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.: RTC-USQ-2005-248

Subject: GAP-005-05 – Radiation Monitoring and Seal System Setpoint Derivation

Describe the New Information/Discovery:

The derivations of the analytical limit setpoint and response time requirements for the ATR radiation monitoring and seal system (RMSS) are not consistent with the system functional performance assumed in the radiological consequence analyses. The derivations are based on limits that are not consistent with the ATR plant protection criteria specified in the safety basis.

The basis for the analytical limit setpoint (TSR-186 LCO 3.2.2 Table 3.2.2-1) for the RMSS is stated in TRA-ATR-1022, Update of ATR RMS GM-34[1] Gamma Source/Shield Calculations: "setpoints should be set such that in the event of any accidental release of airborne radioactive material within the gas-tight area, an individual located on the nearest site boundary for a period of two hours would not contract a radiological dose in excess of those specified in 10 CFR 100."

The analysis in TRA-ATR-1022 starts with a 300-rem thyroid exposure at the nearest site boundary and back-calculates a radioactive material discharge rate and concentration for the ATR stack. The direct radiation field at the bottom of the stack is then calculated for this concentration of radioactive material. The RMSS detector is located at the bottom of the ATR stack. This direct radiation field (mR/hr) is the basis for the analytical limit setpoint (350 mR/hr) for the detector.

This basis is not consistent with the radiological consequence analyses presented in SAR-153 Sections 15.7, Radioactive Release from a Subsystem or Component, and 15.12, Severe Accident Analyses, for personnel located off of the Reactor Technology Complex (RTC) site. These analyses (TRA-ATR-1562, Radiological Analysis Supporting an ATR UFSAR Revision) assume the confinement seal function has occurred prior to the start of the release of the accident source term from the confinement building. The basis for the setpoint derivation would not require a trip until the discharge rate from the ATR stack reached a level that would challenge 10 CFR 100 limits.

The setpoint basis is also not consistent with criteria defined in Section 15.0.14, ATR Plant Protection Criteria, of SAR-153. These criteria have escalating limits on off-site exposure consequences for lower frequency accidents. 10 CFR 100 limits are specified for Condition 4 events but lower consequences are specified for Condition 2 and 3 accidents. The derivation of the setpoint only considers the Condition 4 protection criterion.

The basis for the response time requirement for the RMSS (TSR-186 LCO 3.2.2 Table 3.2.2-1) is also stated in TRA-ATR-1022: "With the greater percentage of TRA personnel located at about 400 meters, or greater, from the ATR stack, and setting the thyroid inhalation dose criteria at 30 rem (1/10 of the 300-rem limiting value ...), the time delay value for the ATR should be no greater than 3 minutes.

The exposure to RTC workers was calculated at various distances from the stack using the radioactive material discharge rate determined from the setpoint derivation. The result was a 30-rem thyroid exposure at 400 m for a 3-minute exposure time.

This basis is also not consistent with radiological consequence analyses presented in SAR-153 Section 15.7 and 15.12. These analyses (TRA-ATR-1562) assume the confinement seal function has occurred prior to the start of the release of the accident source term from the confinement building. The analyses also assume that RTC workers can avoid resident exposure because there are two separate evacuation staging areas and because plume

[1] Note that the calculations in TRA-ATR-1022 refer to the GM-34 detector. This is not the RMSS detector and was not the RMSS detector in 1995 when the analysis was performed. However, the three RMSS detectors are located in essentially the same position as the GM-34 detector so the analysis can be applied to the RMSS detectors.

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dispersion should be insufficient to contaminate both areas. The RTC worker exposures are limited to those received while traversing the plume at 100 m from the building on the way to a staging area.

The worker exposure limit of 30-rem thyroid used for the response time derivation does not correlate directly to the exposure limits for workers defined in the ATR plant protection criteria.

The radiological consequence results in TRA-ATR-1562 are scaled to present results of less severe accidents in both SAR-153 and experiment safety assurance packages. Thus RMSS functional performance assumed in the safety basis is that the confinement seal will occur prior to any accidental release of radioactive material. The setpoint derivation, on the other hand, is based on not tripping the confinement seal until there is an appreciable accident source term discharging from the stack.

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

ATR Technical Safety Requirements, Revision 9, April 7, 2005, TSR-186, LCO 3.2.2, Radiation Monitoring and Seal System, Table 3.2.2-1

ATR Upgraded Final Safety Analysis Report, Revision 16, April 7, 2005, Section 15.7, Radioactive Release from a Subsystem or Component

ATR Upgraded Final Safety Analysis Report, Revision 16, April 7, 2005, Section 15.12, Severe Accident Analyses

ATR Upgraded Final Safety Analysis Report, Revision 16, April 7, 2005, Section 15.0.14, ATR Plant Protection Criteria

ATR Upgraded Final Safety Analysis Report, Revision 16, April 7, 2005, Section 12.5.2.3.5.3, Airborne Effluent Monitoring Basis

Peterson, H. K., 1995, Update of ATR RMS GM-34 Gamma Source/Shield Calculations, EDF TRA-ATR-1022, LMITCO, February 28, 1995.

Knudson, D.L., 2000, Radiological Analysis Supporting an ATR UFSAR Revision, EDF-TRA-ATR-1562, May, 30, 2000.

Wagner, W. D., 1995, ATR Airborne Effluent Limits, EDF TRA-ATR-837, LMITCO, March 27, 1995

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

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Provide an explanation of the assessment result:

The derivation of the analytical limit setpoint and response time are not consistent with the methods used in the radiological consequence analyses presented in SAR-153 Section 15.7 and 15.12. The methodology used for the derivation of the setpoint could allow higher off-site doses than predicted by the radiological consequence analyses. Since these radiological consequence analyses are the basis upon which DOE approved operation of the ATR, the discrepancy represents a potentially inadequate safety analysis.

R. T. McCracken USQ Evaluator Print/Type Name	USQ Evaluator Signature	**5-4-05** Date
N.B. McDONOUGH Nuclear Facility Manager Print/Type Name	Nuclear Facility Manager Signature	5/4/05 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

ATR was operating at full power in Cycle 134B at the time of discovery. No immediate action was necessary.

Procedurally, the in-plant setting for the RMSS is required to be ≤45 mR/hr. The instrument uncertainty is required to be ≤35 mR/hr. Thus the maximum in-plant setting allowed by operating procedures is 80 mR/hr. The instrument reads about 1.5 to 2.5 mR/hr during normal operation when the stack discharge rate is 4 to 6 Ci/day of noble gases (primarily argon-41). In SAR-153 Chapter 12, Radiological Protection, annual off-site doses were calculated for each radioisotopic category (i.e., noble gases, iodines, and particulates) in typical ATR stack effluents. An exposure of 2.5 mrem/yr effective dose equivalent is reached with an average release of 450 Ci/day of noble gases or 24 Ci/day of iodine or 620 Ci/day of particulates for a receptor located at the nearest site boundary for 365 days per year (Wagner 1995). Thus the noble gas discharge would have to increase by a factor of 75 (450/6) before the limits for routine discharge would be exceeded. Noble gases are the first materials released during failure of fuel and discounting the presence of other materials is conservative. The instrument reading at this discharge rate (1.5 mR/hr x 75 = 112.5 mR/hr) point would clearly exceed the setpoint.

With the current in-plant setting, RMSS actuation and confinement isolation would occur prior to the stack discharge rate exceeding the limits for normal operation. Thus the in-plant setting is consistent with the system functional performance assumed in the radiological consequence analyses for accidental releases. The RMSS is operable and no additional interim controls are necessary. The facility is in a safe condition provided the RMSS setting is not raised above the current procedural value. The procedure change control process is sufficient to ensure this setting is maintained during evaluation of this issue.

~~III. DETERMINATION~~

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III. DETERMINATION

Identify applicable section(s) of the safety basis document(s) (i.e., SAR, BIO, TSRs, OSRs).
SAR-153, Chapters 15.12.10, 15.7, and 15.0.14.
TSR-186, 3/4 .8

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:
This PISA does not involve the probability of occurrence of an accident previously evaluated in the safety basis. Therefore, there has been no increase 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:
Several issues were raised in Section 1of this PISA concerning consequences. One issue was concerned that some radioactive material might be in the ventilation system before radiation detectors reached their set points to shut down the ventilation system. The material already in the system would then be released up the stack, not through the confinement. The concern was that this release might make the calculation presented in the ATR SAR non-conservative.

Having some release escape the confinement through the stack before confinement isolation is actually conservative. The reason stacks are used is that they allow better dispersion of pollutants than a ground level releases. The entire release from the ATR confinement was treated as ground level release. Therefore, any release up a stack would reduce the dose consequences due to better dispersion seen from the stack release. The only situation were this might not be case would be where a somewhat uncommon meteorological event occurred where a fumigation event occurred exactly where the TRA 670 evacuating employees walked through the rest of the plume from the ground level release. Due to the extremely low probability of this event occurring, it was not considered.

The other major concern was the derivation of the setting used to trigger confinement isolation. As described above the in-plant setting is suitably low that the setting will isolate at a setting that protects even the allowable normal operation levels. These levels are much less than any accident condition reported in the SAR. It is imperative that the in-plant setting not be changed without a safety assessment until the next annual SAR update is issued and the applicable TSR bases (3/4.8) is revised, to reflect this change. If the maximum allowed setting were used the interrelationship of that setting to the accident analysis is not well developed in the SAR. Since the interrelationship is not understood there is a possibility that the safety analysis in not bounding for the maximum allowable setting and the PISA could increase the consequences of an accident previously evaluated in the safety basis.

GLS 8/11/05

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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:

   This PISA did not address or was concerned with equipment malfunction. Therefore, the PISA does not increase the 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:
   This PISA did not address or was concerned with equipment malfunction. Therefore, the information in this PISA does 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 only possible accident of a different type discussed in the PISA was for the release of some amount of fission products up the stack before the ventilation system is isolated. Stacks releases allow better dispersion of pollutants than ground level releases. If some of the fission products were released up the stack before confinement isolation the doses reported in the SAR would actually be lower. The only situation where this might not be the case would be where a somewhat uncommon meteorological event occurred where a fumigation event occurred exactly where the TRA 670 evacuating employees walked through the rest of the plume from the ground level release. Due to the extremely low probability of this happening it was not considered in the analysis. GLS 8/11/05

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 malfunction of equipment was not an issue ~~addressed~~ identified in this PISA. Therefore, there is no possibility of a malfunction of equipment important to safety of a different type than previously evaluated in the safety basis. GLS 8/11/05

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:
   Until issues associated with the allowable setpoint of the Radiation Monitoring and Seal System are resolved the margin of safety defined in the safety basis might be affected. However, as long as the in plant setting does not change, the margin of safety identified in the in the UFSAR will remain the same. GLS 8/11/05

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:

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

MBA 8/17/05

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

IV. APPROVAL/CONCURRENCE SIGNATURES

APPROVAL:

GLS 8/11/05

Steve Wagoner	Steve Wagoner	8/10/05
USQ Evaluator Print/Type Name	USQ Evaluator Signature	Date
MARTIN B McDONOUGH	Martin B McDonough	8/11/05
Nuclear Facility Manager Print/Type Name	Nuclear Facility Manager Signature	Date

CONCURRENCE: (Routed to IRC for concurrence on 8/17/05)

Alan P Hoskins	Alan P Hoskins	8-17-05
Independent Review Committee Chair Print/Type Name	Independent Review Committee Chair Signature	Date