REQUEST TO CONVERT TO THE IMPROVED STANDARD TECHNICAL SPECIFICATIONS ANALYSIS SUMMARY OF THE LOW TEMPERATURE-OVERPRESSURE PROTECTION SYSTEM (SIEMENS POWER CORPORATION METHODOLOGY)

April 1997
(Revised)

1.0 INTRODUCTION

This report documents an analysis of the operation of the Low Temperature Overpressure Protection (LTOP) system in the event a single Safety Injection (SI) pump starts in MODE 4 and MODE 5 with Reactor Coolant System (RCS) temperatures ≥ 175°F. The LTOP system is in service when the RCS temperature is below 350°F and supplements the Residual Heat Removal (RHR) system relief valves and the RCS letdown system to prevent overpressurization of the RCS. When the LTOP system is placed into service it adjusts the operating setpoints of the Power Operated Relief Valves (PORV) to provide the protection. This analysis justifies operation within the MODE applicability of LTOP for RCS temperatures ≥ 175°F, assuming an OPERABLE Safety Injection (SI) pump starting and running continuously through the analysis, three (3) charging pumps in operation, three (3) Reactor Coolant Pumps (RCPs) in operation, and both Residual Heat Removal (RHR) pumps in operation and aligned to the RCS in the shutdown cooling mode.

This analysis summary demonstrates that without taking credit for the operation of the RHR relief valves or the RCS letdown system, and assuming the cooldown limits from American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel (B&PV) Code Appendix G, the LTOP system provides protection against the inadvertent operation of one SI pump.

This analysis summary supersedes the information provided in Carolina Power & Light (CP&L) Company letter dated August 27, 1996.

2.0 SUMMARY AND RESULTS

The cases analyzed were selected to bound the operating conditions allowed for Mode 4 (i.e., RCS temperature of 200°F < T ≤ 350°F) and Mode 5 (i.e., RCS temperature of 175°F < T ≤ 200°F) with a corresponding pressure range of 400 psig to 275 psig . The maximum flow supported over the entire range corresponds to the operation of three (3) RCPs, three (3) charging pumps, and two (2) RHR pumps. No credit was taken for the operation of the RHR relief valves or the RCS letdown system, and only one of the two PORVs was assumed to operate.

The extremes of these conditions were analyzed in five cases initialized at one of the following conditions:

a. RCS temperature of 175°F, RCS pressure of 275 psig, temperature of SI and charging water of 38°F,
b. RCS temperature of 175°F, RCS pressure of 275 psig, temperature of SI and charging water of 100°F,
c. RCS temperature of 175°F, RCS pressure of 400 psig, temperature of SI and charging water of 100°F,
d. RCS temperature of 350°F, RCS pressure of 275 psig, temperature of SI and charging water of 100°F, and
e. RCS temperature of 350°F, RCS pressure of 400 psig, temperature of SI and charging water of 100°F.

The cases analyzed are summarized in Table 2.1.

Table 2.1 LTOP System Analysis Results

Initial Conditions			Total Downcomer Pressure at Bottom of Fuel Elevation (psig)	ASME Code Appendix G Pressure Limit (psig)	Margin to Limit (psi)
Pressure (psig)	RCS Temp.(°F)	SI Temp. (°F)			
275	175	38	597.72	602.61	4.89
275	175	100	599.25	602.61	3.36
400	175	100	599.44	602.61	3.17
275	350	100	575.15	813.88	238.73
400	350	100	574.57	813.88	239.31

3.0 MODEL AND ASSUMPTIONS

The analysis used a modified ANF-RELAP model was based upon the HBRSEP, Unit No. 2 Cycle 17 Non-LOCA transient model. This model was constructed in accordance with Siemens Power Corporation's (SPC) methodology (Reference 1) for analyzing events from the Standard Review Plant (SRP) (Reference 2).

3.1 Modeling Changes

Modeling changes were incorporated in the ANF-RELAP deck to reflect the design information and assumptions below.

PORV

The operation of the PORV assumes no dynamic compensation and has opening and closing setpoints of 445.9 psig and 430.9 psig, respectively. These values incorporate a ± 45.9 psi error allowance on the 400 psig opening setpoint and a hysteresis in the closing pressure of -30 psi ±15 psi. The instrument uncertainty calculation of ± 45.9 psi is summarized in Attachment VI to this letter. After a fixed delay of 0.6 seconds, the PORV is assumed to cycle to full open in 2.4 seconds. The flow for the PORV was based on the relation.

$$F_{PORV} = (50 \text{ gpm}) \times (\Delta P)^{1/2}$$

where ΔP is the pressure difference across the valve seat in psi. The pressure difference is the lift setpoint (i.e., 445.9 psig) less the backpressure (i.e., 10 psig), or 435.9 psid. The resulting flow rate is 1043.9 gpm of 60°F water through the valve. The resulting mass flow is 145.27 lbm/s at 60°F. To obtain this flow rate at the lift pressure, it was necessary to iteratively run an ANF-RELAP calculation, changing the valve flow area until the resulting flow rate matched the mass flow of 145.27 lbm/s.

SI Pump

The flow delivery of a single SI pump was input as data into the analysis as a function of RCS backpressure. The flow rate at each pressure point was increased by 10% to provide a conservative upper bound for the SI flow.

Charging Pumps

The flow capacity of each charging pump is 77 gpm. The charging pumps are variable speed positive displacement pumps, so the pump capacity does not vary with RCS backpressure. The mass flow rate of the three charging pumps was density corrected from a water temperature of 38°F for the 38°F mass addition case, and to the mass flow rate corresponding to a water temperature of 100°F for the 100°F cases. The charging pump flows were increased 5% to conservatively bound the maximum flow rate expected from the pumps.

RCP Modeling

Since the ANF-RELAP input model did not include the secondary system and contained a simplified RHR model, there was no method by which to easily remove the RCP heat input from the running RCPs. The model was therefore modified by adding a heat structure to each

running RCP volume that was adjusted until the heat input of the RCPs was balanced and RCS pressure and temperature remained constant. This effectively removed RCP heat addition to the RCS which actually is removed from the RHR heat exchangers.

RHR Pumps

The RHR was simulated by removing flow from the Loop B hot leg and discharging into the cold legs. The flow rate utilized was 7500 gpm corresponding to the maximum flow of two (2) pumps.

Pressurizer

The pressurizer was initialized as a water filled volume to maximize the pressure transient. The pressurizer heaters were disabled to prevent a bubble from forming.

Acceptance Criteria

The acceptance criteria for this analysis are the ASME B&PV Code Appendix G limits, applied in the reactor vessel downcomer at the elevation corresponding to the bottom of the active fuel. The limits are:

Temperature (°F)	Pressure (psig)
100 - 160	563.51
160 - 220	602.61
220 - 350	813.88

Other

The reactor vessel pressure in the downcomer at the elevation of the bottom of the active fuel was selected as a measuring point for convenience which is slightly below the lower circumferential beltline weld of the reactor vessel, and therefore is conservative. The static pressure, dynamic pressure, total of static and dynamic pressures, and maximum total pressure during the transient were calculated at this location.

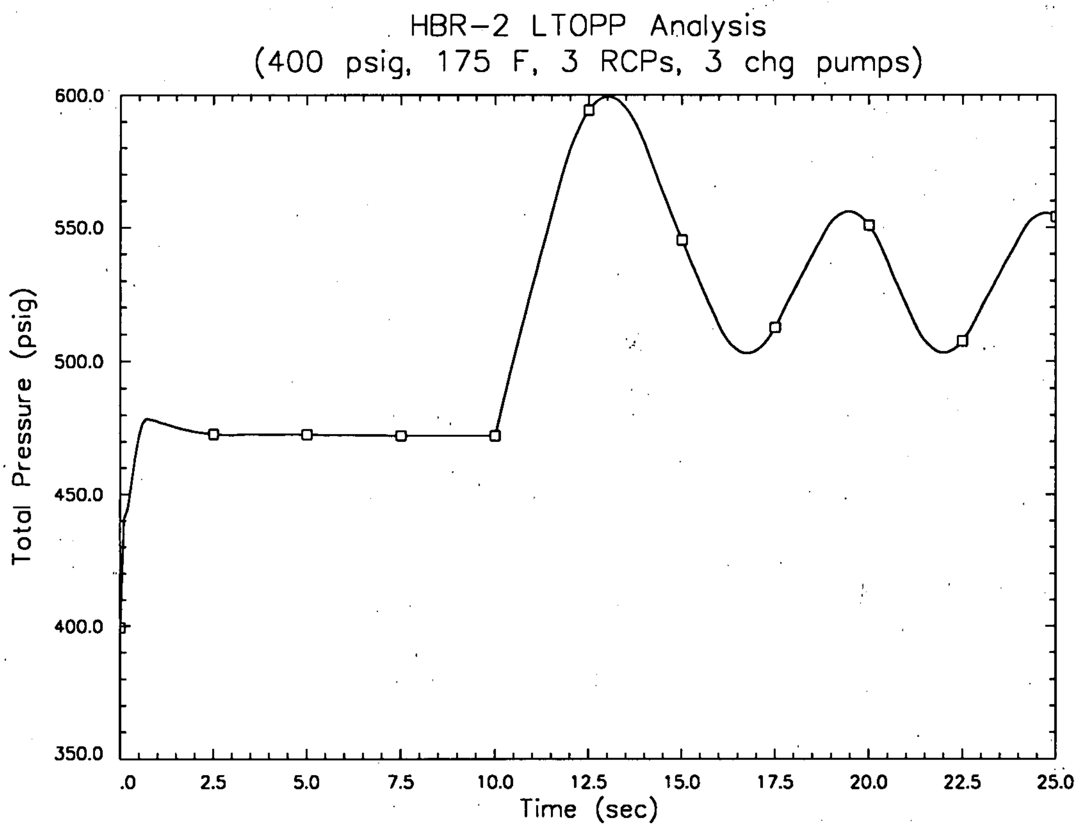

Figure 3.1 Pressure in Vessel Downcomer at the Elevation of the Bottom of the Active Fuel (Limiting Case)

3.2 Results and Conclusions

Each of the cases summarized in Table 2.1 were analyzed to determine the maximum pressure at the reactor vessel location defined in Section 3.1 above. This pressure conservatively bounds the pressure at the reactor vessel lower circumferential beltline weld, which is the limiting weld. Figure 3.1 shows the pressure trace in the downcomer at the bottom of the active fuel elevation during the event.

The results indicate that in all cases, there is sufficient margin to the pressure limit to allow one (1) SI pump to be capable of injecting into the RCS under the stated conditions. The maximum pressure was obtained in the case depicted in Figure 3.1, where the initial pressure was 400 psig and the initial temperature was 175°F.

The initial pressure in the downcomer is seen to quickly stabilize at approximately 470 psig. The indicated pressurizer pressure at this time was the desired 400 psig. The difference is due to both

the elevation head and the dynamic head from the RCPs and RHR pumps. The SI and charging flow injection began at 10.0 seconds, quickly raising pressure in the system until the PORV opened. The lift setpoint is 445.9 psig, but pressure continued to rise during the 0.6 second delay in opening the PORV and continued to rise until the mass flow rate through the PORV was greater than or equal to the mass flow rate into the RCS from the SI and charging pumps. The peak pressure reached in this case was 599.44 psig at 13.0 seconds, or 3.0 seconds after the transient initiation.

These results verify that operation of three charging pumps together with a single SI pump in Mode 4 (i.e., RCS temperature is between 200°F and 350°F) and down to an RCS temperature of 175°F in Mode 5 will not violate the RCS pressurization limits. This conclusion places no restrictions on the number of RCPs or RHR pumps in operation. This conclusion likewise does not rely on the operation of the RCS letdown system, and assumes that the RHR relief valves are isolated from the RCS. Only one of the two available PORVs was assumed to operate. The reactor vessel downcomer pressure is corrected to the elevation of the bottom of the fuel and the total pressure (static plus dynamic) is used to compare against the ASME B&PV Appendix G limits. The flow rates for the charging pumps were biased upward by 5% and the SI pump delivery was biased upward by 10% for additional conservatism.

4.0 REFERENCES

1. "ANF-RELAP Methodology for Pressurized Water Reactors: Analysis of Non-LOCA Chapter 15 Events, "ANF-89-151 (P) (A), Siemens Nuclear Power Corporation, Office of Nuclear Reactor Regulation, July 1981.

2. "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plant." NUREG-0800, LWR Edition, U. S. Nuclear Regulatory Commission, Office of Nuclear Reactor Regulation.

H. B. ROBINSON STEAM ELECTRIC PLANT, UNIT NO. 2
RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION REGARDING THE TECHNICAL SPECIFICATIONS CHANGE REQUEST TO CONVERT TO THE IMPROVED STANDARD TECHNICAL SPECIFICATIONS

(NRC Letter Dated January 10, 1997)

Questions 1 through 8
(Revised Responses)

The following is revised responses to the NRC Request for Additional Information (RAI) issued by letter dated January 10, 1997, and originally responded by Carolina Power & Light (CP&L) Company letter dated February 18, 1997. The responses below reflect a new analysis and supersede the information provided in Carolina Power & Light (CP&L) Company letter dated February 18, 1997.

Question 1.

"Provide the power-operated relief valve (PORV) lift setpoint calculations for the entire range of LTOP. Include supporting discussions and material for: dynamic head effect, static head effect, overshoot, and instrument uncertainty. Indicate whether the values in Table 2.1, "LTOP System Analysis Results," include the above four effects."

Response.

The Power-Operated Relief Valve (PORV) lift setpoint calculation for the Low Temperature Overpressure Protection (LTOP) System was originally provided to the NRC by letter dated December 15, 1977. New analyses are provided in Attachments III and V to this letter. A single LTOP setpoint of 400 psig is used and applies to Reactor Coolant System (RCS) temperatures of 350°F and below. The analysis in accordance with the Siemens Power Corporation (SPC) methodology in Attachment III accounted for the static head from the LTOP transmitter location at the top of the pressurizer to the reactor vessel downcomer at the elevation of the bottom of the active fuel and the dynamic head from three (3) Reactor Coolant Pumps (RCPs) and two (2) Residual Heat Removal (RHR) pumps. The analysis in accordance with the Westinghouse Methodology in Attachment V accounted for the static head from the LTOP transmitter location at the top of the pressurizer to the reactor vessel downcomer at the elevation of the bottom of the active fuel and the dynamic head from three (3) Reactor Coolant Pumps (RCPs). An instrument uncertainty of ± 45.9 psi was assumed in the SPC methodology analyses. The instrument uncertainty used in the Westinghouse Methodology was also ± 45.9 psi. The evaluated instrument uncertainty was developed in accordance with the Company setpoint methodology procedure and a summary of the uncertainty calculation is provided in Attachment VI.

The limiting mass input case from Table 2.1 of Attachment III, is for an RCS pressure of 400 psig at a RCS temperature of 175°F. The calculated overshoot reaches 599.44 psig utilizing the 400 psig setpoint, taking into account static and dynamic effects, and utilizing the instrument uncertainty of ± 45.9 psig. The American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel (B&PV) Code Appendix G limit is 602.61 psig at an RCS temperature of 175°F. The net margin in the analysis from a 400 psig setpoint is then 3.17 psi.

The limiting mass input case from Attachment V occurs at an RCS temperature of 100°F. The calculated overshoot reaches 559.40 psig utilizing the 400 psig setpoint, taking into account static and dynamic effects, and utilizing the instrument uncertainty of ± 45.9 psi. The ASME B&PV Code Appendix G limit is 563.51 psig at an RCS temperature of 100°F. The net margin in the analysis from a 400 psig setpoint is then 4.11 psi.

Question 2.

"Discuss how the restriction on the number of reactor coolant pumps (RCPs) operating (i.e., only two RCPs may be operating when the RCS temperature is between 350°F and 175°F) is controlled. Describe the acceptable configurations of operating RCPs below 175°F and provide the supporting analyses. Also, with regard to the dynamic head, describe the effect of operating residual heat removal pumps and include, as appropriate, an evaluation or analysis of this effect on the overall setpoint determination. Submit the proposed and current TS sections affected by this request."

Response.

The analysis justifies the operation of three (3) RCPs throughout the applicability of LTOP in Improved Technical Specifications (ITS) Limiting Condition for Operation (LCO) Section 3.4.12, "Low Temperature Overpressure Protection (LTOP) System."

The supporting analyses for operation at an RCS temperature below 175°F utilizes the Westinghouse Methodology described below.

By letter dated August 11, 1976, the NRC requested an evaluation of the H. B. Robinson Steam Electric Plant (HBRSEP), Unit No. 2 system designs to determine susceptibility to overpressurization events, an analysis of the possible events and proposed interim and permanent modifications of systems and procedures to reduce the likelihood and consequences of such events. By letters dated July 28, 1977, October 31, 1977, December 15, 1977, and January 25, 1978, CP&L provided analyses of overpressurization events including the expected response of the LTOP system in response to overpressurization events. By letter dated December 22, 1977, CP&L requested a change to Technical Specifications to provide operability and surveillance requirements for the LTOP System. By letter dated

September 14, 1979, Amendment No. 42 was issued to the Facility Operating License for HBRSEP, Unit No. 2, that changed Technical Specifications (TS) to incorporate the LTOP System requirements. The accompanying Safety Evaluation (SE) determined that the limiting events identified in the SE formed an acceptable basis for analyses of the performance of the HBRSEP, Unit No. 2 LTOP System.

The proposed HBRSEP, Unit No. 2 ITS LCO Section 3.4.12 maintains the current licensing basis for operation with RCS temperature below 175°F. Below this temperature, in accordance with the previously approved LTOP analyses, three (3) RCPs and three (3) charging pumps may be capable of operating, and no SI pumps may be capable of injecting into the RCS when the reactor vessel is not vented to the minimum requirements. As stated in the Bases to SR 3.4.12.1, 3.4.12.2, and 3.4.12.3, the SI pump is rendered incapable of injecting into the RCS through removing the power from the pumps by racking the breakers out under administrative control. An alternate method of LTOP control may be employed using at least two independent means to prevent a pump start or to isolate the injection flow paths into the RCS such that a single failure or single action will not result in an injection into the RCS. This may be accomplished through removal of control power fuses and at least one valve in the injection flow paths being closed, or at least one valve in the injection flow paths being locked closed or closed and deenergized.

The RHR flow rate was included in the dynamic head at the reactor vessel beltline. The RHR system takes suction from the RCS Loop B Hot Leg. The normal flow path is through the RHR pumps and heat exchangers, then through the Emergency Core Cooling System (ECCS) accumulator lines to each of the cold legs. The maximum RHR flow corresponding to two (2) RHR pumps of 7500 gpm was assumed in the SPC analysis. In the analyses performed in accordance with the Westinghouse Methodology, the combination of three (3) RCPs and two (2) RHR pumps is not considered credible at an RCS temperature below 175°F, so the dynamic head from three (3) RCPs is assumed to be limiting.

The inlet to the RHR system was modeled in ANF-RELAP by attaching a time dependent junction to the RCS Loop B (i.e., Loop 2) Hot Leg which was connected to a time dependent boundary condition volume. The flow rate through the junction was a constant value. The return of RHR flow to the cold legs was modeled with another time dependent junction connecting a time dependent boundary condition volume to the ECCS connecting header to the ECCS accumulator injection lines. This junction distributed the RHR flow to each cold leg. The conditions of the time dependent volume were adjusted to correspond to the desired conditions of pressure and temperature for each case. By modeling the RHR system in this way, the dynamic head was sensed at the limiting location in the reactor vessel and the operation of the RHR pumps was accounted for in the verification of the setpoint.

Supplement 3 to the CP&L ITS submittal, included as Attachment VI to this letter, provides revised information to the conversion of current Technical Specifications (CTS) to ITS LCO Section 3.4.12.

Question 3.

"You requested to allow for an operable safety injection (SI) pump in Mode 4. Please discuss acceptable configurations for other Modes. Indicate when the SI pump is disabled and how it is made inoperable. Submit your proposed and current TS sections affected by this request."

Response

The operating configuration for the SI pumps, RCPs and charging pumps are outlined in Table 1 below.

Table 1, "Acceptable Configuration of RCPs, SI Pumps and Charging Pumps

	RCPs	SI Pumps	Charging Pumps
MODE 1	3	2	3
MODE 2	3	2	3
MODE 3	3	2	3
MODE 4	3	1	3
MODE 5, RCS ≥ 175°F	3	1	3
MODE 5, RCS < 175°F	3	0	3
MODE 5, Vessel Vented[1]	0	(later)	3
MODE 6, Vessel Not Vented[1]	0	0	3
MODE 6, Vessel Vented[1]	0	(later)	3

1 The minimum required vent cross sectional area is three (3) square inches.

The SI pump is rendered incapable of injecting into the RCS through removing the power from the pumps by racking the breakers out under administrative control. An alternate method of LTOP control may be employed using at least two independent means to prevent a pump start or to isolate the injection flow paths into the RCS such that a single failure or single action will not result in an injection into the RCS. This may be accomplished through removal of control power fuses and at least one valve in the injection flow paths being closed, or at least one valve in the injection flow paths being locked closed or closed and deenergized.

Supplement 3 to the CP&L ITS submittal, included as Attachment VII to this letter, provides revised information to the conversion of current Technical Specifications (CTS) to ITS LCO Section 3.4.12.

Question 4.

"In the request dated August 27, 1996, you stated:

> "The existing analysis for H. B. Robinson Steam Electric Plant (HBRSEP), Unit No. 2, was based on generic vessel cooldown limits and the more restrictive curves, which resulted in the current technical specifications that require the SI pump be disabled when LTOP is placed into service."

You also stated,

> "The pressurization limits correspond to the 0°F cooldown limitation curve in Fig. 3.1-2 of Ref. 1."

Explain the first statement and any changes to it. Regarding the second statement, describe to what the limits correspond currently. Indicate what is required by the current methodology approved for HBR. Submit the current LTOP methodology (in its entirety), and provide an itemized discussion of any changes proposed."

Response

The additional embrittlement margin gained in the development of P-T curves from the reactor vessel material surveillance program has enabled the necessary margin in the P-T limits to permit a single train of Safety Injection to be OPERABLE in MODE 4 as an analyzed condition.

The Pressure-Temperature (P-T) curves, which resulted in the current TS requirement to disable the SI pumps, were incorporated into TS by Amendment 26, issued by NRC letter dated February 11, 1977. The P-T curves in Amendment 26 were developed utilizing the upper circumferential weld material as most limiting at End-of-Life (EOL) based on

Regulatory Guide 1.99, Revision 1, without taking credit for surveillance data. Consequently, the P-T curves in Amendment 26 were more restrictive than the current P-T curves. By letter dated December 22, 1988, CP&L responded to Generic Letter 88-11, "NRC Position on Radiation Embrittlement of Reactor Vessel Materials & Its Impact on Plant Operations," and stated that with the embrittlement margin gained for the upper circumferential beltline weld through surveillance results, the lower circumferential beltline weld was most limiting for EOL. By letter dated March 9, 1990, the NRC concurred with the use of reactor vessel capsule surveillance data for the development of HBRSEP, Unit No. 2 P-T curves. By letter dated September 15, 1993, CP&L requested changes to TS incorporating new P-T curves utilizing the additional embrittlement margin covering plant operations through 24 Effective Full Power Years (EFPYs). By letter dated July 29, 1994, the NRC issued Amendment No. 149 to TS incorporating the new P-T curves. The NRC found the new curves acceptable to 24 EFPYs by performing an independent calculation. In its response to Generic Letter 92-01, Revision 1, Supplement 1, "Reactor Vessel Structural Integrity," dated November 20, 1995, CP&L provided revised chemistry and initial Reference Temperature - Nil Ductility Transition (RT_{NDT}) values for Reactor Pressure Vessel materials in some cases, and stated that none of the changes would result in projections exceeding the screening criteria specified in 10 CFR 50.61 for Pressurized Thermal Shock (PTS) considerations through EOL, nor would the changes necessitate a change to the LTOP or P-T limits.

With regard to the second question, the acceptance criteria for this analysis are the ASME B&PV Code Appendix G limits, applied in the reactor vessel downcomer at the elevation corresponding to the bottom of the active fuel.

The LTOP methodology is contained in the report, "Pressure Mitigating Systems Transient Analysis Results," Westinghouse Electric Corporation, submitted to the NRC by letter dated July 28, 1977, and in the report supplement, "Supplement to the July, 1977 Report on Pressure Mitigating Systems Transient Analysis Results," Westinghouse Electric Corporation, submitted to the NRC by letter dated October 31, 1977.

Application of the Westinghouse Methodology is provided in Attachment V to this letter. In order to accommodate the static and dynamic effects that were originally not included in the Westinghouse Methodology, the limiting mass addition case for RCS temperatures $< 175°F$ assumes three (3) charging pumps as the mass input to the analysis and that the SI pumps are rendered incapable of injecting into the RCS. The SPC Methodology contained in Attachment III to this letter, assumes a single SI pump injecting into the RCS at temperature ranging from $\geq 175°F$ to $< 350°F$.

Question 5.

"Justify why H. B. Robinson is using peak reactor vessel lower head pressure for the calculation of the maximum pressures. Explain how this is used (i.e., whether it is used as the peak pressure or if back calculations of pressures at the limiting locations are performed)."

Response

The maximum pressure observed during the transient was obtained from the reactor vessel downcomer at the elevation corresponding to the bottom of the active fuel. This location is slightly below the elevation of the lower circumferential weld and is therefore conservative. A static head adjustment was necessary in the SPC Methodology to make the nodal height of the downcomer volume to match the elevation of the bottom of the active fuel. The dynamic pressure was added to the static pressure to result in the total (i.e., stagnation) pressure being reported as the maximum.

Question 6.

"You stated that opening and closing setpoints of 430 psig and 415 psig, respectively, were used in the analysis. Further, you stated that these values incorporate a 30 psi error allowance on the 400 psig opening setpoint and a hysteresis in closing pressure of 30 psi ±15 psi. However, the TS-required setpoint is 420 psi. Indicate whether the value is in psig or psia. Explain the discrepancy between the 400 psig analysis value and the 420 psi TS value."

Response

The CTS Section 3.1.2.1 requires an LTOP lift setting of less than or equal to 420 psi. The units for the lift setting are psig. The new analysis margin for overpressure events, which allows for operation in MODE 4 with a single OPERABLE SI pump, requires a reduction in the currently required LTOP setpoint of 420 psig as specified in the CTS to the new setpoint of 400 psig as specified in proposed ITS LCO Section 3.4.12.

The LTOP System instrumentation consists of the items identified below:

- Field transmitters and process sensors which provide a measurable electronic signal based upon the physical characteristics of the parameter being measured;
- Signal processing which provides signal conditioning, bistable setpoint comparison, process actuation, compatible electrical signal output to protection system devices, and control room indications;

- Relay logic which initiates LTOP actuation in accordance with the defined logic, which is based on the bistable outputs from signal processing; and

- Pressurizer PORVs which receive a signal to open when the system is armed and the pressure setpoint is exceeded.

To meet the design demands for redundancy and reliability, two field transmitters and sensors are used to measure the pressure parameter. To account for the calibration tolerances and instrument drift, which are assumed to occur between calibrations, statistical allowances are provided in the trip setpoint. The OPERABILITY of each transmitter or sensor can be evaluated when its "as found" calibration data are compared against its documented acceptance criteria.

The trip setpoint is the nominal value at which the bistables are set. Any bistable is considered to be properly adjusted when the "as left" value is within the band for CHANNEL CALIBRATION accuracy (i.e., rack calibration + comparator setting accuracy).

For the SPC methodology, the trip setpoints used in the bistables are based on the calculated peak pressure of 599.44 psig in the limiting case identified in Table 2.1 of Attachment III. A detailed description of the methodology used to calculate the trip setpoints, including their explicit uncertainties, is provided in the CP&L setpoint methodology procedure which is based upon current Instrument Society of America (ISA) standards[2]. Using the proposed required LTOP setpoint of 400 psig as an "as left" LTOP setpoint, the ± 45.9 psi instrument uncertainty allows for instrumentation uncertainty. The resulting value of 445.9 psig is then input into the SPC Methodology analysis to determine that pressure overshoot will remain below the required pressure limit.

The proposed ITS LCO Section 3.4.12 has been changed to be consistent with the specifications of instrument setpoints in proposed ITS Section 3.3, "Instrumentation." ITS LCO Section 3.4.12 specifies both the instrument setpoint and an allowable value for the setpoint that represents the maximum allowable "as found" value for the instrument for the instrument to be considered OPERABLE during calibration. The actual nominal trip setpoint entered into the bistable is more conservative than that specified by the allowable value to account for changes in random measurement errors detectable by a Channel Operational Test (COT). One example of such a change in measurement error is drift during the surveillance interval. If the measured setpoint does not exceed the allowable value, the channel is considered OPERABLE. A new instrument uncertainty and allowable value have been calculated and is provided in Attachment VI to this letter.

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2 ISA Standard S67.04, Part I, 1994, "Setpoints for Nuclear Safety Related Systems," and
ISA Recommended Practice RP67.04, Part II, 1994, "Methodologies for the Determination of Setpoints for Nuclear Safety Related Instrumentation,"

Therefore, the proposed ITS LCO Section 3.4.12 has been revised in Attachment VII to require two power operated relief valves (PORVs) with the lift settings of ≤ 400 psig and an allowable value of less than 418 psig.

Question 7.

"For Section 3.1, "Modeling Changes," provide a discussion of the changes, their bases, and whether these were assumed in the previous mass addition LTOP analysis."

Response

The mass addition LTOP analysis performed in accordance with the Westinghouse Methodology, which will remain the analysis of record for plant conditions when RCS temperature is below 175°F, is described in our letter dated July 28, 1977. The mass input analysis was performed utilizing the one loop version of the LOFTRAN[3]. The input modeling, input additions and initialization changes were described in the report, "Pressure Mitigating Systems Transient Analysis Results," prepared by Westinghouse Electric Corporation, and attached to our letter dated July 28, 1977 (i.e., Westinghouse Methodology). The Westinghouse Methodology originally assumed an inadvertent start of an SI pump as the limiting event in the mass input case. The Westinghouse Methodology also assumed a two (2) second opening time for the PORV. The current application of the Westinghouse Methodology, as presented in Attachment V to this letter, assumes three (3) charging pumps as the limiting mass input case and no SI pumps capable of injecting into the RCS. The current application of the Westinghouse Methodology assumes a PORV total opening time of 2.5 seconds rather than the original assumption of 2.0 seconds.

The proposed ITS LCO Section 3.4.12, Mode 4 with RCS temperatures ≥175°F, is based upon the analyses presented in Attachment III to this letter (i.e., the SPC Methodology). Section 3.1, "Modeling Changes," describes the modeling changes and input assumptions associated with utilizing the ANF-RELAP model for performing the LTOP analysis.

A comparison of the input assumptions between the Original and Current Westinghouse Methodology and SPC Methodology has been performed in Table 2 below.

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Table 2, "Comparison of Westinghouse and SPC Methodology."

	Original Westinghouse Methodology	**Current Westinghouse Methodology**	**SPC Methodology**
Applicable RCS Temperature	≤ 350°F	< 175°F	175°F ≤ T_{cold} ≤ 350°F
SI Pumps	1	0	1
Charging Pumps	40 gpm	3	3
RCPs in operation	Not considered because analysis was performed at RCS temperature of 100°F	3	3
RHR Pumps	Not considered	Bounded by RCP Assumption	2

Westinghouse Electric Corporation advised CP&L by letter dated March 15, 1993, that certain non-conservatism may exist in the Westinghouse Methodology utilized in the performance of the analyses. Specifically, the Westinghouse Methodology did not consider the pressure differences between the LTOP transmitter and the reactor vessel at the core midplane elevation, and that the analyses did not account for the dynamic head due to coolant flow through the reactor vessel to the pressure sensing location. The CP&L evaluation of this issue that was conducted in 1993 resulted in the corrective action to restrict operation of the number of RCPs to two (2) with RCS temperature less than 260°F in accordance with the previous P-T curves. With the issuance of the current P-T curves in Amendment 149 to TS, adequate margin existed to remove the operating restriction on the RCPs at RCS temperatures lower than 260°F. A new calculation of instrument uncertainty has been performed that resulted in a total uncertainty of ± 45.9 psi. The calculation of instrument uncertainty does not result in exceeding the ASME Appendix G limits in the Westinghouse Methodology analysis.

Therefore, the proposed ITS will not result in restrictions for operation of the RCPs or the charging pumps. No SI pumps are allowed to be capable of injecting into the RCS at RCS temperatures < 175°F in conformance with the Westinghouse Methodology, and one SI pump will be allowed to be capable of injecting into the RCS at temperatures ≥ 175°F in conformance with the SPC Methodology.

<u>Question 8</u>.

"You are shifting the TS curves up by 30 psi because instrument uncertainty is 30 psi less than is accounted for in these curves. Indicate what values (curves) were used in the previous LTOP analysis, and whether you have provided the instrument uncertainty calculations for NRC staff review."

<u>Response</u>

The Westinghouse Methodology was originally performed when the more restrictive previous P-T curves, as described in the response to Question 4, were in effect (i.e., 1977). The previous P-T curves included a 60 psig and 10°F margin for instrument error. Attachment V contains the current application of the Westinghouse Analysis and includes evaluation of the calculation results against the ASME B&PV Code Appendix G limits. Attachment VI contains a summary of the current instrument uncertainty calculation for LTOP.

H. B. ROBINSON STEAM ELECTRIC PLANT, UNIT NO. 2 TECHNICAL SPECIFICATION CHANGE REQUEST TO CONVERT TO THE IMPROVED STANDARD TECHNICAL SPECIFICATIONS CALCULATION SUMMARY OF THE LOW TEMPERATURE-OVERPRESSURE PROTECTION SYSTEM (WESTINGHOUSE METHODOLOGY)

1.0 PURPOSE

This calculation determines values to be used to ensure that the Low Temperature Overpressurization Protection (LTOP) system provides adequate overpressure protection for the reactor vessel. The calculation determined values for the following:

- Pressure Overshoot,
- Reactor Coolant Pump (RCP) Dynamic Head, and,
- LTOP Pressure Transmitter Static Head.

While this calculation was performed to support operation in accordance with the requirements of the current Technical Specifications (CTS), this calculation justifies operation in accordance with the proposed requirements in the H. B. Robinson Steam Electric Plant (HBRSEP), Unit No. 2 Improved Technical Specification, in Mode 6 with the reactor vessel head on, and in MODE 5 for Reactor Coolant System (RCS) temperatures up to 175°F.

The LTOP system protects the Reactor Coolant System (RCS) against overpressurization when RCS temperature is below 350°F. Without the protection of the LTOP system, a postulated overpressure transient could occur when the RCS is at a low temperature that could exceed limits that protect the reactor vessel from brittle fracture.

2.0 INPUT DATA AND ASSUMPTIONS

The dynamic head associated with the operation of 3 RCPs was calculated separately to be 53 psid. The opening time for the Pressurizer Power Operated Relief Valves (PORV) was assumed to be ≤ 2.5 seconds. This stroke time limit is verified by testing. The volume of the RCS is 9343 cubic feet. The heat transfer area of the steam generators is 43,467 ft^2. The LTOP setpoint is set at 400 psig.

Cooldown of the RCS was assumed to be performed at the maximum rate permitted by procedure for the temperature(s) under consideration. Heatup of the RCS was assumed to be performed at the maximum rate permitted by procedure.

The Safety Injection (SI) Pumps are disabled when the RCS temperature is below 350°F in accordance with CTS Section 3.3.1.3. In the proposed Improved Technical Specifications (ITS) Limiting Condition for Operation (LCO) Section 3.4.12, "Low Temperature Overpressure

Protection (LTOP) System," the SI pumps will be rendered incapable of injecting into the RCS when the RCS temperature is below 175°F.

Three (3) charging pumps are assumed to be operating at maximum speed. The maximum flow rate for three charging pumps is 230 gallons per minute (gpm). Using a density of 63.8 lbm/ft^3 (which corresponds to 21,000 ppm Boric Acid solution), a volumetric flow rate of 230 gpm equals a mass flow rate of 32.7 lbm/sec.

3.0 CALCULATION OF LTOP VALUES

The generic methodology used to establish the LTOP setpoint is described in References 1 and 2. This methodology used the following relationship to prevent exceeding the American Society of Mechanical Engineers (ASME) Boiler Pressure & Vessel (B&PV) Code Appendix G pressure/temperature limits for the reactor vessel at low temperatures.

LTOP Setpoint + Pressure Overshoot + Instrument Error ≤ Appendix G Limit.

Correlations were provided in the methodology to determine the pressure overshoot as a function of mass input rate, RCS volume, setpoint, and PORV opening time. In 1993, a Westinghouse Nuclear Safety Advisory Letter reported that the original Westinghouse LTOP methodology (References 1 and 2) did not account for the following:

- Static head between the reactor vessel and the LTOP pressure transmitter, and
- Dynamic head due to RCP flow.

Factoring these two effects in gives the following relationship:

Setpoint + Overshoot + Instrument Error + Static Head + Dynamic Head
≤ ASME B&PV Code Appendix G Limit

The value for the dynamic head correction has been determined to be 53 psid. Values for the static head correction and pressure overshoot will be determined in this calculation. The above relationship will also be evaluated to determine the amount of instrument uncertainty that can be tolerated and still meet the ASME B&PV Code Appendix G Limits.

Calculation Of Static Head

The lower circumferential weld is the most limiting area for brittle fracture. For conservatism, the elevation difference from the instrument tap to the bottom of the active fuel length is used for the static head correction. The bottom of the active fuel length is approximately 16 inches below the lower circumferential weld on the vessel wall.

The elevation difference (EL) can be determined by the sum of the following:

EL = A + B + C + D - E + F

where:
A = Distance from the bottom of the active fuel length to the bottom of the upper core plate,
B = Thickness of upper core plate,
C = Distance from top of upper core plate to centerline of vessel nozzle,
D = Distance from the centerline of the vessel nozzle to elevation of center of lower radius of pressurizer,
E = Distance from center of lower radius of pressurizer to lower pressurizer instrument tap, and
F = Distance from lower pressurizer instrument tap to upper pressurizer instrument tap.

Plant drawings indicate the following information.

A =	160.5 in. - 3.875 in.	=	13.0521 ft.
B =	1.75 in.	=	0.1458 ft.
C =	42.25 in.	=	3.5208 ft.

The centerline of the vessel nozzles are at an elevation of 242 ft. 2-11/16 in., and the elevation of the center of the lower radius of the pressurizer vessel is 249 ft. 0 in.

Therefore:

D = 249 ft. - 242.224 ft. = 6.776 ft.

The vertical distance from the center of the lower radius to the reference working line is 4 inches and from that reference working line to the centerline of the lower instrument tap is 2 inches. Therefore:

E = 4 in. + 2 in. = 6 in. = 0.5 ft.

The distance from the lower skirt to the centerline of the lower tap is 4 ft. 10 in., and from the lower skirt to the centerline of the upper tap is 35 ft. 6 in. Therefore:

F = 35 ft. 6 in. - 4 ft. 10 in. = 368 in. = 30.6667 ft.

Substituting values gives:

EL = 13.0521 ft. + 0.1458 ft.+ 3.5208 ft. + 6.776 ft. - 0.5 ft. + 30.6667 ft. = 53.66 ft.

Converting this to a static head correction using a density of 63.8 lbm/ft^3;

$$SH = 53.66 \text{ ft.} \times 63.8 \text{ lbm/ft}^3 \times 1 \text{ ft}^2/144 \text{ in}^2 = 23.77 \text{ psig}$$

Calculation Of Pressure Overshoot-Mass Input Case

The pressure overshoot associated with the mass input case is determined from the following equation:

$$\Delta P\ (V, S, Z, x) = \Delta P_{REF}(x) * F_V * F_S * F_Z$$

where:

$\Delta P\ (V, S, Z, x)$ = Pressure Overshoot (psi),
$\Delta P_{REF}(x)$ = Reference Overshoot (psi) for a given mass input rate,
F_V = RCS Volume Factor,
F_S = Relief Valve Setpoint Factor, and
F_Z = Relief Valve Opening Time Factor.

The Reference Overshoot as a function of mass input rate (lbm/sec) is determined from Figure 4.2.1 of Reference 1. For a mass input rate of 32.7 lbm/sec, the Reference Overshoot is 44 psi.

$$\Delta P_{REF}(32.7 \text{ lbm/sec}) = 44 \text{ psi}$$

The RCS Volume Factor as a function of Total RCS Volume (ft^3) is determined from Figure 4.2.2 of Reference 1. For a RCS Volume of 9343 ft^3, the RCS Volume Factor is 0.76.

$$F_V = 0.76$$

The Relief Valve Setpoint Factor as a function of Relief Valve Setpoint (psig) is determined from Figure 4.2.4 of Reference 1. For an LTOP Setpoint of 400 psig, the Relief Valve Setpoint Factor is 1.27.

$$F_S = 1.27$$

The Relief Valve Opening Time Factor as a function of Relief Valve Opening Time (sec) is determined from Figure 4.2.3 of Reference 1. For an opening time of 2.5 seconds, the Relief Valve Opening Time Factor is 0.865.

$$F_Z = 0.865$$

Substituting the values determined above into the pressure overshoot equation gives the

following :

$$\Delta P\,(V, S, Z, x) = \Delta P_{REF}(x) * F_V * F_S * F_Z$$
$$\Delta P_{Overshoot} = 44 \text{ psi} * 0.76 * 1.27 * 0.865$$
$$\Delta P_{Overshoot} = 36.7 \text{ psi}$$

Calculation Of Pressure Overshoot-Heat Input Case

The method for determining the Pressure Overshoot associated with the heat input from the inadvertent startup of a RCP is presented in Reference 2. Section A of Reference 2 presents the setpoint overshoot variation with relief valve opening times for various relief valve setpoints.

For an Relief Valve Setpoint of 400 psig and a RCS Volume of 6000 ft^3, Figures 14 and 20 of Reference 2 are used to determine the Reference Normalized Heat Transfer Area (UA) for relief valve opening times of 3.0 seconds and 1.5 seconds respectively. The normalized UA data is as follows:

Figure 14 (RCS = 6000 ft^3, Relief Valve Opening Time = 3.0 seconds)

Initial RCS Temperature	Reference Normalized UA
100°F	0.085
250°F	0.139

Figure 20 (RCS = 6000 ft^3, Relief Valve Opening Time = 1.5 seconds)

Initial RCS Temperature	Reference Normalized UA
100°F	0.085
250°F	0.139

For a relief valve setpoint of 400 psig and a RCS Volume of 13000 ft^3, Figures 15 and 21 of Reference 2 are used to determine the Reference Normalized Heat Transfer Area (UA) for relief valve opening times of 3.0 seconds and 1.5 seconds respectively. The normalized UA data is as follows:

Figure 15 (RCS = 13000 ft^3, Relief Valve Opening Time = 3.0 seconds)

Initial RCS Temperature	Reference Normalized UA
100°F	0.120
250°F	0.222

Figure 21 (RCS = 13000 ft^3, Relief Valve Opening Time = 1.5 seconds)

Initial RCS Temperature	Reference Normalized UA
100°F	0.131
250°F	0.220

Figures 14, 15, 20 and 21 are based on a RCS/Steam Generator (SG) ΔT of 50°F. Both the CTS and the proposed ITS prohibit the start of an RCP unless the RCS/SG ΔT ≤ 50°F or there is a bubble in the pressurizer.

To account for the difference between the actual steam generator heat transfer area and the heat transfer area used in Figures 14, 15, 20 and 21, the actual UA is divided by the Reference UA of 58,000 ft^2. The UA for the steam generators is 43,467 ft^2.

Heat Transfer Area Fraction (F) = 43,467 ft^2 / 58,000 ft^2 = 0.7494

To determine the Actual Normalized Heat Transfer Area for relief valve opening times of 3.0 seconds and 1.5 seconds, multiply the Reference Normalized Heat Transfer Area by the Heat Transfer Area Fraction. The Actual Normalized UA data is as follows:

RCS = 6000 ft^3, Relief Valve Opening Time = 3.0 seconds

Initial RCS Temperature	Actual Normalized UA (Ref Normalized UA * F)
100°F	0.085*0.7494 = 0.064
250°F	0.139*0.7494 = 0.104

RCS = 6000 ft^3, Relief Valve Opening Time = 1.5 seconds

Initial RCS Temperature	Actual Normalized UA (Ref Normalized UA * F)
100°F	0.085*0.7494 = 0.064
250°F	0.139*0.7494 = 0.104

RCS = 13000 ft^3, Relief Valve Opening Time = 3.0 seconds

Initial RCS Temperature	Actual Normalized UA (Ref Normalized UA * F)
100°F	0.120*0.7494 = 0.089
250°F	0.222*0.7494 = 0.166

RCS = 13000 ft^3, Relief Valve Opening Time = 1.5 seconds

Initial RCS Temperature	Actual Normalized UA (Ref Normalized UA * F)
100°F	0.131*0.7494 = 0.098
250°F	0.220*0.7494 = 0.165

Using Figures 14, 15, 20 and 21, determine the pressure overshoot associated with a given RCS Volume and Relief Valve Opening Time from the Actual Normalized UA and the initial RCS temperature. The pressure overshoots are as follows:

Figure 14 (RCS = 6000 ft^3, Relief Valve Opening Time = 3.0 seconds)

Initial RCS Temperature	Actual Normalized UA	Pressure Overshoot
100°F	0.064	25 psi
250°F	0.104	92 psi

Figure 20 (RCS = 6000 ft^3, Relief Valve Opening Time = 1.5 seconds)

Initial RCS Temperature	Actual Normalized UA	Pressure Overshoot
100°F	0.064	12 psi
250°F	0.104	46 psi

Figure 15 (RCS = 13000 ft^3, Relief Valve Opening Time = 3.0 seconds)

Initial RCS Temperature	Actual Normalized UA	Pressure Overshoot
100°F	0.089	15 psi
250°F	0.166	70 psi

Figure 21 (RCS = 13000 ft^3, Relief Valve Opening Time = 1.5 seconds)

Initial RCS Temperature	Actual Normalized UA	Pressure Overshoot
100°F	0.098	10 psi
250°F	0.165	32 psi

To account for the actual Relief Valve Opening Time of 2.5 seconds, linearly interpolate the overshoot values (P') determined for the 3.0 second and 1.5 second Relief Valve Opening Times as follows:

$$P'_{2.5\,sec} = \frac{(t\,sec - 1.5sec)}{(3.0sec - 1.5sec)} * (P'_{3.0\,sec} - P'_{1.5\,sec}) + P'_{1.5\,sec}$$

RCS Volume = 6000 ft^3, 100°F, Relief Valve Opening Time = 2.5 seconds

$$P'_{2.5\,sec} = \frac{(2.5\,sec - 1.5\,sec)}{(3.0\,sec - 1.5\,sec)} * (25\,psi - 12\,psi) + 12\,psi$$

$$P'_{2.5\,sec} = 21\,psi$$

RCS Volume = 6000 ft^3, 250°F, Relief Valve Opening Time = 2.5 seconds

$$P'_{2.5\,sec} = \frac{(2.5\,sec - 1.5\,sec)}{(3.0\,sec - 1.5\,sec)} * (92\,psi - 46\,psi) + 46\,psi$$

$$P'_{2.5\,sec} = 77\,psi$$

RCS Volume = 13000 ft^3, 100°F, Relief Valve Opening Time = 2.5 seconds

$$P'_{2.5\,sec} = \frac{(2.5\,sec - 1.5\,sec)}{(3.0\,sec - 1.5\,sec)} * (15\,psi - 10\,psi) + 10\,psi$$

$$P'_{2.5\,sec} = 13\,psi$$

RCS Volume = 13000 ft^3, 250°F, Relief Valve Opening Time = 2.5 seconds

$$P'_{2.5\,sec} = \frac{(2.5\,sec - 1.5\,sec)}{(3.0\,sec - 1.5\,sec)} * (70\,psi - 32\,psi) + 32\,psi$$

$$P'_{2.5\,sec} = 57\,psi$$

To account for the actual RCS Volume of 9343 ft^3, linearly interpolate the overshoot pressures (P') determined for the 6000 ft^3 and 13000 ft^3 RCS volumes as follows:

$$P'_{9343} = P'_{6000} - \frac{(9343 - 6000)}{(13000 - 6000)} * (P'_{6000} - P'_{13000})$$

RCS Volume = 9343 ft^3, 100°F, Relief Valve Opening Time = 2.5 seconds

$$P'_{9343} = 21\,psi - \frac{(9343 - 6000)}{(13000 - 6000)} * (21\,psi - 13\,psi)$$

$P'_{9343} = 17.2$ psi

RCS Volume = 9343 ft^3, 250°F, Relief Valve Opening Time = 2.5 seconds

$$P'_{9343} = 77 \text{ psi} - \frac{(9343 - 6000)}{(13000 - 6000)} * (77 \text{ psi} - 57 \text{ psi})$$

$P'_{9343} = 67.4$ psi

Limiting Pressure Overshoot

Comparison of the mass input and heat input cases shows the following pressure overshoots:

RCS Temperature (°F)	Mass Input Case Pressure Overshoot (psi)	Heat Input Case Pressure Overshoot (psi)
100	36.7	17.2
250	N/A	67.4

Per Reference 1, the mass input case is most limiting at low temperatures due to the low compressibility of the RCS and injection fluids. Therefore, the 36.7 psi overshoot is only evaluated at 100°F. Based on this comparison, the mass input case is more limiting at low temperatures (100°F) while the heat input case is more limiting at higher temperatures (250°F).

The ASME B&PV Appendix G cooldown limits are summarized in Table 4.1 below. The ASME B&PV Appendix G heatup limits are summarized in Table 4.2 below. The Appendix G limits associated with the heatup curve at a temperature of 100°F and heatup rate of 15°F/hr were used to evaluate LTOP operation. The Appendix G limit associated with the lower temperature of the various ranges specified was used for conservatism and simplicity.

Table 4.1, Appendix G Cooldown Limits

Temperature Range (°F)	Maximum Cooldown Rate (°F/hr)	Appendix G Limit (psig)
350-300	60	1450
300-250	30	918.94
250-200	15	699.73
200-170	10	612.54
170-100	3	565.55

Table 4.2, Appendix G Heatup Limits

Temperature Range (°F)	Maximum Heatup Rate (°F/hr)	Appendix G Limit (psig)
100-160	15	563.51
160-220	30	602.61
220-350	60	813.88

Determination Of Analytical Limit

The analytical limit for the LTOP instrument setpoint uncertainty was determined from the following relationship:

Analytical Limit = Appendix G Limit - Setpoint - Overshoot - Static Head - Dynamic Head

The limiting case occurs at 100°F with a mass input event. The values for the above equation are as follows:

Appendix G Limit at 100°F = 563.51
LTOP Setpoint = 400 psig
Pressure Overshoot = 36.7 psig for the mass input case
Static Head = 23.8 psi
Dynamic Head = 53 psid

Substituting into the above equation gives the following:

Analytical Limit = 563.51 - 400 - 36.7 - 23.8 - 53

Analytical Limit = 50.01 psig

Given an instrument uncertainty of ±45.9 psig for an LTOP setpoint of 400 psig, the margin is 4.11 psi.

4.0 REFERENCES

1 Westinghouse Owners Group Report, "Pressure Mitigating Systems Transient Analysis Results," July 1977.
2 Westinghouse Owners Group Report, "Pressure Mitigating Systems Transient Analysis Results Supplement to the July 1977 Report, September 1977.

H. B. ROBINSON STEAM ELECTRIC PLANT, UNIT NO. 2 TECHNICAL SPECIFICATION CHANGE REQUEST TO CONVERT TO THE IMPROVED STANDARD TECHNICAL SPECIFICATIONS CALCULATION SUMMARY OF THE LOW TEMPERATURE-OVERPRESSURE PROTECTION SYSTEM INSTRUMENT UNCERTAINTY

1.0 SUMMARY

This calculation determines instrument setpoint uncertainty for loops P-500 and P-501 in the Reactor Coolant System (RCS), which are used to actuate the Low Temperature Overpressure Protection (LTOP) System. Loop P-500 is identical to Loop P-501. Only instruments in Loop P-500 are addressed in this calculation. This calculation determines the instrument setpoint uncertainties for input to PCV-456 valve control setpoint. The components addressed are:

Pressure Transmitter	PT-500,
I/V Input Module	PC-500/R, and
Comparator	PC-502.

2.0 FUNCTIONAL DESCRIPTION

The LTOP system protects the RCS against overpressurization when RCS temperature is below 350°F. Without the protection of the LTOP system, a postulated overpressure transient could occur when the RCS is at a low temperature that could exceed limits that protect the reactor vessel from brittle fracture. In Loop P-500, Pressure Transmitter PT-500 provides a signal to comparator PC-500 which allows valve PCV-456 to operate.

3.0 INPUTS AND ASSUMPTIONS

The environment conditions for the instrumentation were determined based upon normal ambient conditions in the Hagan Rack Room of 50°F to 83°F and in the containment of 88°F to 120°F. The minimum and maximum voltages on the four safety related instrument buses are 105.10 and 132.0 corresponding to a nominal voltage of 120 VAC. This range is equivalent to a voltage swing of +10% and -12.4%. With all equipment operable, devices in a current loop that do not control loop current do not affect other devices in a current loop. Such devices would include power supplies, I/V converters, indicator, and comparators.

The Reference Accuracy (RA) for analog devices consists of three portions, linearity, hysteresis, and repeatability. When these components were not called out specifically, it was assumed that they were random, independent, normally distributed, and equal. This results in each equaling RA × SQRT (1/3) = 0.58 × RA. Note that this does not apply to digital devices such as comparators.

The loop power supplies are Westinghouse Model 6627032-G01. The vendor manual contains very limited information on the 45 vdc loop power supplies. It was assumed that the power supplies have the same output regulation as the Hagan 103 power supplies, 5% of the 45 vdc nominal voltage = ± 2.25 vdc.

For conservatism, a 0 to 4000 psig device with ± 0.2% full scale input Measurement & Test Equipment (MTE) inaccuracy for calibration of transmitter was assumed to be used.

4.0 CALCULATION OF UNCERTAINTIES & SETPOINTS

The uncertainty contribution to each individual analog instrument uncertainty has been determined. A Total Device Uncertainty (TDU) was developed by combining the random uncertainties using the Square Root of the Sum of the Squares (SRSS) method and the bias uncertainties algebraically. This technique was performed in accordance with the Company setpoint calculation procedure.

Some of the uncertainty terms were combined to produce a device As Found Tolerance (AFT), while certain others were combined to produce a device As Left Tolerance (ALT). For consistency, all % span values were rounded off to 2 decimal places. Uncertainties relating to a specific device have a subscript with a device identifier.

When the calibration procedure does not confirm linearity, hysteresis, and repeatability, an allowance to account for the missing portions was added to the calibration procedure acceptance criteria to develop the Calibration Tolerance (CAL). This adjusted value will not be used as the As Left acceptance criteria.

Pressure Transmitter

The LTOP System Pressure Transmitter measures pressure directly, so no process error was appropriate.

The pressure transmitter is PT-500. The transmitter is a Rosemount 1154GP9 pressure transmitter. This is a gauge pressure unit with a pressure range from 0-500 to 0-3000 psig, and 4 to 20 MA output. The calibrated range is 0-3000 psig. The reference accuracy is

$$RA_{xmtr} = \pm 0.25\% \text{ span}$$

The transmitter calibration tolerance is ± 0.50% of span and the procedure verifies linearity and hysteresis. Therefore, the repeatability portion of RA must be added to obtain CAL.

$$\begin{aligned} \text{Repeatability} &= RA \times SQRT\ (1/3) \\ &= 0.25 \times 0.58 \\ &= 0.15 \end{aligned}$$

$$CAL_{xmtr} = \pm \text{ SRSS (calibration procedure tolerance, Repeatability)}$$
$$= \pm \text{ SRSS } (0.50, 0.15)$$
$$= \pm 0.52\% \text{ span}$$

In accordance with the assumptions in Section 3.0, the MTE input accuracy is ± 0.2% full scale. For the MTE input to the calculation, 0.2% of a 0-4000 psi scale is 8 psi, which is 0.27% of the 3000 psig calibrated span. The MTE output accuracy is ± 0.25% of the reading. The maximum reading is 5 vdc; 0.25% of 5 vdc is 0.013 vdc; 0.013 is 0.31% of the four volt span. The input and output readings are independent, therefore,

$$MTE_{xmtr} = \pm \text{ SRSS } (0.27, 0.31)$$
$$= \pm 0.41\%$$

The temperature effect is 0.75% Upper Range Limit (URL) + 0.5% span per 100°F ambient temperature change. Maximum span is 3000 psig and calibrated span is 1000 psig.

$$TE_{xmtr} = [0.75(3000) + 0.5(3000)]/3000$$
$$= \pm 1.25\% \text{ span per } 100°F$$

The containment temperature varies between 88°F and 120°F. However the transmitter may be calibrated during shut down. Therefore the temperature range used for this calculation was 50°F to 120°F. Since calibration may occur anywhere in this band, the maximum change is 120°F - 50°F = 70°F.

Therefore:

$$TE_{xmtr} = \pm 1.25 \times (70/100)$$
$$= \pm 0.88 \% \text{ span}$$

The power supply effect is less than 0.005% span per volt. In accordance with the assumptions in Section 3.0, the voltage variations is 2.25 volts. Therefore:

$$PSE_{xmtr} = \pm 0.005\% \times (2.25/1 \text{ volts})$$
$$= \pm 0.01\% \text{ span}$$

The drift specification is ± 0.20% URL over 24 months. This value will conservatively be used for the 22.5 month drift:

$$DR_{xmtr} = \pm 0.20\% \text{ URL}$$
$$= \pm 0.0020 \text{ H } 3000/3000$$
$$= \pm 0.20\%$$

The Total Device Uncertainty is:

$$TDU_{xmtr} = \pm SRSS\ ((CAL_{xmtr}+MTE_{xmtr}),\ TE_{xmtr},\ PSE_{xmtr},\ Dr_{xmtr})$$
$$= \pm SRSS\ ((0.52+0.41), 0.88, 0.01, 0.20)$$
$$= \pm 1.29\%$$

The As Found Tolerance (AFT) is:

$$AFT_{xmtr} = \pm SRSS\ (CAL_{xmtr},\ MTE_{xmtr},\ DR_{xmtr})$$
$$= \pm SRSS\ (0.52, 0.41, 0.20)$$
$$= \pm 0.69\%$$

The As Left Tolerance (ALT) is:

$$ALT_{xmtr} = \pm \text{setting tolerance}$$
$$= \pm 0.50\%$$

Signal Comparator

The signal comparators are Westinghouse Model 4111082-001 Single Input Comparators.

The vendor manual does not state a reference accuracy for the comparator. Per the Company sepoint methodology procedure, when reference accuracy is not stated, it is set equal to the calibration tolerance. The calibration tolerance for the comparator is ± 0.5% span.

Therefore,

$$RA_{COMP1} = \pm 0.50\%$$

and,

$$CAL_{COMP1} = \pm 0.50\% \text{ span}$$

Since linearity and hysteresis do not apply to comparators, no correction of this value is required.

With respect to MTE, the comparators are calibrated with a Digital Voltmeter (DVM) accurate to ± 0.25% reading. The maximum reading is 5 vdc; 0.25% of 5 vdc is 0.0125 vdc; 0.0125 vdc is 0.31% of the four volt span. Therefore,

$$MTE_{COMP} = 0.31\% \text{ span}$$

With respect to the Power Supply Effect, the comparator was assumed to operate on 117 ±10%. Uncertainty from this source was considered negligible.

With respect to the Temperature Effect, the vendor manual does not state a temperature effect or a drift value for the comparator. An analysis of As Found/As Left data was done to determine the combined temperature and drift value. The analysis utilizing actual calibration data sheets results yielded the following information.

$$Dr_{comp} = \pm 0.1\ \%\ \text{span}$$

The Total Device Uncertainty (TDU) is:

$$
\begin{aligned}
TDU_{COMP} &= \pm\ SRSS\ ((\ CAL_{COMP} + MTE_{COMP}),\ Dr_{comp}) \\
&= \pm\ SRSS\ ((\ 0.50 + 0.31),\ 0.1) \\
&= \pm\ 0.82\%\ \text{span}
\end{aligned}
$$

LTOP Setpoint Uncertainties

The LTOP Setpoint Uncertainties depend on the transmitter and signal comparator PC-500 uncertainties.

Increasing Setpoint

PE	N/A	$Bias_1$	N/A
PME	N/A	$Bias_2$	N/A
TDU_{sensor}	1.29%	$Bias_3$	N/A
TDU_1	0.82%	Total Bias	N/A
TDU_2	N/A		
TDU_3	N/A		

$$TLU = (PE^2 + PME^2 + TDU_{sensor}{}^2 + TDU_1{}^2 + TDU_2{}^2 + TDU_3{}^2)^{1/2} + \text{Total Bias}$$

TLU 1.53% = 45.9 PSI

References

1. ISA Standard S67.04, 1988 "Setpoints for Nuclear Safety Related Instrumentation used in Nuclear Power Plants."

2. ISA Recommended Proactive DRP 67.04, Draft 10, "Methodologies for the Determination of Setpoints for Nuclear Safety Related Instrumentation."

3. USNRC Regulatory Guide 1.105, Rev. 2, "Instrument Setpoints for Safety Related Systems."

United States Nuclear Regulatory Commission
Attachment VII to Serial: RNP-RA/97-0087
(81 Pages)

H. B. ROBINSON STEAM ELECTRIC PLANT, UNIT NO. 2
TECHNICAL SPECIFICATION CHANGE REQUEST TO CONVERT
TO THE IMPROVED STANDARD TECHNICAL SPECIFICATIONS
CALCULATION OF LOW TEMPERATURE-OVERPRESSURE PROTECTION SYSTEM
SUPPLEMENT 3

Page Insertion Instructions for inserting pages into Enclosure 12 to Serial: RNP-RA/96-0141, dated August 27, 1996, "Conversion Package Section 3.4."

Remove Page	Insert Page

a. Part 1,"Markup of Current Technical Specifications (CTS)."

3.1-4(3.4.12), 3.1-4a(3.4.12)	3.1-4(3.4.12), 3.1-4a(3.4.12)
3.3-5(3.4.12), 4.1-13(3.4.12)	3.3-5(3.4.12), 4.1-13(3.4.12)
4.1-7a(3.4.12),4.2-7a(3.4.12)	4.1-7a(3.4.12),4.2-7a(3.4.12)

b. Part 2, "Discussion of Changes (DOCS) for CTS Markup."

4,16,17, 18, 20, 21, 22, 29	4,16,17, 18, 20, 21, 22, 29

c. Part 3, "No Significant Hazards Consideration and Basis for Categorical Exclusion From 10 CFR 51.22"

12	12

d. Part 4, "Markup of NUREG-4131, Revision 1, 'Standard Technical Specifications - Westinghouse Plants' (ISTS)"

3.4-27	3.4-27
Insert 3.4.12-1(no page number)	3.4-27a
3.4-28	3.4-28
Insert 3.4.12-2(no page number)	3.4-28a
3.4-29, 3.4-30	3.4-29, 3.4-30
Insert 3.4.12-4(no page number)	3.4-30a
3.4-31, 3.4-32	3.4-31, 3.4-32

e. Part 5, "Justification for Differences (JFDs) to ISTS" - N/A

1, 2, 3, 4, 6	1, 2, 3, 4, 6

f. Part 6, "Markup of ISTS Bases" - N/A

B3.4-59	B3.4-59
-	B3.4-59a
B3.4-60, B3.4-61, B3.4-62	B3.4-60, B3.4-61, B3.4-62
Insert B3.4.12-2(no page number)	B3.4-62a
B3.4-63, B3.4-64, B3.4-65	B3.4-63, B3.4-64, B3.4-65
Insert B3.4.12-5(no page number)	B3.4-65a
B3.4-66, B3.4-67	B3.4-66, B3.4-67
Insert B3.4.12-6(no page number)	B3.4-67a
B3.4-68, B3.4-69	B3.4-68, B3.4-69
Insert B3.4.12-8(no page number)	B3.4-69a
B3.4-70, B3.4-71, B3.4-72	B3.4-70, B3.4-71, B3.4-72

g. Part 7, "Justification for Differences (JFDs) to ISTS Bases" - N/A

4, 5, 6	4, 5, 6

h. Part 8, "Proposed HBRSEP, Unit No. 2 ITS"

Pages 3.4-29 through 3.4-35	Pages 3.4-29 through 3.4-35

i. Part 9, "Proposed HBRSEP, Unit No. 2 ITS Bases"

Pages B 3.4-60 through B 3.4-74	Pages B 3.4-60 through B 3.4-74

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