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

Facility or Activity: Advanced Test Reactor (ATR)

USQ Process No.: TRA-USQ-2004-176

Subject: Reactor Shutdown System Reactor Vessel Level Limiting Control Setting

Describe the New Information/Discovery:

The Advanced Test Reactor (ATR) plant protective system (PPS) has a subsystem that monitors reactor vessel level. The PPS low vessel level subsystem has a safety-related alarm function for notifying the operators that the vessel level is decreasing during outage operations when the vessel contains irradiated fuel elements. It also has a reactor scram function during depressurized reactor operation. The limiting control setting (TSR 3.1.1) and the minimum alarm setpoint (TSR 3.2.1.3) specified in the ATR Technical Safety Requirements are 92' 3". The reference leg for the PPS low vessel level subsystem is on the reactor vessel lower drain line. Based on a review of facility drawings (drawing 120347and 120441), the lower range of the subsystem instrumentation is 92' 4" (the elevation of the reactor vessel lower drain overflow). Thus the TSR limiting control setting may be outside of the range of the instrument such that the limiting control setting and minimum TSR alarm setpoint would never be reached.

SAR-153 Figure 6.3-1 indicates the elevation of the reactor vessel lower drain is 92' 0". SAR-153 Table 5.3-2 elevations for upper drain nozzle, lower drain nozzle, and instrumented capsule nozzles do not match facility drawings. The TSR basis for the minimum alarm setpoint states that 92' 3" is just at the elevation of the lower drain while the drawings indicate 92' 4".

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

Upgraded Final Safety Analysis Report for the Advanced Test Reactor, SAR-153, August 10, 2004, Section 15.6, Decrease in Primary Coolant System Inventory

Upgraded Final Safety Analysis Report for the Advanced Test Reactor, SAR-153, August 10, 2004, Chapter 16, Derivation of Technical Safety Requirements

Technical Safety Requirements for the Advanced Test Reactor, TSR-186, August 10, 2004

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

Provide an explanation of the assessment result:

The derivation of the limiting control setting for the PPS low vessel level is supported by potentially erroneous values for the lower range of the instrument (i.e., 92' 0" and 92' 3"). With a comparator setting of 92' 3" and the lower range of the instrument limited to 92' 4", the comparator setting cannot be reached and the protective function would not occur.

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Subject: Reactor Shutdown System Reactor Vessel Level Limiting Control Setting

	Original screen signed 9/9/04	
USQ Evaluator Print/Type Name	USQ Evaluator Signature	Date
	Original screen signed 9/9/04	
Nuclear Facility Manager Print/Type Name	Nuclear Facility Manager Signature 10/6/04	Date

If the answer to ALL of the assessment questions above is No, file the completed form.

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, for PISA.
- USQ evaluator proceed to Section **III**.

II. DOCUMENT ACTIONS TAKEN TO PLACE OR MAINTAIN FACILITY IN A SAFE CONDITION

None.

There are no plans in the near future for depressurized operations. All procedures related to depressurized operation are suspended. So the scram setting for depresurized operation is not an issue.

The nominal procedural setting for the alarm function is 92' 10"; well above the lower drain elevation . The PPS surviellance and test system is set to alarm if the setting is found to be less than 92' 7". Thus the facility is in a safe condition provided these settings are not lowered to the limiting control setting. The procedure change control process is sufficient to ensure these settings are maintained during evaluation of this issue.

Additionally, the emergency firewater injection system (EFIS) vessel level actuation system provides an alternate to the PPS low vessel level subsystem. The potenital error in the elevation of the lower drain does not affect the EFIS vessel level actuation system since the reference leg for this system is not on the lower drain line. Thus the facility is in a safe condition provided these settings are not lowered to the limiting control setting.

III. DETERMINATION

Identify applicable section(s) of the safety basis document(s) (i.e., SAR, BIO, TSRs, OSRs).

Upgraded Final Safety Analysis Report for the Advanced Test Reactor, SAR-153, August 10, 2004, Section 15.6, Decrease in Primary Coolant System Inventory

Upgraded Final Safety Analysis Report for the Advanced Test Reactpr, SAR-153, August 10, 2004, Section 15.12, Severe Accident Analyses.

Upgraded Final Safety Analysis Report for the Advanced Test Reactor, SAR-153, August 10, 2004, Chapter 16, Derivation of Technical Safety Requirements

Technical Safety Requirements for the Advanced Test Reactor, TSR-186, August 10, 2004

TRA System Design Description for the ATR Plant Protection Systems, SDD 7.7.2, Revision 1, October 5, 2000

Additional items pertinent to the USQ determination:

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Subject: Reactor Shutdown System Reactor Vessel Level Limiting Control Setting

1. The RSS vessel level instrument channel is a differential pressure instrument that measures the height of a water column above the reactor vessel lower drain.
2. The RSS vessel level subsystem provides a scram function for depressurized operation and an engineered safety feature (ESF) alarm function for shutdown with irradiated fuel and emergency firewater injection system in manual.
3. There are some discrepancies in the relationship of the 0" level on the RSS vessel level instrument and the physical plant parameter of concern (water level in the reactor vessel above the core). The safety basis documents and facility drawings provide different physical plant elevations for the elevation of the reactor vessel lower drain (i.e., 0" level of the RSS vessel level instrument).
4. Based on the plant drawings, the physical elevation of the lower drain is 92' 4". The Technical Safety Requirements (TSR) and safety analysis report indicate this elevation is 92' 3". Some drawings in the safety analysis report show an elevation of 92' 0".
5. The RSS vessel level system instrumentation measures a small portion of the range of the parameter of concern. That is the instrument cannot register elevations below the elevation of the lower drain.
6. The safety analysis is based on the physical plant parameter not the scale of the instrument. The level of concern in the safety analysis is well below the level of the lower drain.
7. It appears the intent of the current safety basis was to specify the liming control setting (LCS) and ESF alarm setpoint at the elevation of the lower drain or 0 on the instrument.
8. There is no formal control to prevent the trip or ESF alarm setting from being equal to the TSR LCS or ESF alarm setpoint.
9. The current practice is to establish the trip setting as ≥ LCS + SATS ½ window + δ where δ ≥ 0. The SATS ½ window for this subsystem is 3".
10. The TSR would allow a trip setting = the LCS.
11. The current trip setpoint and Lo-Lo alarm setpoint for this instrument are 7" and the lower SATS setting is 4".
12. The precursor alarm is set much higher at 78".
13. The combination of the LCS and ESF alarm setpoint specified at the lower drain (0" on the instrument) and the current practice for establishing trip and alarm setpoints leaves the potential for a trip setting that cannot be reached. Under the current practice the trip setting could be as low as 3" while the channel's ability to measure 0" is ±5". Note the TSR would allow a trip setting equal to 0".

Observations based on the above

- The TSR does not establish an LCS and ESF alarm setpoint for the RSS vessel level that ensure the instrument settings will be within the operable range of the instrumentation.
- It may be better to derive the LCS and ESF alarm setpoint in terms of the range of the instrument noting that the 0 on the instrument is well above the level of concern for the safety analysis.
- The current setting of 7" is above the worst-case uncertainty for the instrument.

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 X No

Explain:
The safety basis does not specifically evaluate the consequences of the depressurized operation loss of coolant accident (LOCA) or the shutdown LOCA without mitigation to ensure the core fuel elements remain covered. The most significant function of the RSS vessel level subsystem is to alert operators that manual action must be taken to provide makeup water such that the core fuel elements remain covered. A depressurized or shutdown LOCA without mitigation would be considered a severe accident (i.e., beyond design basis).

The purpose of the TSR control is to provide assurance that the RSS vessel level is operable. The TSR control is

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Subject: Reactor Shutdown System Reactor Vessel Level Limiting Control Setting

selected to provide a high level of confidence. With an inadequate control, the probability of the event without mitigation could be increased.

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

The safety basis does not specifically evaluate the consequences of the depressurized operation loss of coolant accident or the shutdown loss of coolant accident without mitigation to ensure the core fuel elements remain covered. Such an event would be considered a severe accident (i.e., beyond design basis). The safety basis presents consequences representative of a severe accident in Section 15.12, Severe Accident Analyses. The consequences of the representative severe accident are not affected by the issue under evaluation.

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:

Based on the above observations, the TSR does not provide an adequate control to ensure the RSS vessel level subsystem is operable. The TSR does not require a diverse system for defense in depth. The probability of malfunction of the RSS vessel level subsystem is increased.

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 issue under evaluation, the setpoint for the RSS vessel level subsystem, relates to the functionality of the subsystem. The consequences of a malfunction of the subsyetm are not affected.

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:
There is no indication of an accident of a different type.

USQ PROCESS
POTENTIAL INADEQUACY IN THE SAFETY ANALYSIS (PISA) FORM
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Subject: Reactor Shutdown System Reactor Vessel Level Limiting Control Setting

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:
   There is no indication of a malfunction of a different type.

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:

   Margins of safety are defined in terms of the approach to consequence limits. The new information that the TSR control is not adequate to ensure operability of the RSS vessel level subsytem does not directly impact the margin of safety defined 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:

   The TSR does not provide an adequate control to ensure operability of the RSS vessel level subsystem. This results in the potential for an increase in the likelihood that the RSS vessel level subsystem could be inoperable and could fail to provide the mitigation function assumed in the safety basis. Therefore this detemination concludes there is an unreviewed safety question.

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

IV. APPROVAL/CONCURRENCE SIGNATURES

APPROVAL:

R. T. McCracken USQ Evaluator Print/Type Name	R. T. McCracken USQ Evaluator Signature	10-6-04 Date
D. W. Suthers Nuclear Facility Manager Print/Type Name	D. W. Suthers Nuclear Facility Manager Signature	10/6/04 Date

CONCURRENCE:

A. P. Hoskins Independent Review Committee Chair Print/Type Name	A. P. Hoskins Independent Review Committee Chair Signature	10/6/04 Date

The following pages are the original USQ screen signatures.

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Technical Safety Requirements for the Advanced Test Reactor, TSR-186, August 10, 2004

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

Provide an explanation of the assessment result:

The derivation of the limiting control setting for the PPS low vessel level is supported by potentially erroneous values for the lower range of the instrument (i.e., 92' 0" and 92' 3"). With a comparator setting of 92' 3" and the lower range of the instrument limited to 92' 4", the comparator setting cannot be reached and the protective function would not occur.

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Facility or Activity: Advanced Test Reactor (ATR)

USQ Process No.: TRA-USQ-2004-176

Subject: Reactor Shutdown System Reactor Vessel Level Limiting Control Setting

R. T. McCracken USQ Evaluator Print/Type Name	R. T. McCracken USQ Evaluator Signature	9-9-04 Date
D. W. Sutherland Nuclear Facility Manager Print/Type Name	Nuclear Facility Manager Signature	9/9/04 Date

If the answer to ALL of the assessment questions above is No, file the completed form.

If the answer to any one of the assessment questions is Yes, there is a potentially inadequate safety analysis (PISA):

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- Nuclear Facility Manager execute reporting process per MCP-190, for PISA.
- USQ evaluator proceed to Section **III**.

II. DOCUMENT ACTIONS TAKEN TO PLACE OR MAINTAIN FACILITY IN A SAFE CONDITION

None.

There are no plans in the near future for depressurized operations. All procedures related to depressurized operation are suspended. So the scram setting for depresurized operation is not an issue.

The nominal procedural setting for the alarm function is 92' 10"; well above the lower drain elevation . The PPS surviellance and test system is set to alarm if the setting is found to be less than 92' 7". Thus the facility is in a safe condition provided these settings are not lowered to the limiting control setting. The procedure change control process is sufficient to ensure these settings are maintained during evaluation of this issue.

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III. DETERMINATION

Identify applicable section(s) of the safety basis document(s) (i.e., SAR, BIO, TSRs, OSRs).

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:

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

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:

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

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:

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:

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:

USQ PROCESS
POTENTIAL INADEQUACY IN THE SAFETY ANALYSIS (PISA) FORM
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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:

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

IV. APPROVAL/CONCURRENCE SIGNATURES

APPROVAL:

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

CONCURRENCE:

Independent Review Committee Chair Print/Type Name	Independent Review Committee Chair Signature	Date