INL USQ PROCESS
POTENTIAL INADEQUACY IN THE SAFETY ANALYSIS (PISA) FORM
(DO NOT USE FOR PROPOSED CHANGES)

Facility or Activity: RTC, TRA-670 Advanced Test Reactor

USQ Process No.: RTC-USQ-2006-376

Subject: Discrepancies with the high inlet pressure setpoint derivation

Describe the New Information/Discovery:

The limiting Condition 2 event which bounds all Condition 2 and 3 high pressure accidents is the loss of instrument air. The loss of instrument air will close back pressure control valve PCV-1-1 and open pressurizing flow control valve FCV-1-8. This event was last evaluated in 1975; Technical reports TR-750, TR-752, TR-797, and TR-829 analyze this accident. This review resulted in identifying the following discrepancies/concerns with the high inlet pressure setpoint derivation:

1. The protective margin identified in TR-829 is based on the nominal air volume ($50ft^3$) in the surge tank. TR-752 identifies that the margin is reduced as surge tank air volume decreases.

2. The surge tank level indication error is not considered and it may be substantial. See Gap -001-05 and draft EDF-5090.

3. The analysis incorrectly assumes the trip point for the PPS/ESF occurs at the low point of the inlet piping (Volume 48 in RELAP4 model). The bottom of this pipe in Volume 48 is at an elevation of 47.5 feet. In actuality, the PPS inlet pressure taps are located on the inlet piping located in the pipe tunnel downstream of BF-1-14. The three taps are at an average elevation of 63.25 ft. with the highest tap at 64 ft. and the lowest tap at 62-½ ft this would make the RELAP4 model non-conservative by ~ 7.1 psig.
   Note: the current RELAP5 model has the correct pressure tap elevations.

4. The analysis assumes that when the standby pressurizing pump starts the total inflow is 600 gpm (pressurizing pumps) + 70 gpm gland seal flow. It is assumed to remain constant until tripped off by ESF function. The standby pump starts when the discharge pressure of the running pump decreases to 260 psig, and at this pressure, the combined flow from both pressurizing pumps is close to 700 gpm (SO-16 data).

Identify the applicable safety basis document(s) (e. g., DSA, SAR, BIO, TSRs, etc.):

SAR-153, chapter 15.5 - Accident Analysis Increase In Primary Coolant Inventory,

TR-750- RELAP4 Primary Coolant System Models Utilized tor the Advanced Test Reactor Technical Specifications,

TR-752 - RELAP4 Analysis Results For Utilization In The Development Of The ATR Technical Specifications, and

TR-829 - ATR PPS Limiting Safety System Settings From ATR Technical Specifications Development Work

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I. PISA ASSESSMENT

a. Is there a potential inadequacy in the analytical methodology and/or tools used in the safety basis?
☒ Yes ☐ No

b. Is there a potential discrepancy between the safety basis assumptions, provisions, or conditions, in the accident analysis and the facility operation or parameters?
☒ Yes ☐ No

c. Is the actual physical condition of the facility different than as described in the safety basis (discrepant as-found condition)?
☒ Yes ☐ No

d. Has an actual or postulated operational event or incident revealed a potential inadequacy in the safety basis?
☐ Yes ☒ No

e. Is this an activity or condition not analyzed in the existing safety basis?
☐ Yes ☒ No

Provide an explanation of the assessment result:

There is reason to believe that the safety analysis for the SAR might be in error. Therefore this constitutes a PISA

USQ Evaluator Print/Type Name	USQ Evaluator Signature	Date
Nuclear Facility Manager Print/Type Name	Nuclear Facility Manager Signature	Date

If the answer to ALL of the assessment questions above is No, file the completed form. Do not complete Section II, III, or IV.
If the answer to any one of the assessment questions is Yes, there is a potentially inadequate safety analysis (PISA):

- Nuclear Facility Manager document actions (Section II), including interim operating restrictions, taken to place or maintain the facility in a safe condition.
- Nuclear Facility Manager execute reporting process per MCP-190 or AWP-3.1, for PISA.
- USQ evaluator proceed to Section III.

II. DOCUMENT ACTIONS TAKEN TO PLACE OR MAINTAIN FACILITY IN A SAFE CONDITION AND PROVIDE THE BASIS FOR THE SELECTION OF ANY INTERIM CONTROLS

Combining the errors above, the maximum pressure during the high pressure transient is below the condition 2 acceptance criteria and well below the safety limit for the PCS piping.

High Inlet Pressure Protective Margins

High inlet pressure analytical limit (SAR-153) **408.6 psig**

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Pressure correction for Volume 48

Highest PPS inlet pressure tap elevation	64 ft	
Tap elevation assumed in RELAP4	47.5 ft	
Difference	16.5 ft	
Pressure correction (0.433 psi/ft) (16.5 ft) =		**7.2 psi**

Maximum allowed surge tank level (TSR-186)	73%	
Worst case instrument error (draft EDF-5090)	25.2%	
Worst case surge tank level	**98.2%**	
Air volume in the surge tank at 98.2% (EDF-4106)	31.9 ft^3	
Response time error due to 31.9 ft^3 (TR-752)		
for conservatism 25 ft^3 air volume was used, from TR-752, page 106 the rate of pressure increase is 12.5 psi/sec. Using the 0.7 sec (0.5 sec instrument response to trip the pump breakers and 0.2 sec for the effect of the breaker trip to be seen in the PCS pressure) time response, 12.5 psi/sec * 0.7 sec =		**8.8 psi**

The response time used in the analysis is 0.7 sec (0.5 sec instrument response to trip the pump breakers and 0.2 sec for the effect of the breaker trip to be seen in the PCS pressure.) the total inflow assumed in the analysis is 670 gpm, from the SO test data (SO-16) the actual inflow at the worst-case trip point (408.6 psig) could be as high as 700 gpm (630 gpm pressurizing flow and 70 gpm GSW flow) this would cause a pressure overshoot of (700 gpm - 670 gpm)(0.7 sec)(1/60 sec)= 0.35 gallons or 0.047 ft^3 Using the data from PG-T-88-005 rev 1 & TR-752 at the end of the transient the surge tank pressure and air volume are 285 psia and 22.44 ft^3 respectively, due to the increased pressurizing pump flow the new air volume would be 22.39 ft^3 (22.44 ft^3-0.047 ft^3)the resulting pressure change would be

(285 psia * 22.44 ft^3 / 22.39 ft^3) - 285 psia = **0.6 psi**

Combining the errors the worst case pressure 408.6 + 7.2 + 8.8 + 0.6 = 425.2 psig

Acceptance criteria for condition 2 events is 110% of design pressure (SAR-153) =			429 psig
Protective Margin	429 – 425.2 =	3.8 psig	
Safety limit (TSR-186)			468 psig
Protective margin	468 – 425.2 =	42.8 psig	

Continued operation is justified based on meeting the acceptance criterion, Maintaining the current plant PPS high inlet pressure setting of 385.0 psig, will add an additional 5.6 psig of margin.

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Safety Analyst Print/Type Name	Safety Analyst Signature	Date
Nuclear Facility Manager Print/Type Name	Nuclear Facility Manager Signature	Date

Is independent technical review required? Yes ☐ No ☐

Nuclear Facility Manager Signature or Initials

Independent Reviewer Print/Type Name	Independent Reviewer Signature	Date

III. DETERMINATION

Identify applicable section(s) of the safety basis document(s) (e.g., DSA, SAR, BIO, TSRs, etc.).

SAR-153, chapter 15.5
Technical reports TR-750, TR-752, TR-797, and TR-829

IIIa: POTENTIAL FOR AN INCREASE IN PROBABILITY OR CONSEQUENCE OF AN ACCIDENT OR MALFUNCTION EVALUATED IN THE SAFETY BASIS

1. Could the PISA increase probability of occurrence of an accident previously evaluated in the safety basis?
Yes ☐ No ☒
Explain:

The PISA raised issues that the surge tank air volume assumed in the safety analysis did not correctly account for the surge tank level uncertainty, that the actual location of the PPS pressure taps was different than modeled and that the amount of inflow to the surge tank during a high pressure transient could be greater than modeled. Each of these issues could result in a higher pressure response than predicted by the analysis. Even with combining all the factors the transient analysis results were within the acceptance criteria. The PISA did not question the function of the ESF used to terminate pressure transient nor the acceptance criteria of the event. Therefore, the PISA did not increase the probability of occurrence of an accident previously evaluated in the safety basis.

2. Could the PISA increase the consequences of an accident previously evaluated in the safety basis?
Yes ☐ No ☒
Explain:

The PISA raised issues that the surge tank air volume assumed in the safety analysis did not correctly account for the surge tank level uncertainty, that the actual location of the PPS pressure taps was different than modeled and that the amount of inflow to the surge tank during a high pressure transient could be greater than modeled. Each of these issues could result in a higher pressure response than predicted by the analysis. Even with combining all the factors the transient analysis results were within the acceptance criteria. The PISA did not question the function of the ESF used to terminate pressure transient nor the acceptance criteria of the event. Therefore, this PISA could

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not increase the consequences of an accident previously evaluated in the safety basis.

3. Could the PISA increase the probability of occurrence of a malfunction of equipment important to safety previously evaluated in the safety basis? Yes ☐ No ☒

Explain:

The PISA raised issues that the surge tank air volume assumed in the safety analysis did not correctly account for the surge tank level uncertainty, that the actual location of the PPS pressure taps was different than modeled and that the amount of inflow to the surge tank during a high pressure transient could be greater than modeled. Each of these issues could result in a higher pressure response than predicted by the analysis. Even with combining all the factors the transient analysis results were within the acceptance criteria. The PISA did not question the function of the ESF used to terminate pressure transient nor the acceptance criteria of the event. Therefore, the PISA did not increase probability of occurrence of a malfunction of equipment important to safety previously evaluated in the safety basis.

4. Could the PISA increase the consequences of a malfunction of equipment important to safety previously evaluated in the safety basis? Yes ☐ No ☒

Explain:

The PISA raised issues that the surge tank air volume assumed in the safety analysis did not correctly account for the surge tank level uncertainty, that the actual location of the PPS pressure taps was different than modeled and that the amount of inflow to the surge tank during a high pressure transient could be greater than modeled. Each of these issues could result in a higher pressure response than predicted by the analysis. Even with combining all the factors the transient analysis results were within the acceptance criteria. The PISA did not question the function of the ESF used to terminate pressure transient nor the acceptance criteria. Therefore, the PISA did not increase the consequences of a malfunction of equipment important to safety previously evaluated in the safety basis.

IIIb: POTENTIAL FOR CREATION OF AN UNANALYZED ACCIDENT OR MALFUNCTION OF A DIFFERENT TYPE

5. Could the PISA create the possibility of an accident of a different type than previously evaluated in the safety basis? Yes ☐ No ☒

Explain:

The PISA raised issues that the surge tank air volume assumed in the safety analysis did not correctly account for the surge tank level uncertainty, that the actual location of the PPS pressure taps was different than modeled and that the amount of inflow to the surge tank during a high pressure transient could be greater than modeled. Each of these issues could result in a higher pressure response than predicted by the analysis. Even with combining all the factors the transient analysis results were within the acceptance criteria. The PISA did not question the function of the ESF used to terminate pressure transient nor the acceptance criteria. Therefore, the PISA did not create the possibility of an accident of a different type than previously evaluated in the safety basis.

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6. Could the PISA create the possibility of a malfunction of equipment important to safety of a different type than previously evaluated in the safety basis? Yes ☐ No ☒

Explain:

The PISA raised issues that the surge tank air volume assumed in the safety analysis did not correctly account for the surge tank level uncertainty, that the actual location of the PPS pressure taps was different than modeled and that the amount of inflow to the surge tank during a high pressure transient could be greater than modeled. Each of these issues could result in a higher pressure response than predicted by the analysis. The PISA did not question the function of the ESF used to terminate pressure transient nor the acceptance criteria. Even with combining all the factors the transient analysis results were within the acceptance criteria. Therefore, the PISA did not create the possibility of a malfunction of equipment important to safety of a different type than previously evaluated in the safety basis.

IIIc: POTENTIAL FOR REDUCTION IN A MARGIN OF SAFETY

7. Could the PISA reduce a margin of safety as defined in the safety basis? Yes ☒ No ☐

Explain:

The margin of safety presented in SAR-153 has been reduced. The maximum pressure obtained during the loss of instrument air event when all the possible uncertainties are accounted for is closer to the acceptance criteria than what was presented in SAR-153. The margin went from 20.4 psig to 3.8 psig. Therefore, the PISA does reduce the margin of safety established in the safety basis.

IIId: USQ DETERMINATION CONCLUSION

8. Based on the responses to questions 1 – 7 above, does the PISA constitute an Unreviewed Safety Question?
Yes ☒ No ☐

Explain:

Part I shows that there is no potential for an increase in probability or consequence of an accident evaluated in the safety basis, Part II shows that there is potential for the creation of an unanalyzed accident or malfunction of a different type, and Part III shows that there is a reduction in the margin of safety established in the safety basis. Therefore, this PISA does constitute a USQ.

NOTE: If USQ determination result is positive, additional notification for ORPS is required per MCP-190 or AWP-3.1.

IV. APPROVAL/CONCURRENCE SIGNATURES

APPROVAL:

Steve Wagoner	Steve Wagoner	6/08/06
USQ Evaluator Print/Type Name	USQ Evaluator Signature	Date
MARTIN B. McDONOUGH	Martin B McDonough	6/08/06
Nuclear Facility Manager Print/Type Name	Nuclear Facility Manager Signature	Date

CONCURRENCE:

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Alan P Hoskins	Alan P Hoskins	6-8-06
Independent Review Committee Chair Print/Type Name	Independent Review Committee Chair Signature	Date