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

Facility or Activity: ATR

USQ Process No.: RTC-USQ-2008-622 Rev. 1

Subject: Essential Test Requirements for the Manual RSS Functional Test Procedure (Manual SATS)

Describe the New Information/Discovery:
The ATR documented safety analysis SAR-153 implies that the manual ATR Reactor Shutdown System (RSS) functional testing performed when the computerized Surveillance and Test System (auto SATS) of the RSS is inoperable is a complete functional equivalent of the auto SATS.

Identify the applicable safety basis document(s) (e. g., DSA, SAR, BIO, TSRs, etc.):
ATR Upgraded Final Safety Analysis Report (SAR-153) Chapter 7, ATR Technical Safety Requirements (TSR-186) Section 3/4

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.

Background

The RSS consists of 25 subsystems, each measuring a distinct parameter inside the reactor. Parameters include are reactor pressure (inlet, outlet, and differential), reactor temperature (inlet, outlet, and differential), coolant radioactivity, and neutron flux. Each parameter is required to be within a certain range for normal operation. For each parameter, three sensors measure the parameter's value. Each sensor's value is transmitted to an analog comparator. Each comparator checks to see that the parameter's analog value is within an acceptable range for normal operation. Each comparator then provides outputs to an array of subsystem and division logic modules. The Rod Clutch Coil Controllers (RCCCs) de-energize to release safety rods into the reactor when signaled by the logic modules.

Each subsystem of the RSS consists of all the sensors, transmitters, analog comparators, digital logic, and RCCCs necessary to cause a scram should one of the parameters reach the trip setpoint. The four division logic modules and eight RCCCs are common to all subsystems.

The auto SATS test provides real-time, online testing, surveillance, and fault diagnosis of the RSS. SATS verifies system

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calibration by interchannel comparison and verifies operability of the comparators, two-out-of-three logic modules, division logic modules, and the RCCC logic circuitry. The TSR-186 requires periodic surveillance of the RSS subsystems. The TSR Bases states that this surveillance requirement is performed by the SATS (auto SATS). If auto SATS is inoperable, manual measurements and testing (manual SATS) can provide the required information. The manual SATS verifies system calibration by interchannel comparison, verifies operability of the comparators by verifying setpoints and verifying that a manual trip of the comparator trips the input to the two-out-of-three logic modules, and that a trip of a two-out-of-three module will trip the division logic module.

The original Failure Modes and Effects Analysis (FMEA) of 1975 verified a RSS subsystem unavailability of less than 10^{-6}. Further, some subsystems are considered diverse to each other, and credit is given for this diversity. For example, outlet temperature is considered diverse to inlet temperature. For diverse systems, the original FMEA verified an unavailability of less than 10^{-9}.

The FMEA analyzed three possible SATS intervals-8 hours, 24 hours, and 48 hours-and concluded that only a 24-hour (or less) surveillance interval guaranteed satisfaction of the previously mentioned criteria. The FMEA made no distinction between safe and unsafe failures. When a scram component fails safe, it transmits a scram signal, when in fact no condition requiring a scram exists in the reactor. When a scram component fails unsafe, it will not transmit a scram signal when one is required. The TSR-186 currently requires a SATS testing interval of 48 hours (interval was increased to 48 hours due to the demonstrated reliability of the RSS). SATS testing is normally performed daily.

SAR-153 Section 7.2.2.11 *Capability for Test and Calibration* states that "The testing and surveillance of the RSS must meet the applicable requirements of NE [AEC Reactor Development and Technology (RDT)] Standard C 16-1T. The SATS is used to periodically check the RSS during reactor operation. These checks confirm system operability, monitor setpoint values, and verify system calibration by interchannel comparison. If SATS is inoperable, the function of SATS must be performed manually."

SAR-153 Section 7.7.4 *Surveillance and Test System* describes the SATS including tests performed by SATS. The description states that SATS "provides real-time, online testing, surveillance, and fault diagnosis of the PPS [ATR Plant Protective System] comparator or contact-to-logic level converter (CLLC) modules, two-out-of-three logic modules, division logic modules, the reactor mode selector switch position status, and the Rod Clutch Coil Controllers (RCCC) logic circuitry to ensure safe operation of the ATR." Auto SATS is an operator initiated surveillance tool and does not provide continuous on-line testing. SAR-153 further states that should the auto sequence become inoperable, manual checks of the PPS can be performed." The tests identified reflect the testing requirements of Standard C 16-1T.

Further SAR-153 Section 7.7.4 states "The [auto] SATS testing does not inhibit the ability of the PPS to respond to an event that requires reactor shutdown, nor does it contribute to the initiation of the reactor shutdown."

SAR-153 Section 7.7.4.1 *Analysis* states that "The SATS is not safety-related because its essential surveillance functions can be done manually."

Issue

The manual SATS procedure, DOP-2.7.25 *PPS Manual Checkout*, does not perform all the functions that the auto SATS performs nor does manual SATS perform all the tests identified in Standard C 16-1T, as implied in SAR-153.

Evaluation

Although SAR-153 implies the manual SATS must have the same functionality as the auto SATS, the manual SATS procedure was not developed as a complete substitute for the auto SATS; rather, the procedures was written only to provide an acceptable level of surveillance. The RSS predates the upgrade of the ATR SAR. The RSS including the auto SATS was installed in the mid-1970's, while the upgrade of the ATR Safety Analysis Report was started in the late 1980's. The manual SATS procedure was developed by a team that included the Vendor, ATR Operations, ATR Engineering, and ATR Nuclear Engineering. The procedure was developed to perform the essential surveillances to ensure operability and reliability of the RSS.[1] Documentation of the development of the procedure, which may have discussed the teams approach and justification of not fully implementing Standard C 16-1T, however, have not been found.

The descriptions of the auto SATS in SAR-153 implied additional functionality of the manual RSS testing that did not exist at the time SAR-153 was written and that currently do not exist. SAR-153 fails to adequately identify what essential RSS testing

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consists of.

End Note
1. Based on a personal conversation with Mr. J. A. Jacobi who was in ATR Operations at the time when the RSS was installed and when manual testing procedure was developed.

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.

Initial Operability Determination

The RSS uses two diverse subsystems for each parameter e.g., inlet primary coolant system (PCS) pressure and outlet PCS pressure to protect the plant from high and low pressure events. The only exception is the short period scram protection at startup, which is provided by the wide-range system. The wide-range neutron level is confirmed operable prior to each startup. Based on a preliminary review of the Vendor's (Nuclear Service Corporation) final design availability and reliability calculations for the PPS system upgrade, ATR Programs considers the probability of failure for the primary and diverse RSS subsystem is on the order of 10^{-12} for a 48-hour test interval or lower. This implies that the test interval could be extended by factor of a 1000 and the RSS would continue to meet an unavailability of 10^{-9} for diverse subsystems. Since the auto SATS was last used to perform the RSS functional test less than a year ago (a factor of 48 hr/ [366 days * 24 hr/day] = 1/183), the unavailability of the diverse subsystem of the RSS is on the order of 10^{-10}, which meets the reliability goal of the RSS. No evidence of RSS subsystem inoperability has been observed during the 10 months that manual SATS has been in use.

Based the high reliability and the success of the manual SATS, No immediate actions are necessary to place the plant in safe condition; further, no interim controls are necessary for continued operations.

J. C. Chapman	ORIGINAL SIGNED 26 AUGUST 2008	
Safety Analyst Print/Type Name	Safety Analyst Signature	Date
M. B. McDonough	ORIGINAL SIGNED 27 AUGUST 2008	
Nuclear Facility Manager Print/Type Name	Nuclear Facility Manager Signature	Date

Is independent technical review required? Yes ☐ No ☐

Nuclear Facility Manager Signature or Initials

J. A. Jacobi	ORIGINAL SIGNED 27 AUGUST 2008	
Independent Reviewer Print/Type Name	Independent Reviewer Signature	Date

III. USQ DETERMINATION

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Identify applicable section(s) of the safety basis document(s) (e.g., DSA, SAR, BIO, TSRs, etc.).

SAR-153 Sections 3.1.3.2.1, 3.1.3.3.1, 3.1.3.5.1, 3.1.3.10.1, 3A, 6.2.4, 7.2.1.1.3.5, 7.2.1.1.3.6, 7.2.1.1.3.7, 7.2.2.10, 7.2.211, 7.3.1.3.2.2, 7.3.2.1.3, 7.3.2.3.1.5, 7.3.2.3.1.7, 7.3.2.3.1.8, 7.3.3.2.1.5, 7.3.3.2.1.7, 7.3.3.2.1.11, 7.7.4, 7.7.4.1, 9.5.1.2.2, 9.5.1.3.17, 9.5.1.3.18

TSR-186 Surveillance Requirements (SRs) 4.1.1.11,(12), 4.2.1.3.5, 4.2.1.3.6; SR Bases 4.1.1.1, 4.1.1.7, 4.1.1.11, 4.2.1.1.4, 4.2.1.3.5, 4.2.1.3.6, 4.2.2.1, 4.2.3.1.1, 4.2.3.2.1, 4.2.3.3.1

Advanced Test Reactor Safety Evaluation Report (SER) ATR UFSAR/TSR Review Comments, February 1996.

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:
Auto SATS is used to test the functionality of the Reactor Shutdown System (RSS), which is relied upon to terminate reactor critical operations for most postulated accident sequences. SATS also tests the two-out-of-three logic modules of the Engineered Safety Features (ESFs), which are relied upon to mitigate the consequences of certain postulated accident sequences. The safety basis states that [auto] SATS is used to perform the periodic function tests on the RSS and on the ESF logic modules. The safety basis also states that when [auto] SATS is not available, the required information may be obtained by performing manual SATS testing. The safety basis implies that performing manual SATS is an adequate substitute for the auto SATS testing.

The accident analyses consider the following Condition 2 family of accident scenarios: a) Decrease in Reactor Primary Coolant Flow Rate, b) Reactivity and Power Distribution Anomalies, c) Increase in Primary Coolant Inventory, and d) Decrease in Primary Coolant Inventory. With the concurrent failure of the primary RSS protective function, these scenarios are considered Condition 4 events. The safety analyses also consider one of the Condition 2 Decrease in Primary Coolant family of accident scenarios with concurrent failure of an ESF function. This scenario is considered a Condition 3 event.

The safety basis assumes that the RSS and the ESFs are highly reliable and that manual SATS provides the required information to verify the functionality of the RSS and the ESF logic modules. The PISA, which states that the safety basis implies greater capability of the manual SATS procedure than actually exists. The PISA does not imply that manual SATS is inadequate only that the description in the safety basis was inaccurate.

DOE guidance, DOE G 424.1-1A, *Implementation Guide for use in Addressing Unreviewed Safety Question Requirements*, suggests using a "backward looking" USQD when an "as-found" condition is different than described in the safety analysis. In this case, the manual SATS does not and can not perform all the testing that auto SATS performs. The backward looking USQD question is then if this were a proposed change would this change increase the probability of occurrence of an accident previously evaluated in the safety basis? However, without a safety analysis of the proposed change this question can not be answered. Therefore, it is assumed that this change would increase the probability of occurrence of an accident previously evaluated.

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

Explain:
The backward looking USQD question is would the proposed change increase the consequence of an accident previously evaluated in the safety basis? The PISA, which is that the safety basis implies additional functionality of manual SATS procedure than actually exists, does not imply that manual SATS is inadequate only that the description in the safety basis was inadequate. However, without a safety analysis of the proposed change this question can not be answered. Therefore, it is assumed that this change would increase the consequence of an accident.

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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:
   The backward looking USQD question is would the proposed change increase the probability of occurrence of a malfunction of equipment important to safety previously evaluated in the safety basis? The PISA, which is that the safety basis implies additional functionality of manual SATS procedure than actually exists, does not imply that manual SATS is inadequate only that the description in the safety basis was inadequate. However, without a safety analysis of the proposed change this question can not be answered. Therefore, it is assumed that this change would increase the probability of occurrence of a malfunction of equipment important to safety.

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 backward looking USQD question is would the proposed change increase the consequence of a malfunction of equipment important to safety previously evaluated in the safety basis? The PISA, which is that the safety basis implies additional functionality of manual SATS procedure than actually exists, does not imply that manual SATS is inadequate only that the description in the safety basis was inadequate. However, without a safety analysis of the proposed change this question can not be answered. Therefore, it is assumed that this change would increase the consequence of a malfunction of equipment important to safety.

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 backward looking USQD question is could the proposed change create the possibility of an accident of a different type than previously evaluated in the safety basis? The PISA, which is that the safety basis implies additional functionality of manual SATS procedure than actually exists, does not imply that manual SATS is inadequate only that the description in the safety basis was inadequate. The safety basis postulates three accident sequences in which the failure of the primary RSS and one accident sequence in which the failure of the ESF are contributing factors. However, without a safety analysis of the proposed change this question can not be answered. Therefore, it is assumed that this change could create the possibility of an accident of a different type.

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 backward looking USQD question is could the proposed change create the possibility of a malfunction of equipment important to safety of a different type than previously evaluated in the safety basis? The PISA, which is that the safety basis implies additional functionality of manual SATS procedure than actually exists, does not imply that manual SATS is inadequate only that the description in the safety basis was inadequate. However, without a safety analysis of the proposed change this question can not be answered. Therefore, it is assumed that this change could create the possibility of a malfunction of equipment important to safety of a different type.

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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 backward looking USQD question is could the proposed change reduce the margin of safety as defined in the safety basis? The PISA, which is that the safety basis implies additional functionality of manual SATS procedure than actually exists, does not imply that manual SATS is inadequate only that the description in the safety basis was inadequate. However, without a safety analysis of the proposed change this question can not be answered. Therefore, it is assumed that this change could reduce the margin of safety.

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 PISA is addressed as a backward looking USQD. The backward looking proposed change is to define the required elements of the RSS and ESF logic functional testing to be consistent with the existing manual SATS procedure. This USQD requires a safety analysis of the proposed change. Since a safety analysis of the proposed changes does not currently exist, nor will a safety analysis be completed within the time frame expectation of DOE for USQDs following PISA declarations, the inconsistency between the testing of the manual SATS as it actually exists and the testing that is implied in safety basis is assumed to involve a USQ.

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	J C Chapman USQ Evaluator Signature	10 Sept 2008 Date
M. B. McDonough Nuclear Facility Manager Print/Type Name	M. B. McDonough Nuclear Facility Manager Signature	10 SEP 2008 Date

CONCURRENCE:

J. A. Jacobi Independent Review Committee Chair Print/Type Name	Jack A. Jacobi Independent Review Committee Chair Signature	11 SEPT 2008 Date