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

Facility or Activity: Advanced Test Reactor

USQ Process No.: ATR Complex-USQ-2010-607

Subject: Application of Revised Surge Tank Level Analyses to Interim Operating Controls

Describe the New Information/Discovery:
Revisions of surge tank (670-M-12) level instrument uncertainty analysis (EDF-5090) and surge tank volume versus level indication calculation (EDF-4106) were not applied to interim operating controls on surge tank level imposed by PISA/USQ TRA-USQ-2004-385, Rev. 1. ATR surge tank level interim control is 50% ±5% (reference LCO 3.3.4).

Identify the applicable safety basis document(s) (e. g., DSA, SAR, BIO, TSRs, etc.):
SAR-153, Upgraded Final Safety Analysis Report for the Advanced Test Reactor, Revision 28
TSR-186, Technical Safety Requirements for the Advanced Test Reactor, Revision 24
PISA/USQ TRA-USQ-2004-385 Rev.1, "ATR Surge Tank Instrument Limiting Control Settings"
Pending Evaluation of the Safety of the Situation for TRA-USQ-2004-385, "ATR Surge Tank Instrument Limiting Control Settings," TEV-764

I. REASONABILITY DETERMINATION (Reasonability determinations made as part of the ATR Design Basis Reconstitution effort may be documented per SP-10.2.4.9)

Is it reasonable that the potential for an inadequate safety analysis exists based on the new information or discovery described above? ☒ Yes ☐ No

If "Yes," proceed to Sections II, III, and IV.
If "No," provide an explanation and basis for the reasonability determination.

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

If the answer to the question above is "No," file the completed form. Do not complete Section II, III, or IV.

If the answer to the question above is "Yes," complete Section II, III, and IV.

II. PISA DECLARATION

What is the basis for concern that the safety basis may not be bounding or may be otherwise inadequate? Provide an explanation.

ATR interim operating control on the surge tank level imposed by TRA-USQ-2004-385 is 50% ±5%. The operating range sets the surge tank water level to a minimum of 45% span (50% - 5%). Applying the worst-case instrument uncertainty of -24%, the minimum water level potentially is 21%, which corresponds to a maximum air volume of 61 cubic ft (ft^3). Although the analyzed maximum air volume is 60 ft^3, 61 ft^3 were deemed acceptable based on preliminary calculation (reference TRA-USQ-2004-385, Rev. 1 attachment).

Revised surge tank level instrument uncertainty (EDF-5090) for the lower water level, however, is −24.9%. Applying the revised uncertainty, the minimum water level potentially would be 20.1%. More significantly, applying the revised surge tank volume versus level indication calculation (EDF-4106), 20.1% corresponds to 67.44 ft^3, which is ~12% greater than the analyzed maximum surge tank air volume.

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EDF 4106, Rev., "ATR Primary Surge Tank (670-M-12) Volume/Indication Calculation," January 23, 2008. Matranga, E. C.

EDF-5090, Rev. 2., "ATR Surge Tank Level Uncertainty Analysis," March 18, 2009. Matranga, E. C

ECAR-236, "Analysis of ATR 3-in LOCA with Concurrent Failure of the LOCA PCP Shutoff System," June 18, 2008. Polkinghorne, S. T.

A PISA exists. Complete the following actions

- Nuclear Facility Manager document actions (below) including interim operating restrictions taken to place or maintain the facility in a safe condition.
- Nuclear Facility Manager execute reporting process for PISA per LWP-9301 and LWP-13830.
- Qualified USQ evaluator proceed to Section III.

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

At the time of discovery the plant was in power operations. No immediate actions are necessary to place the plant in a safety condition. ECAR-236 demonstrates that the limiting accident (3-inch loss-of-coolant-accident with concurrent failure of the LOCA primary coolant system pump shutoff engineered safety feature) analysis satisfies the ATR Plant Protection Criteria for an air volume of 70 ft^3. ECAR 236 analysis, however, assumes that Emergency Firewater Injection System pumps provide function within 60 seconds after actuation.

An interim control is necessary to reduce the EFIS Supply System (LCO 3.2.1.2) firewater supply pressure (pump start) Response Time requirement to less than or equal to 60 seconds (Table 3.2.1.2-2).

PARAMETER	**Firewater supply pressure (pump start)**
RESPONSE TIME	**≤ 60 sec**

Annual Functional Test Surveillance, DOP-8.3.3 conducted 6/29/2009 verified Firewater Pump Response Times were less than 60 seconds.

J. C. Chapman Safety Analyst Print/Type Name	JC Chapman Safety Analyst Signature	5 Aug 2010 Date
E. J. Schuebert Nuclear Facility Manager Print/Type Name	E Schuebert Nuclear Facility Manager Signature	8/5/10 0904 Date

Is independent technical review required? Yes ☐ No ☒

Nuclear Facility Manager
Signature or Initials

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Independent Reviewer Print/Type Name	Independent Reviewer Signature	Date

III. USQ DETERMINATION

Identify applicable section(s) of the safety basis document(s) (e.g., DSA, SAR, BIO, TSRs, etc.).
See PISA/USQ TRA-USQ-2004-385 Rev.1, "ATR Surge Tank Instrument Limiting Control Settings"

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 pertinent limiting accident is an equivalent 3-inch diameter opening in the primary coolant system loss-of-coolant-accident (3-in. LOCA) with a concurrent failure of the LOCA primary coolant pump (PCP) shutoff engineered safety feature (ESF) in which one PCP continues to operate. This is considered a Condition 3 event. The PISA identifies the potential for the initial surge tank air volume to be greater than 60 cubic ft (ft^3). Surge tank level (surge air volume) is an initial condition of the accident analyses. The initial surge tank level is not an initiator for a LOCA or for a failure of the LOCA ESF. Since the initial surge tank level is not an initiator, potentially larger than analyzed initial surge tank air volume would not affected the probability of occurrence of this accident.

2. Could the PISA increase the consequences of an accident previously evaluated in the safety basis?
   Yes ☒ No ☐
   Explain:
   The pertinent limiting accident is the 3-in. LOCA with a concurrent failure of the LOCA PCP shutoff ESF in which one PCP continues to operate. The accident analysis demonstrates that Condition 3 Plant Protection Criteria (PPC) are met. Fuel damage and radiological release is not expected for scenarios that meet Condition 3 PPC. The PISA identifies the potential for the initial surge tank air volume to be greater than 60 ft^3. The current safety analysis, however, assumes that the maximum initial air volume in the surge tank is 60 ft^3. The current safety analysis demonstrates that air from the surge tank will not be drawn into the emergency pump suction which could result in degrading primary coolant flow through the core. The potentially greater initial air volume in the surge tank (~67 ft^3) may result in air drawn into the pump suction with the resultant primary coolant flow degradation and adverse effect on core cooling. Adverse core cooling may result in fuel damage and radiological release.

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 important to safety equipment relevant to the LOCA is the reactor shutdown system (RSS), the LOCA PCP shutoff ESF, emergency coolant pumps (ECPs), and emergency firewater injection system (EFIS). Potentially greater air volume in the surge would not affect the RSS, ESF, or EFIS, because these systems and feature are functionally isolated from the surge tank and from any effect of entrained air into to the primary coolant system (PCS). Potentially greater surge tank air volume, however, could affect the performance of ECPs due to air entrainment into the pump suction which would degrade the pump performance.

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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 important to safety equipment relevant to the LOCA is the RSS, the LOCA PCP shutoff ESF, ECPs, and EFIS. As noted in question 3, potentially greater air volume in the surge would not affect the RSS, ESF, or EFIS. Potentially greater surge tank air volume, however, could adversely affect the performance of ECPs due to air entrainment into the pump suction. In the context of increase [dose] consequence, the ECPs are not barriers to the release of radiological material. Air entrainment into the ECP suctions per se would not affect the [dose] consequence of the degraded ECP performance. (The question as to whether degraded ECP performance affects the accident consequence is address by question 2.)

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 air volume in the surge tank during operation, the operating surge tank level, is an initial condition of the accident analyses. Due to the expansion of the larger air volume, The effect of greater initial air volume would be to retard pressure transients, due to the expansion of the larger air volume. PCS pressure transients are addressed in the safety analysis. The greater initial air volume in the surge tank also may result in air entrainment into the PCS during LOCAs, due vapor pull through. Entrained air may accumulate in the pump suctions. (ECP pump degradation due to air entrainment in the ECP suction during a LOCA is address by question 2.) Entrained air may degrade heat transfer in core and heat exchangers; however, the effects of the depressurization and loss of coolant due to the LOCA would over shadow any effect of entrained air in the PCS.

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 operating air volume in the surge tank is an initial condition of the accident analyses. The effect of greater initial air volume would be to retard pressure transients and may result in air entrainment into the PCS during LOCAs. (ECP pump degradation due to air entrainment in the ECP suction is address by question 4.) Entrained air may affect the heat transfer in the heat exchangers. However, the major decay heat removal mechanism for the LOCA is EFIS injection, which would over shadow any degradation of the heat exchanger heat removal.

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 current accident analysis demonstrates that Condition 3 PPC are met for the analyzed event (reference question 2). The PISA identifies the potential for the initial surge tank air volume to be greater than 60 ft^3. The current safety analysis assumes that the maximum initial air volume is 60 ft^3. The potentially greater initial air volume in the surge (~67 ft^3) may result in air drawn into the ECP pump suction with the resultant primary coolant flow degradation and adverse effect on core cooling. Adverse core cooling will result in decreased thermal hydraulic margins to the Condition 3 PPC.

IIId: USQ DETERMINATION CONCLUSION

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

Explain:
The PISA identifies the potential for the maximum initial surge tank air volume to be greater than that assumed in the accident analysis (~67 ft^3 vs. 60 ft^3). The potentially greater initial air volume may result in air drawn into the pump suction and primary coolant flow degradation, which would result in degradation of core cooling.

The evaluation of the safety of the situation for unreviewed safety question TRA-USQ-2004-385, "ATR Surge Tank Level Instrument Limiting Control Settings," supports ATR operations with a maximum initial surge tank air volume of 70 ft^3 with the EFIS firewater pump Response Time of 60 s. Firewater Annual Fucntional Test DOP-8.3.3, conducted 6/29/2009 verified firewater pump Response Times were less than 60 seconds.

If "No," is a Safety Basis document revision required at next annual update? ☐ Yes ☐ No

NOTE: If USQ determination result is positive, additional notification for ORPS is required per LWP-9301.

IV. APPROVAL/CONCURRENCE SIGNATURES

APPROVAL:

J. C. Chapman USQ Evaluator Print/Type Name	JC Chapman USQ Evaluator Signature	5 Aug 2010 Date
E. J. Schuebert Nuclear Facility Manager Print/Type Name	E Schuebert Nuclear Facility Manager Signature	8/5/10 0904 Date

CONCURRENCE:

J. A. Jacobi Independent Review Committee Chair Print/Type Name	Jack A Jacobi Independent Review Committee Chair Signature	8/9/2010 Date