232.10 #6
12/21/2006
Rev. 02
Use with LWP-9302

CRITIQUE REPORT

ATR-CR-5-31-09

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: Unplanned Reactor Shutdown Due To Rod Control Relay Failure

Date & Time of Event: 5/31/09 1831 hrs

Date & Time of Critique: 6/1/09 1330

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 1831 on 31 May 2009, the Advanced Test Reactor (ATR) was shut down due to an unexplained reactor power increase. During test reactor operations, reactor power is normally controlled at a prescribed level by means of a regulating rod. The regulating rod control system compares actual reactor power to a set value and automatically repositions the rod in or out to maintain reactor power at the set value. At 1830, the ATR Senior Reactor Operator observed the controlling regulating rod moving in an outward direction and reactor power level increasing.

A reactor slow setback (lowers the regulating rod control system set point which results in a reduction of reactor power) was manually initiated at 1831 and power was reduced to 80% of full power. At 1831 the reactor was manually scrammed to shut down the reactor after securing the slow setback. The shift supervisor reported this action was taken due to unexpected regulating rod motion, inconsistent reactor power level indications and an experiment high temperature alarm reported from the loop operating control station (LOCS). The actual report from the LOCS was experiment temperatures approaching experiment high temperature alarms.

Categorized as: (include a brief discussion on the justification supporting the categorization)
Not reportable

Notifications Made:

To: ATR Operations Mgt - Schuebert/Criswell	Date: 5/31/09	Time: 1905
To: DOE (Denning)	Date: 5/31/09	Time: 1911
To:	Date:	Time:

Procedure/Reference Applicable to the Event:
E-0 Reactor Scram

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

Bruce Criswell		6/1/09
Critique Leader Print/Type Name	Critique Leader Signature	Date
Bruce Criswell		6/1/09
Cause Analyst Print/Type Name	Cause Analyst Signature	Date
Ed Schuebert	E Schuebert	6/4/09
Facility Manager Print/Type Name	Facility Manager Signature	Date

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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
N/A		

PART 1 – EVENT RECONSTRUCTION

1. Operating conditions at time of event: (mandatory for EHES-related events):
Reactor operating normally at Nf for Cycle 144B

2. Detailed chronology of event:
5/31/09

1828 hrs: 57 sec – Northeast Neckshim #5 begins approximate 8 minute insert into the reactor due to failed relay (This event was unknown to watchstanders at the time. No alarm, no position indication selected) This is estimated time based on Loss Of Control Power alarm which has wiring interface with failed relay wiring and no actual condition which would have activated alarm. Assumed spurious alarms due to electrical transient in alarm circuit as result of overheating relay/associated wiring

– 1C-W Loop Experiment Loss of Control Power Alarm (alarm in and clear twice in next 15 second time frame)

1831 hrs: 01 sec Channel 8 (Southwest Quadrant) Neutron Level High Alarm In and Clear 1 second later

1831 hrs: 05 sec – ATR Senior Reactor Operator observed the controlling regulating rod (#1) moving in an outward direction and reactor power level increasing. Additionally notes 3 of 4 quadrant power indications slowly increasing (Northwest, Southwest, and Southeast), with Northeast quadrant power constant.

– Manual Slow Setback Initiated

1831 hrs: 30 sec – Slow Setback secured

– Loop Operating Control station reports rising temperatures on experiment approaching an alarm setpoint.

1831 hrs: 32 sec – Rx Manually Scrammed

Immediate actions taken and results: (mandatory for EHES-related events):
3.
Entered E-0 (RX Scram Procedure) completed all actions required for E-0 and proceeded to DOP- 7.2.7 Rx Outage

4. Data collection:

Personnel Statement:
Four statements

Physical Evidence; parts, debris, hardware:
N/A

Documentation; paper and electronic information, data sheets, logs, procedures:
Recorder Trace from Neutron Level Power Channels A, B, C, #8. Reg Rod #1 Trace, SER (Sequence of Events Recorder Output, NE #5 Neckshim Position vs Time Chart

Other relevant information:

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):
Expected: Regulating Rod moving out to compensate for lowering Rx Power.
Actual : Reg Rod withdrawal while Rx Power Rising

Expected : Each of four quadrant power indications should normally track.
Actual : Three of four quadrant powers rising while fourth quadrant remains constant.

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:
The investigation which ensued following reactor shutdown identified the following causes for indications received during initiation of event.

- A failed relay (27-MA-3) and one adjacent wire was degraded as a result of the relay failure and attendant overheating. As a result of the relay failure, Northeast Neck Shim #5 began to automatically insert from a fully withdrawn position. There is no display available for the respective neck shim unless the specific shim has been selected with the intent to withdraw/insert.

- The Nuclear Instrument which provides actual power sensed to the #1 Reg Rod is adjacent to the Northeast quadrant of the Reactor. As such, the inadvertant insertion of the NE #5 Neckshim rod resulted in a negative reactivity insertion in NE quadrant. The reg rod responded to the insertion by withdrawing of the reg rod. The resulting response of the nuclear instruments was a stable power trace in the NE quadrant and resulting rising power in the remaining three quadrants.

Causes: (See DOE Guide 231.1-2, Occurrences Reporting Causal Analysis, or LWP-9301 for the Cause Analysis Tree and associated Cause Codes.)
A2.B6.C04 Equipment/Component Failure -- End of Lift Failure

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

D. Similar Event:

E. Additional Actions Necessary for Resumption of Operations:

F. Lessons Learned:

G. Corrective Actions:
Replace failed relay and any associated damaged wiring. Perform thermography inspection of equivalent relays in rod control system (extent of conditions). Complete 6/3/09