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

Facility or Activity: ATR Complex

USQ Process No.: ATR Complex-USQ-2010-644

Subject: Experiment Loop Bellows Material

Describe the New Information/Discovery:

The specification (ES-50513D) for the in-pile tube (IPT) bellows requires conformance to ASME B&PVC Sec III Div 1 design rules for Class 2 components. However, the bellows is fabricated from a material (precipitation hardened Inconel 718) which is prohibited by the ASME B&PVC for the flexible element of a bellows. ES-50513d is referenced in SAR-153, Chapter 10, but the SAR does not define whether this specification is intended to provide design requirements applicable to the bellows.

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"
PG-T-86-003, "Stress Report for the ATR High Temperature Loop Inpile Tube (50MW Lobe Power)"
ES-50513D, "ATR High Temperature Loop (AHTL) In-pile Tube Design Specification"
B-MT(EDT)F-563, "Request for Concurrence with Revised ATR Hardware Design Drawings"

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.

The following discussion focuses on the ATR High Temperature Loop (AHTL) IPT assembly as a bounding case with respect to temperature and pressure demands and applicability of the ASME B&PVC Section III Div 1. Similar reasoning also applies to the Large In-Pile Loop Tube (LIPT) bellows.

The AHTL, and LIPT loops have bellows assemblies which seal the insulating helium annulus between the pressure tube and the envelope tube outside the reactor pressure vessel. Due to differences in operating temperatures, the pressure tube experiences more thermal expansion than the envelope tube, and the bellows expands or contracts to accommodate this differential motion. The bellows does not provide the pressure boundary for either the primary coolant system or experiment loop coolant. In the high-pressure loops 1-C and 2-E, the helium pressure in the insulating gas annulus participates in the structural support of the pressure tube under design conditions

The design specification for the AHTL IPT (ES-50513D), which is referenced by SAR-153-10, requires the bellows to be constructed in accordance with ASME B&PVC Section III Div 1 subsection NC (Class 2), including specifically NC-3649.1. This subsection prohibits precipitation hardened material for the flexible element of a bellows assembly. Preciptiation hardened Inconel 718 has been used in the IPT bellows since about 1980. However, the SAR does not credit the entire IPT assembly with meeting the requirements stated in the specification. Specifically, the SAR requires that the IPT pressure tube and envelope tubes be designed, analyzed, and constructed in accordance with ASME B&PVC Section III Class 1, without the N-stamp (Section 10.2.1.1.1). The IPT bellows are not included in this requirement, presumably because they are located outside the reactor vessel and do not contain primary or experiment loop coolant.

For components which resist experiment containment pressures greater than 235 psig, such as the IPT bellows, the SAR requires either that the design meet the intent of ASME Section III Class 1, or that its ability to withstand service conditions without failure be demonstrated by prototype testing or other means (Section 10.1.7.3.2). Thus the SAR provides more design flexibility than the referenced specification for the bellows. Testing documented in the design evaluation of the Inconel 718 bellows (B-MT(EDT)F-563) demonstrates that the bellows will withstand service conditions, including temperature, pressure, and cyclical loading. Therefore the bellows material satisfies

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the design basis requirement attributed to it in the SAR.

S. R. Jensen / J. C. Chapman	JC Chapman	23 Aug 2010
USQ Evaluator Print/Type Name	USQ Evaluator Signature	Date
E. J. Schuebert	E J Schuebert	8/23/10
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.

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.

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 ☐