#11

Entered By:	L. Kinghorn
Date Entered:	12 December 2009
Site:	ATR Complex
Responsible Organization:	ATR Programs Nuclear Engineering
Title:	Incorrect Input to Core Performance Calculation Caused Manual Reactor Shutdown
Discussion of Event/Condition:	**Summary:** At 1100 on 1 December 2009, ATR Programs Engineering informed ATR Operations Management that they had found an error in the Core Safety Assurance Package (CSAP) for Cycle 145B-1. The error was discovered while evaluating reactor core performance data and was determined to be due to an incorrect cross-section calculation for the Reduced Enrichment for Research and Test Reactor (RERTR) ATR Full-Size Plate in Center Position (AFIP) backup test. **Action Taken:** Management was informed. Engineering judgment was that all core safety limits were met, however, there was no analysis to support this judgment and compliance with the ATR Technical Safety Requirements , Limiting Condition for Operation 3.6.1 required a reactor shutdown. The reactor was manually shut down at 1201. A critique will be held on 2 December 2009.
Safety Significance:	The error discovered prompted reactor shutdown in accordance with TSR-186, LCO-3.6.1. The reactor will remain in a safe shutdown condition until the error is corrected and calculations are re-performed.
Reportability:	*Classified at 13:21 12/02/09 as:* Group 3 – Nuclear Safety Basis Subgroup A – Technical Safety Requirement Violations Sequence Number (2) Any violation or noncompliance of a Hazard Category 1, 2, or 3 nuclear facility's TSR (or OSR) Limiting Control Setting, Limiting Condition for Operation, Administrative Control, or Surveillance Requirement. Significance Category 2.

#11

NE-ID--BEA-ATR-2009-0025

FINAL
Rev. 1

Occurrence Report
After 2003 Redesign

Advanced Test Reactor

(Name of Facility)

Category "A" Reactors

(Facility Function)

Idaho National Laboratory — Battelle Energy Alliance, LLC

(Site) (Contractor)

Name: SCHUEBERT, EDMOND J
Title: ATR Operations Facility Manager **Telephone No.:** (208) 533-4246

(Facility Manager/Designee)

Name: OWENS, MARJORIE A
Title: ATR OPERATIONS FACILITY ADMINISTRATI **Telephone No.:** (208) 533-4563

(Originator/Transmitter)

Name: C. P. Forshee **Date:** 06/03/2010

(Authorized Classifier (AC))

1. Occurrence Report Number: NE-ID--BEA-ATR-2009-0025

Incorrect Input to Core Performance Calculation Caused Manual Reactor Shutdown of the Advanced Test Reactor

2. Report Type and Date: FINAL

	Date	Time
Notification:	12/02/2009	19:20 (ETZ)
Initial Update:	01/14/2010	16:05 (ETZ)
Latest Update:	04/07/2010	17:43 (ETZ)
Final:	04/07/2010	18:04 (ETZ)
Revision 1:	06/03/2010	16:37 (ETZ)

3. Significance Category: 2

4. Division or Project: ATR Programs

5. Secretarial Office: NE - Nuclear Energy, Science and Technology

6. System, Bldg., or Equipment: Advanced Test Reactor

7. UCNI?: No

8. Plant Area: ATR

9. Date and Time Discovered: 12/01/2009 12:01 (MTZ)

10. Date and Time Categorized: 12/01/2009 13:25 (MTZ)

11. DOE HQ OC Notification:

Date	Time	Person Notified	Organization
NA	NA	NA	NA

12. Other Notifications:

Date	Time	Person Notified	Organization
12/01/2009	13:25 (MTZ)	R. Denning	DOE-ID

13. Subject or Title of Occurrence:

Incorrect Input to Core Performance Calculation Caused Manual Reactor Shutdown of the Advanced Test Reactor

14. Reporting Criteria:

3A(2) - Any violation or noncompliance of a Hazard Category 1, 2, or 3 nuclear facility's Technical Safety Requirement (or Operational Safety Requirement) Limiting Control Setting, Limiting Condition for Operation, Administrative Control, or Surveillance Requirement.

Exception: An event consisting solely of a surveillance test performed after the prescribed surveillance period, and in which the equipment was found to be capable of performing its specified safety function. (See separate criterion for late surveillance tests below).

15. Description of Occurrence:

At 1100 on 1 December 2009, ATR Programs Engineering informed ATR Operations Management that they had found an error in the Core Safety Assurance Package (CSAP) for Cycle 145B-1. The error was discovered while evaluating reactor core performance data and was determined to be due to an incorrect cross-section calculation for the Reduced Enrichment for Research and Test Reactor (RERTR) ATR

Full-Size Plate in Center Position (AFIP) backup test.

ATR Programs Engineering judgment was that all core safety limits were met; however, there was no analysis to support this judgment and compliance with the ATR Technical Safety Requirements (TSR)-186, Limiting Condition for Operation (LCO)-3.6.1 required a reactor shutdown. The reactor will remain in a safe shutdown condition until the error is corrected and calculations are re-performed.

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16. Is Subcontractor Involved? No

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17. Operating Conditions of Facility at Time of Occurrence:

The ATR was operating at nominal full power for Cycle 145B-1

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18. Activity Category:

03 - Normal Operations (other than Activities specifically listed in this Category)

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19. Immediate Actions Taken and Results:

Appropriate levels of BEA management and DOE-ID were notified of this event.

The reactor was manually shut down at 1201 on December 1, 2009, in accordance with TSR-186, LCO-3.6.1.

A critique was scheduled for December 2, 2009, at 1600.

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20. ISM:

6) N/A (Not applicable to ISM Core Functions as determined by management review.)

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21. Cause Code(s):

A3B2C01 - Human Performance Less Than Adequate (LTA); Rule Based Error; Strong rule incorrectly chosen over other rules
-->couplet - A5B2C08 - Communications Less Than Adequate (LTA); Written Communication Content LTA; Incomplete / situation not covered
A4B1C04 - Management Problem; Management Methods Less Than Adequate (LTA); Management follow-up or monitoring of activities did not identify problems

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22. Description of Cause:

A Formal Cause Analysis was performed in accordance with Laboratory-Wide Procedure (LWP)-13845, Cause Analysis Program, with the following causes identified:

A3B2C01 - Strong rule incorrectly chosen over other rules. Engineer 1 delayed verification of AFIP BU-2 cross-sections file. The delay was not tracked and resulted in not completing the verification in accordance with the laboratory process LWP-10200-3 prior to use. In the past, the engineer has been successful in verification of the files due to the verification occurring soon after development. In this case, the cross-section file was not going to be used in the near future and he decided not to perform the verification immediately. When it came time to use the file, two years later, the engineer did not remember nor did he take positive measures to ensure the file used had been verified. (See corrective action #1) This cause is coupled with the following cause:

A5B2C08 - Incomplete/situation not covered. SP-10.6.2.3 does not contain the details necessary to provide the rigor in the development of the cross-section files that would ensure that configuration control is in place to ensure non-verified cross-section files are not used during the physics calculations. (See corrective action #2)

A4B1C04 - Management follow-up or monitoring of activities did not identify problem. In March 2003, a Formal Cause Analysis was performed due to a CSAP preparation error event. The identified corrective actions were completed. In December 2006 to February 2007, assessment (IAS061157) was performed to assess the CSAP process and resulted in several corrective actions and recommendations to add rigor to the CSAP process. The corrective actions and recommendations completed significantly improved the process and corrected the specific problems that were occurring at the time, including achieving a successful transition of the Management Control Procedure (MCP) for calculation and analysis to the new LWP and implementing a new Quality Level Determination process. The remaining recommendations were to continue improving the CSAP process, because not all aspects of the process had been revised. Nuclear engineering management has not forgotten the need to continue improving the rest of the process, but it has not been a priority that rated higher than other initiatives and requirements for the available resources. A method for monitoring the success of the performance improvement initiatives for the CSAP process has not been established to assist in ensuring the improvement initiative is completed. (See corrective action #3)

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23. Evaluation (by Facility Manager/Designee):

This occurrence report has been determined to be NTS reportable and will require a Formal Cause Analysis. Due to the time involved to perform a formal analysis, the final occurrence report will not be submitted within the normal 45 days, but will be submitted no later than March 16, 2010. DOE Facility Representative concurs.

Technical Evaluation (TEV)-765, which supports Engineering's judgment that all safety limits were met, has been drafted and is currently going through the approval process.

While this event did not have safety significance, it did have the potential for significance, had the error involved a higher magnitude of impact to the analysis calculations. It highlights the importance to have established processes for engineering tasks, especially those on a recurring basis, and for the application of human performance tools for such tasks.

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24. Is Further Evaluation Required?: No

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25. Corrective Actions

Local Tracking System Name: ICAMS

1. Schedule and complete TGTRA612, Human Performance Fundamentals for engineers for all ATR Programs nuclear engineering department personnel.

Target Completion Date: 05/27/2010	**Tracking ID:** ICARE DR 45432, Action 47231

2. Revise SP-10.6.2.3 or create a new procedure to require verification that cross-section files have been independently verified and validated prior to use and provide a method for configuration control of cross-section files stored to prevent use prior to verification.

Target Completion Date: 08/26/2010	**Tracking ID:** ICARE DR 45432, Action 47232

3. Benchmark the ATR CSAP process against commercial industry standards. Benchmarking should include a review against INPO standards such as SOER 96-2 and one or two commercial plant procedures.

Target Completion Date: 06/15/2010	**Tracking ID:** ICARE DR 45432, Action 47465

4. Complete a process map of the CSAP process identifying major steps.

Target Completion Date: 08/12/2010	**Tracking ID:** ICARE DR 45432, Action 47466

5. Based on process mapping and benchmarking, develop a CSAP guidance procedure.

Target Completion Date: 11/15/2010	**Tracking ID:** ICARE DR 45432, Action 47467

6. Develop a core physics procedure based on process mapping and benchmarking.

Target Completion Date: 01/13/2011	**Tracking ID:** ICARE DR 45432, Action 47468

7. Identify changes necessary to subtier procedures (GDE) and establish a schedule to change the procedures if necessary.

Target Completion Date: 01/13/2011	**Tracking ID:** ICARE DR 45432, Action 47469

8. Develop an implementation plan that includes resource requirements and due dates for completion of recommendations to further improve the CSAP process. As part of the plan, include an independent verification that procedures are followed, documented, and inputs are independently verified for the CSAP process.

Target Completion Date: 07/01/2010	**Tracking ID:** ICARE DR 45432, Action 47233

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26. Lessons Learned:

Established engineering processes and application of human performance fundamentals are essential to detect errors before they have consequence.

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27. Similar Occurrence Report Numbers:

NE-ID--BBWI-ATR-2003-0002

28. User-defined Field #1:

GB10

29. User-defined Field #2:

30. HQ Keyword(s):

01A--Inadequate Conduct of Operations - Inadequate Conduct of Operations (miscellaneous)
01B--Inadequate Conduct of Operations - Loss of Configuration Management/Control
01G--Inadequate Conduct of Operations - Inadequate Procedure
01H--Inadequate Conduct of Operations - Inadequate Safety Analysis/USQs
01Q--Inadequate Conduct of Operations - Personnel error
01R--Inadequate Conduct of Operations - Management issues
12A--EH Categories - Authorization Basis
14D--Quality Assurance - Documents and Records Deficiency
14E--Quality Assurance - Work Process Deficiency
14H--Quality Assurance - Inspection and Acceptance Testing Deficiency

31. HQ Summary:

On December 1, 2009, ATR Programs Engineering informed ATR Operations Management that they had found an error in the Core Safety Assurance Package for Cycle 145B-1. The error was discovered while evaluating reactor core performance data and was determined to be due to an incorrect cross-section calculation for the Reduced Enrichment for Research and Test Reactor ATR Full-Size Plate in Center Position backup test. The ATR Programs Engineering judgment was that all core safety limits were met; however, there was no analysis to support this judgment. Compliance with the ATR Technical Safety Requirements (TSR)-186, Limiting Condition for Operation (LCO)-3.6.1 required a reactor shutdown. The reactor will remain in a safe shutdown condition until the error is corrected and calculations are re-performed. A critique was scheduled.

32. DOE Facility Representative Input:

33. DOE Program Manager Input:

34. Approvals:

Approved by: SCHUEBERT, EDMOND J, Facility Manager/Designee
Date: 04/07/2010
Telephone No.: (208) 533-4246

Approved by: DENNING, RICHARD W, Facility Representative/Designee
Date: 04/07/2010
Telephone No.: (208) 526-5015

~~232.10~~ #11
12/21/2006
Rev. 02
Use with LWP-9302

CRITIQUE REPORT

ATR-CR-12-01-09

For EHES-related events: Transmit the approved critique report to the DOE-ID Facility Representative as soon as possible, but within 8 hours following the critique.	
Facility/Area:	ATR Complex
Critique Title:	Incorrect Input To Core Performance Calculations
Date & Time of Event:	1100 on 1 December 2009
Date & Time of Critique:	0800 on 3 December 2009

CRITIQUE REPORT

Description of Event (include a detailed description of the event with times and a nonpersonalized designation of each person involved in the event): (mandatory for EHES-related events):

At 1100 on 1 December 2009, ATR Programs Engineering informed ATR Operations Management that they had found an error in the Core Safety Assurance Package (CSAP) for Cycle 145B-1. The error was discovered while evaluating reactor core performance data and was determined to be due to an incorrect cross-section calculation for the Reduced Enrichment for Research and Test Reactor (RERTR) ATR Full-Size Plate in Center Position (AFIP) backup test.

Time line.

- SCAMP analysis performed for AFIP Backup test approximately 2 years earlier as part of initial AFIP program. AFIP and backup measured in ATRC showing a < 3 cent difference
- SCAMP mentoring done for Reactor Engineering in May 2009
- September 3, CFT Experiment Loading for Cycle 145B-1, Backup test to be used at the discretion of Nuclear Safety, (DJU-14-09).
- September 21, Preliminary Experiment Requirements Letter (DLR-17-09), from Rowsell stating AFIP Backup in center.
- September 28, Preliminary Experiment Requirements Letter Revision 1 (DLR-17-09, Rev1), from Rowsell stating AFIP Backup in center.
- September 30, Preliminary Experiment Requirements Letter Revision 2 (DLR-17-09, Rev2), from Rowsell stating AFIP Backup in center.
- October 1, Reactor Loading Record Revision 0, stating AFIP Backup in center.
- Approximately October 1 – November 1, PDQ analysis performed using Scamp for AFIP backup for first time
- October 15, Preliminary Experiment Requirements Letter Revision 3 (DLR-17-09, Rev3), from Rowsell stating AFIP Backup in center.
- November 2, Preliminary Experiment Requirements Letter Revision 4 (DLR-17-09, Rev4), from Rowsell stating AFIP-BU-2 (AFIP Backup) in center.
- November 2, comment made during review on use of AFIP BU1 or BU2
- November 3, Reactor Loading Record Revision 2, stating AFIP BU-2 in center.
- November 3, Results of Reactor Physics Safety Analysis for Advanced Test Reactor Cycle 145B, ECAR-807, stating AFIP-BU-2 (AFIP Backup) in center.
- November 10, Preliminary Experiment Requirements Letter Revision 5 (DLR-17-09, Rev 5), from Rowsell stating AFIP-BU-2 (AFIP Backup) in center.
- November 10, Reactor Loading Record Revision 3, stating AFIP BU-2 in center.
- November 10, CSAP submitted to SORC for review
- November 17, CSAP exported to DOE, BETTIS, KAPL
- November 22, Reactor Critical. (Startup shim prediction was early but within allowed procedural tolerances.)
- November 22/23, Physics Testing Performed
- November 30, 1st core monitoring data point taken
- December 1, 2nd core monitoring data point taken
- December 1, Started investigation started as to why the deviation existed
- December 1, Determined that the scamp cross section model of the AFIP backup test deviated from expected by ~ 80 cents
- December 2, Determined that the scamp model of AFIP backup test used a ½ inch radius versus a ½ inch diameter. Problem Identification through routine core performance trending
- December 2, The reactor was manually shut down at 1201

CRITIQUE REPORT

Categorized as: (include a brief discussion on the justification supporting the categorization)
Classified at 13:21 12/01/09 as: Group 3 – Nuclear Safety Basis Subgroup A – Technical Safety Requirement Violations Sequence Number (2) Any violation or noncompliance of a Hazard Category 1, 2, or 3 nuclear facility's TSR (or OSR) Limiting Control Setting, Limiting Condition for Operation, Administrative Control, or Surveillance Requirement. Significance Category 2.

Notifications Made:

To: DOE FR	Date: 12/01/2009	Time: 1325
To:	Date:	Time:
To:	Date:	Time:

Procedure/Reference Applicable to the Event:
PR-00778A ATR - CYCLE PHYSICS ANALYSIS CHECKLIST
CORE SAFETY ASSURANCE PACKAGE (CSAP) FOR CYCLE 145B-1
TEM-10200-1 RESULTS OF REACTOR PHYSICS SAFETY ANALYSIS FOR ATR CYCLE 145B/ INDEX CODES

☒ No further analysis required ☐ Apparent Cause Analysis Warranted ☐ Formal Cause Analysis Warranted:

Loran Kinghorn Critique Leader Print/Type Name	Critique Leader Signature	12/03/2009 Date
Loran Kinghorn Cause Analyst Print/Type Name	Cause Analyst Signature	12/03/2009 Date
Edmond Schuebert Facility Manager Print/Type Name	Facility Manager Signature Ed Schuebert per tel con For	12/03/2009 Date

For critique reports involving unplanned access to, or contact with, energized high energy systems (EHES), obtain approval of the appropriate Associate Laboratory Director or Directorate Director. The approval signature shall indicate agreement that the facts were determined and recorded as completely as possible and that decisions were made relative to securing the event and immediate corrective actions.

Print/Type Name and Position	Signature	Date

PART 1 – EVENT RECONSTRUCTION

1. Operating conditions at time of event: (mandatory for EHES-related events):
Reactor was running at full power for 145B-1.

CRITIQUE REPORT

2. Detailed chronology of event:
SCAMP analysis performed for AFIP Backup test approximately 2 years earlier as part of initial AFIP program. AFIP and backup measured in ATRC showing a < 3 cent difference
4. • SCAMP mentoring done for Reactor Engineering in May 2009
5. • September 3, CFT Experiment Loading for Cycle 145B-1, Backup test to be used at the discretion of Nuclear Safety, (DJU-14-09).
6. • September 21, Preliminary Experiment Requirements Letter (DLR-17-09), from Rowsell stating AFIP Backup in center.
7. • September 28, Preliminary Experiment Requirements Letter Revision 1 (DLR-17-09, Rev1), from Rowsell stating AFIP Backup in center.
8. • September 30, Preliminary Experiment Requirements Letter Revision 2 (DLR-17-09, Rev2), from Rowsell stating AFIP Backup in center.
9. • October 1 Reactor Loading Record Revision 0, stating AFIP Backup in center.
10. • Approximately October 1 – November 1 PDQ analysis performed using Scamp for AFIP backup for first time
11. • October 15 Preliminary Experiment Requirements Letter Revision 3 (DLR-17-09, Rev3), from Rowsell stating AFIP Backup in center.
12. • November 2, Preliminary Experiment Requirements Letter Revision 4 (DLR-17-09, Rev4), from Rowsell stating AFIP-BU-2 (AFIP Backup) in center.
13. • November 2 comment made during review on use of AFIP BU1 or BU2
14. • November 3, Reactor Loading Record Revision 2, stating AFIP BU-2 in center.
15. • November 3, Results of Reactor Physics Safety Analysis for Advanced Test Reactor Cycle 145B, ECAR-807, stating AFIP-BU-2 (AFIP Backup) in center.
16. • November 10 Preliminary Experiment Requirements Letter Revision 5 (DLR-17-09, Rev5), from Rowsell stating AFIP-BU-2 (AFIP Backup) in center.
17. • November 10, Reactor Loading Record Revision 3, stating AFIP BU-2 in center.
18. • November 10, CSAP submitted to SORC for review
19. • November 17, CSAP exported to DOE, BETTIS, KAPL
20. • November 22, Reactor Critical. (Startup shim prediction was early but within allowed procedural tolerances.)
21. • Physics Testing Performed November 22/23
22. • November 30: 1st core monitoring data point taken
23. • December 1, 2nd core monitoring data point taken
24. • December 1, Started investigation started as to why the deviation existed
25. • December 1, Determined that the scamp cross section model of the AFIP backup test deviated from expected by ~ 80 cents
26. • December 2, Determined that the scamp model of AFIP backup test used a ½ inch radius versus a ½ inch diameter.
Problem Identification through routine core performance trending
• December 2, The reactor was manually shut down at 1201

Immediate actions taken and results: (mandatory for EHES-related events):
3.
The reactor was manually shut down.

4. Data collection:
TEM-10200-1 RESULTS OF REACTOR PHYSICS SAFETY ANALYSIS FOR ATR CYCLE 145B/ INDEX CODES
PR-00778A ATR - CYCLE PHYSICS ANALYSIS CHECLIST

Personnel Statement:
Nuclear engineer will be providing a personnel statement.

Physical Evidence; parts, debris, hardware:
None

Documentation; paper and electronic information, data sheets, logs, procedures:
TEM-10200-1 RESULTS OF REACTOR PHYSICS SAFETY ANALYSIS FOR ATR CYCLE 145B/ INDEX CODES
PR-00778A ATR - CYCLE PHYSICS ANALYSIS CHECLIST

Other relevant information:
Attendance Roster
Critique Checklist
Attach Form 231.05, Personnel Statement Form and Form 231.09, Critique Attendance Sheet

PART 2 – EVENT ANALYSIS & EVALUATION

CRITIQUE REPORT

A. Comparison of actual and expected response (equipment and personnel):

Actual response: A second check was not performed of AFIP backup test cross-sectional data prior to the data being inputted into the SCAMP program.

Expected response: The ATR - Cycle Physics Analysis checklist did not require a second check of data even though that is the management's expectations - from Nuclear Engineering - that all data is second checked prior to inputting into the SCAMP progam.

B. Factors affecting human performance:

Task Demands

- ☐ Time pressure
- ☒ High workload
- ☐ Simultaneous, multiple task
- ☐ Repetitive actions, monotonous
- ☐ Irrecoverable acts
- ☐ Interpretation of requirements
- ☐ Unclear goals, roles & responsibilities
- ☐ Lack of or unclear standards

Work Environment

- ☐ Distractions/Interruptions
- ☐ Changes/Departures from routine
- ☐ Confusing displays or controls
- ☐ Work-arounds/OOS instructions
- ☐ Hidden systems response
- ☐ Unexpected equipment conditions
- ☐ Lack of alternative indications
- ☐ Personality conflicts

Individual Capabilities

- ☐ Unfamiliarity with task/First time
- ☐ Lack of knowledge
- ☐ New technique not used before
- ☐ Imprecise communication habits
- ☐ Lack of proficiency/inexperience
- ☐ Indistinct problem-solving skills
- ☐ Hazardous attitude for critical task
- ☐ Illness/fatigue

Human Nature

- ☐ Stress
- ☐ Habit patterns
- ☒ Assumptions, inaccurate mental picture
- ☐ Complacency/overconfidence
- ☒ Mindset, "tuned" to see what you expect to see
- ☐ Inaccurate risk perception
- ☐ Mental shortcuts
- ☐ Limited short term memory

Other:

None

Causes: (See DOE Guide 231.1-2, Occurrences Reporting Causal Analysis, or LWP-9301 for the Cause Analysis Tree and associated Cause Codes.)

A3B1C01- Check of Work Less Than Adequate

Nuclear engineering believed that the data had been second-checked two years ago when the cross-sectional data for the AFIP-BU test was completed. When this data was entered into the SCAMP Program, no second check was completed which was the main cause of the CSAP not being correct.

C. Preliminary Root Cause Analysis (mandatory for EHES-related events):

D. Similar Event:

None

E. Additional Actions Necessary for Resumption of Operations:

Issue a revised CSAP for Cycle 145B-1

F. Lessons Learned:

Relying upon exper-based knowledge can lead to human performance induced errors when not proceduralized.

G. Corrective Actions:

CRITIQUE REPORT

1. Validate that SCAMP computer code is verified for correct input into PDQ program. - Actionee: McDaniel Due Date: 12/3/2009

2. Engineering needs to add second check of SCAMP calculations onto form RP-0078A (ATR – CYCLE PHYSICS ANALYSIS CHECKLIST). Actionee: McDaniel Due Date: 01/5/2010

3. Engineering needs to map and develop the procedural process of building the CSAP for ATR . Actionee: McDaniel Due Date: