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Technical Evaluation Study

Evaluation of the Safety of the Situation for ATR RTC-USQ-2008-451

Idaho National Laboratory

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ACRONYMS

ATR Advanced Test Reactor

ATRC Advanced Test Reactor Critical Facility

BEA Battelle Energy Alliance, LLC

CTS cask transfer station

DOE Department of Energy

ESS evaluation of the safety of the situation

FDF fuel damage frequency

HSIS hydraulic shuttle irradiation system

PISA potential inadequacy in the safety analysis

SSC systems, structures, and/or components

TSR technical safety requirement

USQ unreviewed safety question

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1. INTRODUCTION

Revision 1 of the evaluation of the safety of the situation (ESS) proposes and provides the justification for additional revisions to the interim restrictions on canal operation imposed by the potential inadequacy in the safety analysis (PISA), RTC-USQ-2008-451, "Canal Bulkhead Seal Leakage with Air-Pillow Seal Deflated." Interim restrictions of this PISA were initially revised by TEV-284 (Revision 0)[1]. The PISA was reported by Occurrence Report NE-ID-BEA-ATR-2008-0011. TEV-284 (Revision 0), approved in September 2008, demonstrated that 1) the installation of a second isolation bulkhead, between the cask transfer station (CTS) and the irradiated fuel storage section of the Advanced Test Reactor (ATR) canal, supported restoration of cask handling at the CTS and 2) the installed bulkhead, between the Advanced Test Reactor Critical (ATRC) facility canal and the ATR canal, supported restoration of heavy-facility-load lifts in the ATRC bay. Revision 0 demonstrated that interim controls initially established by the PISA could be revised to allow cask handling at the CTS and heavy-facility-load lifts in the ATRC bay, with a second isolation bulkhead, without increased risk to the worker, public, or environment.

This revision of the ESS demonstrates that installation of an isolation bulkhead with dual, independent air-pillow seals supports restoration of cask and heavy-load handling in the ATR canal and that the interim controls can be revised to allow cask and heavy-load handling in the ATR canal without increased risk to the worker, public, or environment.

This ESS briefly discusses the concern that lead to the PISA declaration and the resultant unreviewed safety question (USQ). Next, the ESS provides the USQ resolution plan and status. Then, the ESS provides a justification for continued operation under the interim controls as initially revised by Revision 0 and for operation under the proposed additional revised interim controls. Finally, the ESS concludes that continued operation under the interim controls as initially revised by Revision 0 is within the safety basis and operation under the proposed revised interim controls (Revision 1) will also be within the safety basis. Therefore, the allowed cask and heavy-load lifts in the ATR canal pose no additional risk to the worker, public, or the environment.

2. ESS PURPOSE/OBJECTIVES

The purpose of Revision 1 to this ESS is to propose and justify additional revision of the interim operating controls imposed by PISA RTC-USQ-2008-451, as initially revised by Revision 0[1]. The intent of this revision is to replace TEV-284, Revision 0. The ESS is being revised to support the proposed additional interim controls while preserving the current approved interim controls. The specific objectives of this ESS are as follows:

- Provide background information on the bulkhead seals and the potential inadequacy
- Present the USQ resolution plan and the current status of the USQ resolution

- Provide the initial justification for continued operation, justification for operations under the revised interim controls, and the justification for operation under the proposed additional revision of the interim controls
- Present and incorporate the proposed additional interim controls in technical safety requirement (TSR) format
- Provide statements of the safety of the situation for continued operation under the interim controls that incorporate the proposed additional controls
- Provide the basis for revised interim controls for ATR canal operations, to be submitted for Department of Energy (DOE) approval.

3. BACKGROUND

Sections of the ATR canal may be isolated by installing full-height or short (half-height) bulkheads. The irradiated fuel storage section of the canal typically is isolated by two short bulkheads—one on the east side of the fuel storage section, the other on the west side (locations 2 and 7 on Figure 1). The bulkhead design includes an inflatable air-pillow seal with a passive J-seal/wedge seal. (Similar to Sections A-A and B-B on Figure 2 except only one air-pillow seal.) The accident analysis in the ATR Upgraded Final Safety Analysis Report postulates Conditions 3 and 4 initiating events that could result in draining the canal. Administrative controls ensure that the irradiated fuel is not exposed (i.e., draining the irradiated fuel storage area of the canal is beyond design basis for the initiating events). These controls restrict cask and heavy-load lifts, require isolation of the irradiated fuel storage section, and specify the configurations of the canal drain covers and the vessel drop chute. Combined with the capability of canal makeup to the irradiated fuel storage section, these controls ensure that exposure of irradiated fuel is beyond design basis for the initiating events.

In June 2008, a spare full-height canal bulkhead was installed in the storage canal west of the working canal to establish canal conditions necessary to support installation of hydraulic shuttle irradiation system (HSIS) components and an operating station in the west end of the ATR canal. The water west of the bulkhead was lowered about eight feet to allow access for project work. Once the necessary air-pillow seal inflation pressure was established, the bulkhead seal functioned as expected, allowing only minimal leakage. With the canal level lowered, the pressurized air-pillow seal subsequently failed. The resulting seal leakage, with only the passive J-seal/wedge seal, exceeded the leakage assumed in the safety basis analyses. The excessive seal leakage was due to weaknesses in the bulkhead design, the condition of the bulkhead seals, the installation of the bulkhead, or a combination of these factors.

A PISA was declared, interim restrictions on canal operations were imposed, and a USQ was determined to exist.

The interim controls stopped all handling of heavy-loads in the canal that, if dropped, had the potential to damage the canal to the extent that the isolation bulkheads would be required to limit leakage from the irradiated fuel storage section of the canal. ATR Programs proposed to revise the interim controls to allow cask handling at the CTS if a second isolation bulkhead, with the air-pillow seal pressurized, was installed between the irradiated fuel storage section and the CTS. Cask handling at the CTS supports transfer of loop experiments between the reactor and the working canal. ATR Programs also proposed to revise the interim controls to allow heavy-facility-load lifts in the ATRC bay if the ATRC bulkhead is installed with the air-pillow seal pressurized. Heavy-facility-load lifts in the ATRC bay facilitate inserting new experiments in the ATR by supporting the experiments insertion and physics measurement in the ATRC prior to irradiation in the ATR. These proposed changes were approved[1] and implemented.

Revision 1 proposes additional interim controls to support cask and heavy-load handling in the ATR storage canal. The new control is to require dual, independent, pressurized air-pillow seals (Sections A-A and B-B on Figure 2) on the isolation bulkhead between the fuel storage section and the ATR storage canal (location 2 on Figure 1). The new proposed control or the current interim controls, which require two isolation bulkheads with pressurized air-pillow seals, will provide the necessary preventative and mitigative provisions to ensure that draining the irradiated fuel storage section remains beyond design basis.

4. USQ RESOLUTION PLAN AND CURRENT STATUS

The resolution plan for RTC-USQ-2008-451 is presented and tracked by the Battelle Energy Alliance, LLC (BEA) issues management tracking system, ICARE, as DR 42922. The corrective actions were to: 1) perform a root cause analysis, 2) develop a corrective action plan based on the root cause analysis, and 3) perform a review of prior self-assessments to identify missed opportunities to identify this noncompliance. A separate ICARE, O 42923, tracks repair of the full-height bulkhead seal system for isolation of the irradiated fuel storage area from the CTS and long term replacement of the irradiated fuel isolation system. ICARE, O 43080, tracks the resolution of the recommendations presented in ECAR-343[2] for the installation of the second isolation bulkhead. ICARE, O 43461 tracks the resolution of the recommendations presented in ECAR-411[3] for the modification to add dual, independent air-pillow seals to the short (half-height) isolation bulkhead.

The current status of the USQ resolution plan, the bulkhead seal repair, and irradiated fuel storage isolation system replacement activities are available in BEA's ICARE system.

5. JUSTIFICATION FOR CONTINUED OPERATION AND FINAL OPERABILITY DETERMINATION

Justification for Continued Operation presents the justification for the facility operation a) under the interim controls initially imposed by PISA RTC-USQ-2008-451, b) under

the approved revised interim controls[1], and c) under the proposed additional controls. This revision incorporates the TSR format of the approved revised interim controls (Reference 1). For clarity, the proposed additional control is incorporated into the current approved control. The final operability discusses the final resolution of the USQ.

5.1 Justification for Continued Operation

5.1.1 Justification for Continued Operation Under Initial Interim Controls

All canal operations that could result in an event in which the isolation bulkheads are required to limit leakage from the irradiated fuel storage section have been stopped and are not permitted. By stopping all such operations, the canal drain event remains incredible, which is consistent with the safety basis analysis assumptions and with the level of risk accepted by the DOE. The initial PISA controls are:

> To ensure that facility operation remains within the safety basis analysis, no cask or heavy-load lifts with potential to cause a canal drain event are permitted. This includes heavy-load lifts in the canal area, at the canal transfer station, and the ATRC canal area (e.g., the security enhancement device). Lifts north of the canal, over the canal drains, are permitted with the canal drain covers installed.

5.1.2 Justification for Continued Operation Under Revised Interim Controls

Initial revision to the PISA interim controls was proposed (Revision 0) and approved[1]. The revision allows cask handling at the CTS. Installing an isolation bulkhead in the working section of the ATR canal, which is located between the irradiated fuel storage section and the CTS, isolates the irradiated fuel storage area from the CTS with two bulkheads, each with pressurized air-pillow seals. A surveillance to verify that this second bulkhead air-pillow seal is pressurized prior to cask handling at the CTS ensures that this seal system is functional. As demonstrated during the aforementioned HSIS project, with pressurized air-pillow seals, the bulkhead leakage was minimal. Installing the second isolation bulkhead and verifying that the air-pillow seal is pressurized provides the necessary redundancy to ensure that a canal drain event due to cask handling at the CTS remains incredible. Ensuring that a canal drain event remains incredible is consistent with the safety basis analysis assumptions and with the level of risk accepted by the DOE.

ECAR-343[2] documents the frequency of a canal drain accident from handling a cask at the CTS. The fuel damage frequency (FDF) from any cask handling operation was determined to be less than 1×10^{-7}/yr.

The probability of a cask drop combined with the failure of both bulkhead air-pillow seals would be on the order of 10^{-7}, which is beyond design basis and remains consistent with the safety basis analysis assumptions and with the level of risk accepted by the DOE.

The installed ATRC bulkhead isolates the irradiated fuel storage section from the ATRC canal with two bulkheads, each with pressurized air-pillow seals. A rapid canal drain event in the ATRC canal is treated as a Condition 3 occurrence (10^{-2} to 10^{-4}/yr), which is the same order of magnitude as the occurrence of a cask drop at the CTS. The ATRC full-height bulkhead seal, which also has been submerged in the canal, has been inflated and has not failed. Using similar arguments as used for the cask lifts at the CTS, the probability of a heavy-load drop in ATRC combined with the failure of both bulkhead air-pillow seals would be on the order of 10^{-7}, which is beyond design basis.

The revised PISA control was:

> To ensure that facility operation remains within the safety basis analysis, no cask or heavy-load lifts with potential to cause a canal drain event, with loss of coolant to the stored irradiated fuel, are permitted. This includes heavy-load lifts in the canal area and the ATRC canal area (e.g., the security enhancement device). With an isolation bulkhead installed between the canal transfer station and the short bulkhead on the west end of the irradiated fuel storage area, cask and heavy-load lifts are allowed at the cask transfer station. With the ATRC bulkhead installed, heavy-facility-load lifts are allowed in the ATRC. Air-pillow seal pressure shall be verified daily for the duration of the lift evolution. Lifts north of the canal, over the canal drains, are permitted with the canal drain covers installed. If air pressure is lost on the isolation bulkheads, cask and heavy-load lifts must cease.

5.1.3 Justification for Continued Operation Under Proposed Additional Controls

The observed leakage past the J-seal/wedge seal put into question the adequacy of J-seal/wedge seal of the isolation bulkhead for the irradiated fuel storage section and the adequacy of the emergency canal makeup system capacity. These two mitigative features, combined with cask and heavy-load handling restrictions[4], are relied upon in the ATR safety basis to ensure that draining the irradiated fuel storage section is beyond design basis. In other words, the FDF for any individual cask or heavy-load handling sequence is less than 10^{-7}/yr, and the FDF for all cask and heavy-load handling sequences is less than 10^{-6}/yr. The installation of a second isolation bulkhead with a pressurized air-pillow seal allows cask

and heavy-load handling at the CTS and in the ATRC bay; however, other cask and heavy-load canal operations are not allowed. Additional controls and restrictions are needed to allow cask and heavy-load handling in the ATR storage canal.

ECAR-411[3] analyzes and documents the frequency of a canal drain accident from handling casks during power operations in the ATR canal area. The FDF from all cask handling operation sequences was determined to be less than 1×10^{-6}/yr, which is beyond design basis. The FDF for any individual sequence was determined to be less than 1×10^{-7}/yr, which is consistent with the ATR safety basis commitment.

The documented analysis is for the west short bulkhead adjacent to the irradiated fuel storage section that is modified to have dual, independent air-pillow seals. Each seal is supplied with plant air through an existing isolation valve. This supply is split into two trains, each with the following components: isolation valve, pressure regulator and associated gauge, check valve, overpressure protection, pressure gauge, bleed valve, and air-pillow seal.

The probability of a cask drop combined with the failure of both air-pillow seals would be on the order of 10^{-7}, which is beyond design basis and remains consistent with the safety basis analysis assumptions and with the level of risk accepted by the DOE.

The analytical model, used in ECAR-411 to estimate the FDF, assumes the plant configuration for ATR power operations. The plant configuration, however, can be different during shutdown operations, e.g., Door-51 or the vessel drop chute may be open. Since any change in plant configuration would have a similar effect on either isolation bulkhead configuration, the difference in the FDF for irradiated fuel stored in the ATR canal between an installed isolation bulkhead with a) dual, independent air-pillow seals and b) a single air-pillow seal combined with a passive J-seal/wedge seal would be minimal. Although the ECAR-411 analytical model assumed power operations, the conclusions of ECAR-411 can be applied to shutdown operation.

A rapid draining event in the ATRC canal is described in Reference 2. The only difference is that the full-height bulkhead described is replaced with the dual, independent air-pillow seal half-height bulkhead. The rest of the arguments apply and conclude that the probability of a heavy-facility-load drop in the ATRC combined with the failure of both dual bulkhead seals would be on the order of 10^{-7}, which is beyond design basis.

Incorporated additional control and restrictions are:

- To ensure that facility operations remain within the safety basis analysis:
  - Heavy-facility-loads handling is allowed in the ATRC bay a) with two bulkheads with pressurized air seals isolating the irradiated fuel storage section of the ATR canal from the load handling; or b) with one bulkhead with dual, independent pressurized air seals isolating the irradiated fuel storage section and implementation of the following surveillances. The ATRC canal bulkhead can be used as one of the isolating bulkheads.
  - Cask and heavy-load handling is allowed at the CTS a) with two bulkheads with pressurized air seals isolating the irradiated fuel storage section; or b) with one bulkhead with dual, independent pressurized air seals isolating the irradiated fuel storage section and implementation of the following surveillances.
  - Cask and heavy-load handling is allowed in the ATR canal with one bulkhead with dual, independent pressurized air seals isolating the irradiated fuel storage section from the load handling area and implementation of the surveillances.
- Dual, independent pressurized seal bulkhead surveillances:
  - The following initial and periodic checks of seal performance shall be performed:
    - Upon installation, verify acceptable leakage into the gap between the dual seals on the isolation bulkhead.
    - At the beginning of lift operations and each 24 hours thereafter during lift operations, visually check for excessive leakage of air from each seal (e.g., bubbles and other abnormal conditions, such as the detection of excessive air flow).
    - At the beginning of lift operations and each 24 hours thereafter during lift operations, verify the inflation pressure

of each seal is within normal range using the pressure gauge installed for that purpose. This pressure shall be compared with the indicated pressure of the down-stream pressure regulator gauge for anomalous differences.

- All other seal manufacturer surveillance recommendations (inspections, shelf and service life, etc.) are to be implemented.

The additional controls and restrictions are incorporated into the following table in TSR format.

INCORPORATED ADDITIONAL TSR RESTRICTIONS:

NOTE

Casks and heavy-loads are defined as any load that if dropped from above the lift height limit has the potential to cause canal leakage that exceeds capacity of the emergency canal makeup to the irradiated fuel storage section.

Table 1 Cask Handling

#	AREA	CASK	LIFT HEIGHT LIMIT	REQUIREMENT	APPLICABILITY
(A)	ATRC	Any heavy-facility-load	None	**NOTE** **Installed ATRC canal bulkhead may be used as an isolating bulkhead.** IRRADIATED FUEL ELEMENTS in the ATR canal shall be isolated from heavy-facility-load handling by two canal bulkheads with pressurized seals. **OR** IRRADIATED FUEL ELEMENTS in the ATR canal shall be isolated from heavy-facility-load handling by a canal bulkhead with dual, independent pressurized seals.	During heavy-facility-load movement in the ATRC area with IRRADIATED FUEL ELEMENTS in the ATR canal.

#	AREA	CASK	LIFT HEIGHT LIMIT	REQUIREMENT	APPLICABILITY
(B)	Cask transfer station, adjacent concrete shielding covers above the nozzle trench, adjacent canal wall and the adjacent raised cantilevered section of the circular structural and shielding wall (101 ft elevation).	Per LCO 3.5.5	Per LCO 3.5.5	**NOTE** **Working canal bulkhead location is considered away from the cask transfer station.** IRRADIATED FUEL ELEMENTS in the canal shall be isolated from cask or heavy-load handling by two canal bulkheads with pressurized seals that are away from the cask transfer station. **OR** IRRADIATED FUEL ELEMENTS in the ATR canal shall be isolated from cask or heavy-load handling by a canal bulkhead with dual, independent pressurized seals that is away from the cask transfer station. **AND** Casks or heavy-loads shall not be handled over the working canal.	During cask or heavy-load movement with IRRADIATED FUEL ELEMENTS in the ATR canal.
(C)	Canal areas supported to bedrock.	Per LCO 3.5.5	Per LCO 3.5.5	IRRADIATED FUEL ELEMENTS in the ATR canal shall be isolated from cask or heavy-load handling by a canal bulkhead with dual, independent pressurized seals.	During cask or heavy-load movement with IRRADIATED FUEL ELEMENTS in the ATR canal.
(D)	Floor north of canal over canal drains.	Per LCO 3.5.5	Per LCO 3.5.5	IRRADIATED FUEL ELEMENTS in the canal shall be isolated from cask or heavy-load handling by an installed canal drain cover.	During cask or heavy-load movement with IRRADIATED FUEL ELEMENTS in the ATR canal.

ACTIONS:

CONDITION	REQUIRED ACTION	COMPLETION TIME
Loss of seal pressure to any bulkhead air-pillow seal that is providing isolation for the IRRADIATED FUEL ELEMENTS in the ATR canal from heavy-load-facility handling activities in the ATRC area (#A).	Place the load in a safe condition **AND** Cease heavy-facility-load handling.	IMMEDIATELY
Loss of seal pressure to any bulkhead air-pillow seal that is providing isolation for the IRRADIATED FUEL ELEMENTS in the ATR canal from cask or heavy-load handling at the cask transfer station, adjacent concrete shielding covers above the nozzle trench, adjacent canal wall and the adjacent raised cantilevered section of the circular structural and shielding wall (101 ft elevation) (#B).	Place the load in a safe condition **AND** Cease cask or heavy-load handling.	IMMEDIATELY
Loss of seal pressure to any bulkhead air-pillow seal that is providing isolation for the IRRADIATED FUEL ELEMENTS in the canal from cask or heavy-load handling (#C).	Place the load in a safe condition **AND** Cease cask or heavy-load handling.	IMMEDIATELY
Canal drain cover not installed in IRRADIATED FUEL ELEMENT storage area (#D).	Place the load in a safe condition **AND** Cease cask or heavy-load handling.	IMMEDIATELY

SURVEILLANCE REQUIREMENTS (ALL AREAS):

SURVEILLANCE REQUIREMENT	FREQUENCY
Verify acceptable leakage of second installed isolation bulkhead seal (single air seal).	Upon installation
Verify acceptable leakage into gap between dual seals on west short isolation bulkhead (dual air seals).	Upon installation
Verify that the inflation pressure of each bulkhead seal that provides isolation of the canal IRRADIATED FUEL ELEMENTS is within normal range using the pressure gauge installed for that purpose. This pressure shall be compared with the indicated pressure of the down-stream pressure regulator gauge for anomalous differences.	Prior to lift operations and daily per APPLICABILITY
Visually inspect for excessive leakage of air from each seal (e.g., bubbles and other abnormal conditions, such as the detection of excessive air flow).	Prior to lift operations and daily per APPLICABILITY

5.2 Final Operability Determination

PISA RTC-USQ-2008-451 involves a potential discrepant as-found condition of a system, structure or component (SSC) or nonconforming SSC. The design limit for leakage of a pressurized air-pillow seal was 5 gpm.[5] With the air-pillow seal deflated and the maximum credible degradation of the J-seal/wedge seal, the accident analyses assumed that the maximum leakage of the bulkhead seal system would be 30 gpm.[5] The design or condition of the seals or both, however, do not ensure seal leakage less than or equal to 30 gpm. ATR Programs intends to fully return the canal irradiated fuel storage isolation bulkhead seal system to the functionality assumed in the safety analyses. This may require a significant redesign of the bulkheads or design of an equivalent canal isolation system. The fundamental safety basis requirement is that the storage canal emergency makeup system is capable of supplying enough water to maintain the irradiated fuel storage submerge for at least 24 hours following a canal drain event. The resolution of RTC-USQ-2008-451 will restore this fundamental safety basis requirement.

6. CONCLUSIONS

The interim controls imposed by PISA RTC-USQ-2008-451 ensure that ATR operations can continue without increased risk to the worker, public, or environment. Also the ESS demonstrates that ATR can allow cask lifts at the CTS, cask lifts in the ATR storage canal, and heavy-facility-load lifts in the ATRC bay under the proposed revision to the interim controls without increasing the risk to the worker, public, or environment.

- The ATR safety basis evaluation concludes that the canal drain event, resulting in uncovering stored irradiated fuel, is incredible, i.e., beyond design basis. The initial PISA interim controls did not allow any activity that could potentially result in a canal drain event. This interim control ensures that the conclusion of the safety basis remains valid for the unknown condition of the short bulkhead seal systems that are used to isolate the canal irradiated fuel storage section. Stopping all cask and heavy-load handling in the canal ensured that the canal drain event remained incredible, which is consistent with the safety basis analyses and with the level of risk accepted by DOE.

- The current interim controls (Revision 0)[1] allow cask and heavy-load lifts at the CTS and heavy-facility-load lifts in the ATRC bay, which essentially presents the same risk of a canal drain event as described in the ATR documented safety analysis. In summary, the frequency of a cask drop at the CTS or of a heavy-facility-load drop in the ATRC that results in a canal drain event with the second isolation bulkhead installed in the ATR canal, either in the working canal or the ATRC bulkhead, is on the order of 10^{-7} per year, which is beyond design basis. Ensuring that a canal drain event remains incredible is consistent with the safety basis analysis assumptions and with the level of risk accepted by DOE.

- The proposed revision (Revision 1) to the interim controls to allow cask and heavy-load lifts at the CTS and in the ATR storage canal and to allow heavy-facility-load lifts in the ATRC bay present the same risk of a canal drain event as described in the ATR safety basis. In summary, the frequency of a cask drop at the CTS or ATR storage canal or of a heavy-facility-load drop in the ATRC that results in a canal drain event a) with the second isolation bulkhead installed in the ATR canal, either in the working canal or the ATRC bulkhead, or b) with one isolation bulkhead with dual, independent air-pillow seals is on the order of 10^{-7} per year. Ensuring that a canal drain event remains incredible is consistent with the safety basis analysis assumptions and with the level of risk accepted by DOE.

- This ESS provides the basis for the proposed revision of the interim controls imposed by PISA RTC-USQ-2008-451.

7. REFERENCES

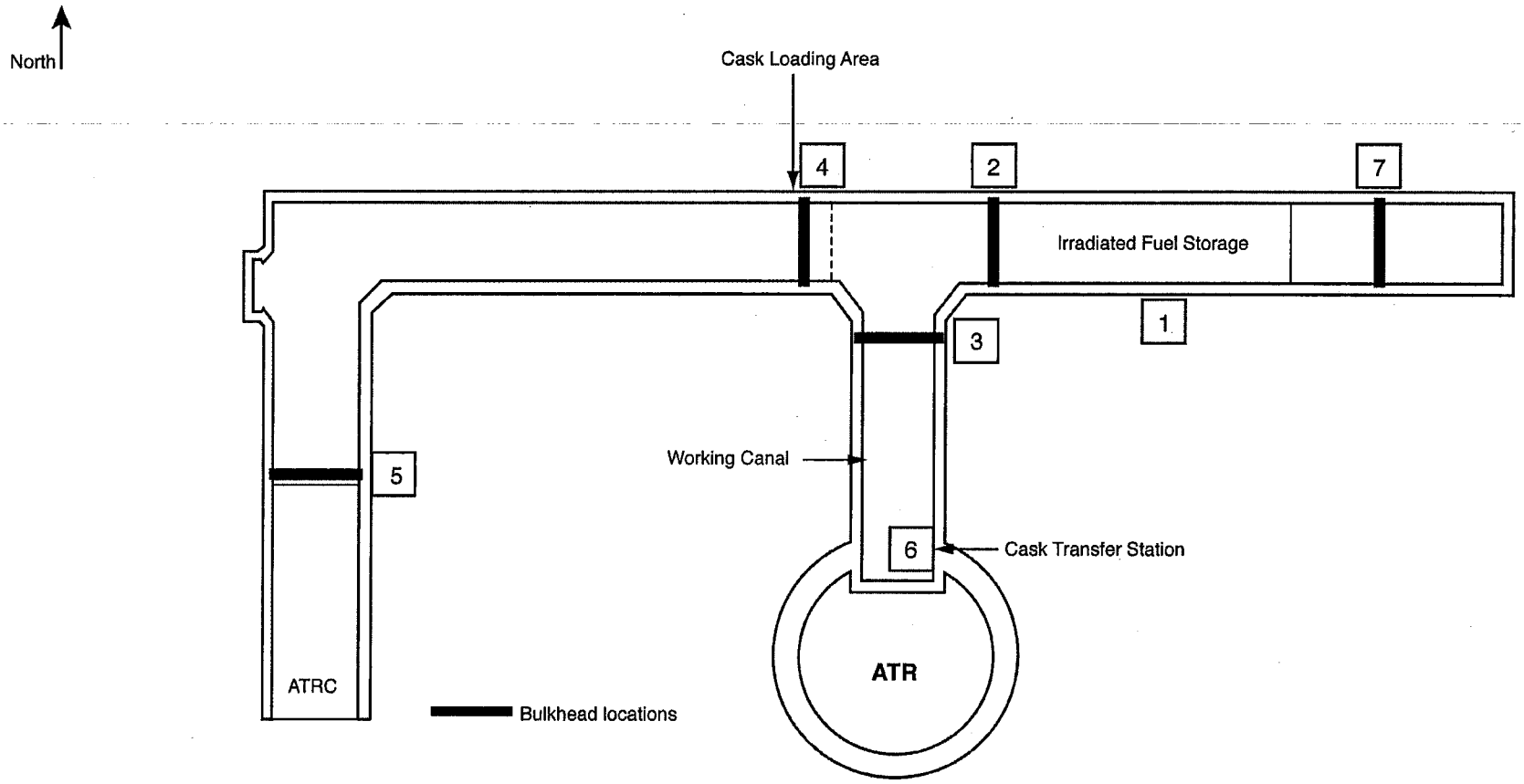
1. R. D. Boston (DOE-ID) letter to D. P. Johnson (BEA), September 12, 2008, Transmittal of the Approval of Revised Interim Controls Imposed by Potential Inadequacy in the Safety Analysis RTC-USQ-2008-451, "Canal Bulkhead Seal Leakage with Air-Pillow Seal Deflated," (IS-RTC-08-067).

2. ECAR-343, "Evaluation of Additional Bulkhead for Allowance of Heavy Load Handling Activities at ATR and ATRC Under RTC-USQ-2008-451," J. W. Nielsen, August 2008.

3. ECAR-411, "Evaluation of Load Handling Activities During Power Operations with West Short Bulkhead Double Seal Under RTC-USQ-2008-451," R. A. Yorg, October 2008.

4. SAR-153, "Upgraded Final Safety Analysis Report for the Advanced Test Reactor," Section 15.8, Fuel Storage Canal and Cask Handling Events.

5. S. A. Atkinson, "Leakage Analysis for ATR Canal Short Bulkhead J-Seal," EDF TRA-ATR-935, May 18, 2000.



1. Area of irradiated fuel storage (IFS)
2. Installed short (6 ft.) bulkhead (west IFS isolation bulkhead)
3. Placement of full-height bulkhead (work canal isolation bulkhead)
4. Location of temporary full-height bulkhead for HSIS
5. Installed full-height bulkhead (ATRC Canal)
6. Cask transfer station
7. Installed short bulkhead (east IFS isolation bulkhead)

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Figure 1. ATR Canal.

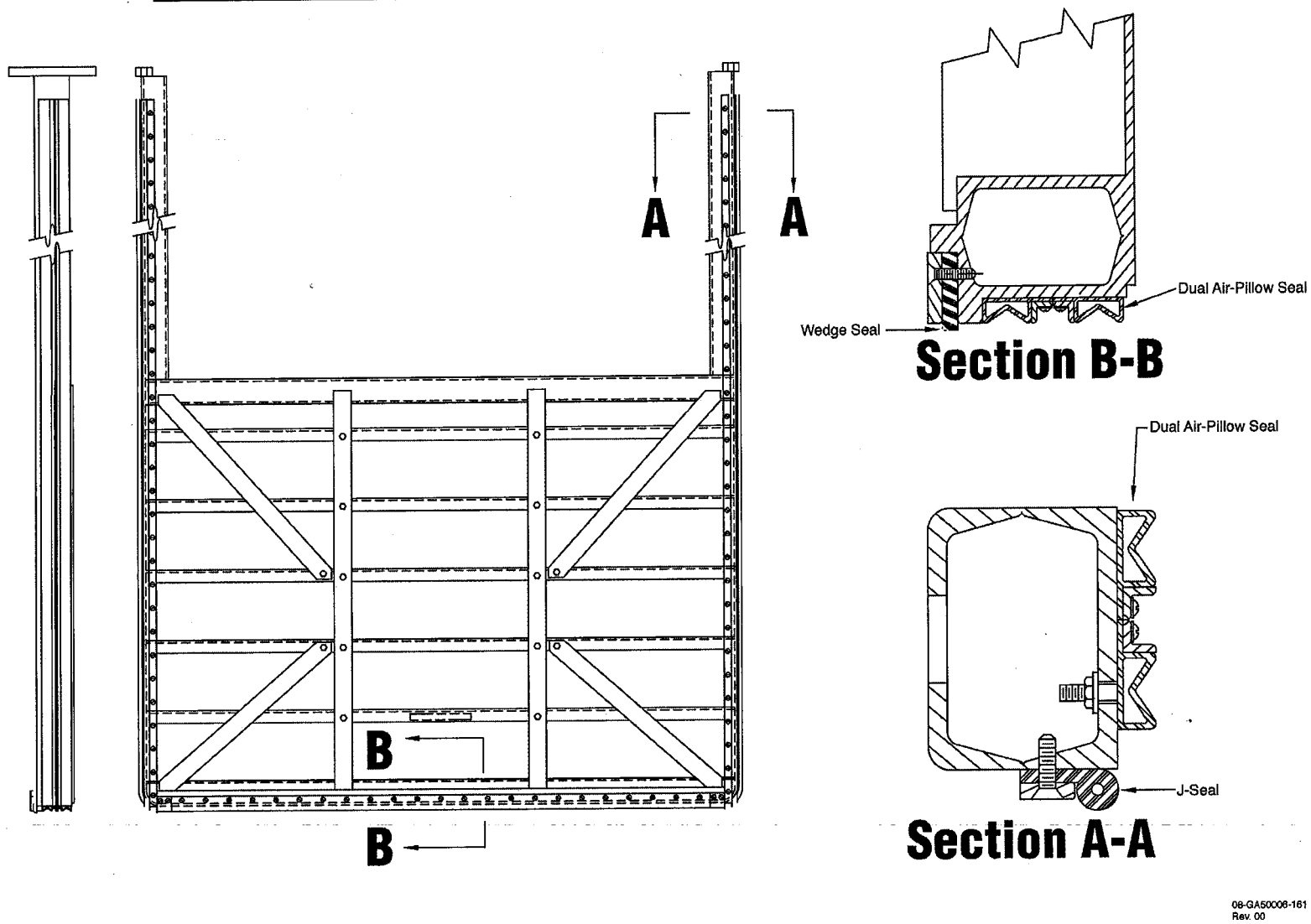

Figure 2. Half-height Isolation Bulkhead.