

November 5, 2004

Mr. Christopher M. Crane  
President and Chief Nuclear Officer  
Exelon Nuclear  
Exelon Generation Company, LLC  
4300 Winfield Road  
Warrenville, IL 60555

SUBJECT: DRESDEN NUCLEAR POWER STATION, UNIT 2,  
NRC INSPECTION REPORT 05000237/2004012(DRP)

Dear Mr. Crane:

On October 8, 2004, the U. S. Nuclear Regulatory Commission (NRC) completed a supplemental inspection using Inspection Procedure 95001, "Inspection for One or Two White Inputs in a Strategic Performance Area," at your Dresden Nuclear Power Station. The enclosed report documents the inspection findings which were discussed on October 8, 2004, with Mr. D. Bost and other members of your staff.

In July 2004, you reported the Unit 2 Unplanned Reactor Scrams performance indicator as White in the second quarter of 2004. This represented a reduction in safety margin and adversely affected the Initiating Events cornerstone. The reduced safety margin associated with this performance indicator warranted a supplemental NRC inspection and assessment of your actions to improve performance in the Initiating Events cornerstone of the Operational Reactor Safety strategic performance area.

Four reactor scrams resulted in the performance indicator crossing the Green/White threshold. These included an automatic scram on September 30, 2003, due to the loss of a reactor feed pump, a manual scram on December 11, 2003, due to a stator water temperature controller failure, an automatic scram on April 24, 2004, due to an induced main steam low pressure signal, and a manual scram on April 28, 2004, due to a loss of a recirculation pump motor.

Based on our review of your root cause evaluations for the four reactor scrams and your cumulative evaluation of all four events, we have concluded that your staff adequately conducted the root cause evaluations to a level of detail commensurate with the significance of the problems. The evaluations were determined to be generally thorough and followed a structured approach for performing such reviews. We also concluded that your staff's planned corrective actions, if properly implemented, are sufficient to adequately address each of the identified root and contributing causes.

While the root cause evaluations were generally thorough, we identified that you did not identify foreign material controls as a common cause for the reactor scrams. The lack of foreign material controls contributed to or likely contributed to three of the four reactor scrams. We also identified that your planned corrective actions to address the White performance indicator did not initially include an effectiveness review that contained the necessary elements to ensure that specific common cause corrective actions were effective. Both of these areas warrant your attention.

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Sincerely,

***/RA by Steven West Acting for/***

Steven A. Reynolds  
Acting Director  
Division of Reactor Projects

Docket No. 50-237  
License No. DPR-19

Enclosure: Inspection Report 05000237/2004012(DRP)  
w/Attachment: Supplemental Information

cc w/encl: Site Vice President - Dresden Nuclear Power Station  
Dresden Nuclear Power Station Plant Manager  
Regulatory Assurance Manager - Dresden  
Chief Operating Officer  
Senior Vice President - Nuclear Services  
Senior Vice President - Mid-West Regional  
Operating Group  
Vice President - Mid-West Operations Support  
Vice President - Licensing and Regulatory Affairs  
Director Licensing - Mid-West Regional  
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U.S. NUCLEAR REGULATORY COMMISSION

REGION III

Docket Nos: 50-237

License Nos: DPR-19

Report No: 05000237/2004012(DRP)

Licensee: Exelon Generation Company

Facility: Dresden Nuclear Power Station, Unit 2

Location: 6500 North Dresden Road  
Morris, IL 60450

Dates: October 4 through October 8, 2004

Inspector: M. Kurth, Resident Inspector, Quad Cities

Approved by: Mark Ring, Chief  
Branch 1  
Division of Reactor Projects

## SUMMARY OF FINDINGS

IR 05000237-04-12(DRP); 10/04/2004-10/08/2004, Dresden Nuclear Power Station, Unit 2; Supplemental Inspection 95001 - Unplanned Reactor Scrams White Performance Indicator.

This report covers a supplemental inspection performed by the Quad Cities Resident Inspector in accordance with Inspection Procedure 95001, "Inspection for One or Two White Inputs in a Strategic Performance Area." There were no findings as a result of this inspection. The NRC's program for overseeing the safe operation of commercial nuclear power reactors is described in NUREG-1649, "Reactor Oversight Process," Revision 3, dated July 2000.

### **Cornerstone: Initiating Events**

The NRC performed a supplemental inspection in accordance with Inspection Procedure 95001, "Inspection for One or Two White Inputs in a Strategic Performance Area," to assess the licensee's evaluation associated with a White Unplanned Reactor Scram performance indicator in the Initiating Events cornerstone.

Based on the inspector's review of the licensee's root cause evaluations for the four reactor scrams and the licensee's cumulative evaluation of all four events, the inspector concluded that the licensee adequately conducted the root cause evaluations to a level of detail commensurate with the significance of the problems. The evaluations were determined to be generally thorough and followed a structured approach for performing such reviews. The licensee's planned corrective actions, if properly implemented, are sufficient to adequately address each of the identified root and contributing causes.

While the root cause evaluations were generally thorough, the licensee did not identify foreign material controls as a common cause for the reactor scrams. The lack of foreign material controls contributed to or likely contributed to three of the four reactor scrams. Also, the licensee's planned corrective actions to address the White performance indicator did not initially include an effectiveness review that contained the necessary elements to ensure that specific common cause corrective actions were effective.

#### **A. Inspector-Identified and Self-Revealed Findings**

No findings of significance were identified.

#### **B. Licensee-Identified Violations**

None.

## Report Details

### 01 Inspection Scope

A supplemental inspection was performed to assess the licensee's root cause evaluation associated with the Unit 2 performance indicator for Unplanned Reactor Scrams of the Initiating Events cornerstone which exceeded the Green/White threshold in the second quarter of 2004. The four unplanned reactor scrams which caused this threshold to be exceeded are described below:

- An automatic reactor scram occurred on September 30, 2003, due to the loss of the 2C reactor feed pump. The reactor feed pump tripped due to an actuation of the over-current ground relay. The over-current ground relay actuated due to a fault in the B phase of the 2C reactor feed pump motor cable. Testing identified a conductor to shield fault which was indicative of a breakdown in the primary cable insulation. Due to the loss of the reactor feed pump and the associated decrease in reactor vessel water level the reactor protection system initiated an automatic reactor scram on low reactor water level.
- A manual reactor scram occurred on December 11, 2003, due to an automatic main turbine runback resulting from a stator water cooling temperature controller failure. The stator water cooling temperature controller failure was due to foreign material impacting the stator water cooling inlet temperature controller. The resultant increased stator water temperatures led operations personnel per procedures to manually scram the reactor.
- An automatic reactor scram occurred on April 24, 2004, due to an induced main steam low pressure signal that actuated the closure of the main steam isolation valves. The induced main steam low pressure signal was attributed to reduced steam drain flows which led to water accumulation in the main steam piping during low power operations. A planned main turbine trip was executed at low power in preparation for a planned maintenance outage. The turbine trip and subsequent turbine control valve closure resulted in the rapid movement of the water slug. The movement of the water slug induced a low pressure condition in main steam piping upstream of the main turbine stop valves. The induced low pressure condition was detected by main steam line low pressure switches which provided a signal to close the main steam isolation valves.
- A manual reactor scram occurred on April 28, 2004, due to the loss of the 2A reactor recirculation pump motor. The loss led operations personnel per procedures to manually scram the reactor.

This supplemental inspection was performed in accordance with Inspection Procedure 95001, "Inspection for One or Two White Inputs in a Strategic Performance Area." The following inspection results are organized by the specific inspection requirements of Inspection Procedure 95001 which are noted in italics in each section.

## 02 Evaluation of Inspection Requirements

### 02.01 Problem Identification

- a. *Determine that the evaluations identify who (i.e., licensee, self-revealing, or NRC), and under what conditions the issues were identified.*

The September 30, 2003, scram was credited as an Unplanned Reactor Scram performance indicator occurrence due to a loss of a reactor feed pump and resultant automatic reactor scram due to low reactor vessel water level.

The December 11, 2003, scram was credited as an Unplanned Reactor Scram performance indicator occurrence due to the loss of stator water cooling and resultant operator actions per procedures to initiate a manual reactor scram.

The April 24, 2004, scram was credited as an Unplanned Reactor Scram performance indicator occurrence due to the induced main steam line low pressure signal due to the transport of a water slug causing main steam isolation valves closures and the subsequent reactor scram.

The April 28, 2004, scram was credited as an Unplanned Reactor Scram performance indicator occurrence due to the loss of a reactor recirculation pump motor and resultant operator actions per procedures to initiate a manual reactor scram.

All of the scrams were self-revealing events.

- b. *Determine that the evaluations document how long the issues existed, and prior opportunities for identification.*

The Dresden Unit 2 Unplanned Reactor Scrams performance indicator exceeded the Green/White threshold as reported in the second quarter 2004 performance indicator submittal.

The September 30, 2003, scram occurred due to a loss of a reactor feed pump. The loss of the feedwater pump was caused by a cable conductor to internal shield fault. Although there were prior opportunities to identify the fault through periodic megger testing, the megger testing did not identify the fault. Therefore, the determination of how long the issue existed could not be conclusively identified.

The December 11, 2003, scram was due to the loss of stator cooling and resultant operator actions per procedures. The issue existed since October 26, 2003, when the stator water cooling instrument line was worked to install a modification. Prior opportunities for identification existed when the tuning of the stator water cooling temperature control valve was to be conducted; however, due to schedule changes, lack of maintenance resources, and the missed opportunity of transferring the work to the daily work schedule after the refueling outage activities were completed, the tuning was not performed.



The April 24, 2004, scram was a result of an induced main steam line low pressure signal due to the transport of a water slug causing main steam isolation valve closures and the subsequent reactor scram. The condition existed for less than two hours while the plant was held at low power which allowed for the build-up of water droplets from steam condensing in the main steam lines. Although it has not been demonstrated, it is believed that foreign material limited flow in the drain line. A prior opportunity for identification did not exist.

The April 28, 2004, scram was due to the loss of a reactor recirculation pump motor and resultant operator actions per procedures. The issue existed since 1999 when the reactor recirculation motor was installed. Although prior opportunities for identification may have existed through megger testing, the testing results did not identify the motor's insulation degradation. Also, chemical residue formed on the motor's internal windings when the reactor building closed loop cooling system, which provides cooling to the motor, leaked during motor operations. This contributed to the motor failure.

- c. *Determine that the evaluations document the plant-specific risk consequences (as applicable) and compliance concerns associated with the issues.*

In response to each of the four reactor scrams, the resident inspectors evaluated plant parameters, operator actions, and overall plant status including the availability of mitigating systems. For all the scrams reviewed the inspectors determined that systems responded as designed and no human performance errors complicated the event response.

The licensee's risk analysis was considered to be acceptable. No concerns were identified.

## 02.02 Root Cause, Extent of Condition, and Extent of Cause Evaluation

- a. *Determine that the problems were evaluated using a systematic method(s) to identify root cause(s) and contributing cause(s).*

The licensee performed a root cause evaluation for each of the four reactor scrams which caused the Unplanned Reactor Scrams performance indicator to cross the Green/White threshold. An evaluation was also performed to determine if any potential common causes for the four events existed. These root cause evaluations and common cause evaluations are listed below.

- Root Cause Report 178507-25, "Unit 2 Reactor Scram due to 2C Reactor Feedwater Pump Trip"
- Root Cause Report 190360-01, "Unit 2 Reactor Scram due to Stator Water Cooling Temperature Control Valve Failure"
- Root Cause Report 216768-07, "Unit 2 Reactor Scram due to Group I Isolation from Main Steam Lead Drain System"
- Root Cause Report 217570-07, "Unit 2 Reactor Scram due to 2A Reactor Recirculation Pump Trip from Faulty Rewind"

- Common Cause Analysis Report 219102-14, "Dresden Aggregate Scram Review"
- Common Cause Analysis Report 218474-01, "Dresden Scrams and Downpowers"

The four root cause evaluations were conducted using a structured methodology to evaluate the root causes and contributing causes of the events. These included event and causal factors analyses, barrier analyses, failure mode identification, human performance contribution determinations, and change analysis. The licensee used a combination of these root cause analysis techniques to evaluate the scrams in accordance with LS-AA-125-1001, "Root Cause Analysis Manual." The documented root cause evaluations adequately described the methods used to identify the root causes for the events.

The inspector reviewed the methods employed and concluded that the licensee had used a formal, structured approach to perform the root cause evaluations to identify root causes and contributing causes.

- b. *Determine that the root cause evaluations were conducted to a level of detail commensurate with the significance of the problems.*

The four root cause evaluations were performed in accordance with LS-AA-125-1001, "Root Cause Analysis Manual." The procedure provided sufficient guidance for personnel to follow a structured and methodical approach to evaluate the events. The inspector determined that the four root cause evaluations were performed with sufficient detail and analysis to support the conclusions reached. The root cause evaluations adequately considered programmatic weaknesses, human error, procedure and training adequacy, operating experience, external events, and communications. In addition, each of the four root cause evaluations adequately incorporated internal and external operating experience into the scope of review. The analysis techniques chosen were considered to be appropriate to each particular event and causal factor identified. The causal factors were then used to identify the root causes and contributing causes.

The licensee's root cause evaluations identified, in most cases, the individual root causes for each event. The December 11, 2003, event was attributed to foreign material intrusion from inadequate maintenance processes for flushing/purging after maintenance on an instrument air line. The April 24, 2004, event was the most probable result of inadequate drainage for the main steam drain line system. The April 28, 2004, event was attributed to a lack of detailed rewinding and acceptance test requirements in the licensee's large motor standard that governed the rewind of the 2A reactor recirculation motor.

The September 30, 2003, event was the result of an internal cable short that fed the "B" phase of the 2C reactor feed pump. For this event a root cause was not determined. The cable was buried under numerous other cables in a cable tray. Disruption of the cabling could have detrimental effects; and therefore, the licensee decided not to disturb the cables. For this event, the inspectors verified that: no further cable faults

were identified in this tray; additional electrical testing of various other cables in the tray did not identify further degraded cables; and cable tray thermography data was taken to predict cable degradation.

The inspectors determined that the root cause evaluations were conducted to a level of detail commensurate with the significance of the problem.

- c. *Determine that the root cause evaluations include a consideration of prior occurrences of the problem and knowledge of prior operating experience.*

For the December 11, 2003, loss of stator water cooling event, the licensee identified that it had not established sufficient monitoring of the stator water cooling inlet temperature as a critical parameter. Therefore, licensee personnel did not recognize the temperature increase after the system was returned to service. Also, the licensee did not transfer the post-outage controller tuning to the daily work schedule when the work and subsequent refueling outage were completed. These were two examples that could have led to the identification of the stator water problems prior to the event occurrence.

For the April 24, 2004, Group I isolation and subsequent reactor scram event, the most probable cause was due to inadequate draining of the main steam lead drain line. This was attributed to, in all likelihood, foreign material that reduced condensate flow through the drain line. During refueling outage D2R18 (Fall 2003) there was the discovery of metal fragments from the breakdown of main steam isolation valve belleville washers. A recovery plan was developed and implemented and portions of the washers were retrieved from the main steam lines. However, there was approximately 74.25 inches of missing belleville spring material. Therefore, belleville spring material could be reducing drainage flow through this pathway. Also the foreign material may be due to the accumulation of corrosion products (i.e., rust particles). The licensee plans to implement recovery efforts during the next refueling outage. The remaining events and associated root causes adequately addressed prior occurrences of the problem and knowledge of prior operating experience.

Overall, the inspector concluded that the licensee's root cause evaluations properly considered and evaluated prior operating experience.

- d. *Determine that the root cause evaluations address the extent of condition and the extent of cause of the problems.*

The licensee's common cause analysis was a collective evaluation of the events which caused the Unplanned Reactor Scrams performance indicator to cross the Green/White threshold. The evaluation identified the following common causes associated with the events:

- The risk impacts of decisions related to critical equipment were not fully developed and contingency measures were not developed and implemented.
- Testing and monitoring of critical equipment was insufficient to avoid reactor scrams.

- Root cause analysis of significant events were not of sufficient scope to identify and correct substantive issues to prevent future events.

The inspector concluded that the licensee's root cause evaluations were conducted to a level of detail commensurate with the significance of the problem. The common cause analysis was a critical review of the four Unit 2 reactor scrams and included three reactor scrams which had occurred on Dresden Unit 3 between September 30, 2003, and May 5, 2004. The inspector reviewed the common cause evaluation and identified that the reports did not identify foreign material as a common contributor to the events. For the events that occurred on December 11, 2003 (Loss of stator water cooling), April 24, 2004 (Group I isolation due to improper main steam line lead drain flow), and April 28, 2004 (loss of the 2A reactor recirculation pump motor), foreign material contributed to or likely contributed to the events. The licensee acknowledged this weakness in its common cause evaluation and initiated Issue Report 264976 to enter this issue in its corrective action program.

The inspector also reviewed the licensee's extent of condition evaluation and concluded that licensee personnel adequately evaluated the extent of condition among the events.

### 02.03 Corrective Actions

- a. Determine that appropriate corrective action(s) are specified for each root/contributing cause or that there is an evaluation that no actions are/were necessary.

The inspector reviewed each of the four root cause evaluations and the associated corrective actions. The corrective actions were clearly described and were entered into the licensee's tracking system. The proposed corrective actions were determined to appropriately address the root causes of the events and if properly implemented would address the problem identified within each of the root cause evaluations. For those events where a definitive root cause was not identified, corrective actions were taken to predict and prevent future events. The established corrective actions were verified not to create new or different problems as a result of the corrective actions to be taken.

- b. Determine that the corrective actions have been prioritized with consideration of the risk significance and regulatory compliance.

Prioritization of the corrective actions from the root cause evaluations were based on a deterministic approach considering the significance of the problem identified rather than being based on a risk perspective.

The inspector reviewed the prioritization of the corrective actions and verified that actions of a generally higher priority were scheduled for completion ahead of those of a lower priority. No concerns were identified.

- c. Determine that a schedule has been established for implementing and completing the corrective actions.

The licensee's corrective action program, as described in LS-AA-125, "Corrective Action Program Procedure," and LS-AA-120, "Issue Identification and Screening Process," identified the processes for assigning significance levels for issue reports.

Subsequently, issue reports were evaluated and corrective actions were identified. These corrective actions were assigned a priority level commensurate with their safety significance. Time limits were assigned for implementing the corrective actions and the licensee had a process in place to track all corrective actions and priority levels. In addition, the inspector selected a number of corrective actions in each of the root cause evaluations and verified that they had been completed or were being tracked for resolution and closure. No concerns were identified.

- d. Determine that quantitative or qualitative measures of success have been developed for determining the effectiveness of the corrective actions to prevent recurrence.

The licensee established an effectiveness review to validate the effectiveness of the corrective action plans. The effectiveness review consisted of addressing the common cause issues identified and are as follows:

- The risk impacts of decisions related to critical equipment were not fully developed and contingency measures were not developed and implemented.
- Testing and monitoring of critical equipment was insufficient to avoid reactor scrams.
- Root cause analyses of significant events were not of sufficient scope to identify and correct substantive issues to prevent future events.

The inspector questioned the adequacy of the initial effectiveness review plans since the plans did not completely address the common causes. The following weaknesses were identified:

- The testing and monitoring deficiencies were to be addressed by reviewing a sample of condition reports on plant events and precursors to determine if ineffective troubleshooting was the causal factor in the event. However, in most cases, troubleshooting efforts are to be implemented once an issue/problem is revealed. Testing and monitoring activities are performed on a periodic basis and are conducted to monitor system or component health in order to trend and detect an issue/problem prior to occurrence. Therefore, there was a disconnect between the common cause and the effectiveness review for assessing corrective actions to minimize/prevent an event.
- The root cause analyses that were not of sufficient scope to identify and correct issues were to be addressed by conducting a survey of personnel who participated on the root cause team to determine if the members were dedicated full-time and of appropriate composition. The survey will address the issue of a lack of dedication by root cause team members due to other job demands; however, the effectiveness review does not assess if future root cause reports are of sufficient scope to identify and correct substantive issues.

The licensee acknowledged these weaknesses in its effectiveness reviews and initiated Issue Report 264976 to enter these issues in its corrective action program.

03 **Management Meetings**

Exit Meeting Summary

On October 8, 2004, the inspector presented the inspection results to Mr. D. Bost and other members of licensee management. The inspector asked the licensee whether any materials examined during the inspection should be considered proprietary. No proprietary information was identified.

ATTACHMENT: SUPPLEMENTAL INFORMATION

## **SUPPLEMENTAL INFORMATION**

### **KEY POINTS OF CONTACT**

#### Licensee

D. Bost, Site Vice President  
D. Wozniak, Plant Manager  
J. Hansen, Regulatory Assurance Manager  
J. Griffin, Regulatory Assurance  
S. Taylor, Radiation Protection Director  
R. Gadbois, Operations Director  
B. Svaleson, Maintenance Director  
C. Symonds, Training Director  
D. Galanis, Design Engineering Manager  
A. Khanifar, Nuclear Oversight Manager

#### Nuclear Regulatory Commission

M. Ring, Chief, Division of Reactor Projects, Branch 1  
C. Phillips, Senior Resident Inspector, Dresden  
M. Sheikh, Resident Inspector, Dresden

#### IEMA

R. Schulz, Illinois Emergency Management Agency

### **ITEMS OPENED, CLOSED, AND DISCUSSED**

#### Opened

None.

#### Closed

None.

#### Discussed

None.

## LIST OF DOCUMENTS REVIEWED

### Updated Final Safety Analysis Report

### Technical Specifications

Engineering Change 350982; Technical Evaluation of Degraded Main Steam Isolation Valve Belleville Springs Identified During D2R18  
Issue Report 222620; FME Controls for Instrument Air Modification  
Issue Report 100529; Assignment 1; NRC Information Notice 2002-12 Submerged Safety Related Cables - Review for Applicability and Required Corrective Actions  
Root Cause Report 178507-25, "Unit 2 Reactor Scram due to 2C Reactor Feedwater Pump Trip"  
Root Cause Report 190360-01, "Unit 2 Reactor Scram due to Stator Water Cooling Temperature Control Valve Failure"  
Root Cause Report 216768-07, "Unit 2 Reactor Scram due to Group I Isolation from Main Steam Lead Drain System"  
Root Cause Report 217570-07, "Unit 2 Reactor Scram due to 2A Reactor Recirculation Pump Trip from Faulty Rewind"  
Common Cause Analysis Report 219102-14, "Dresden Aggregate Scram Review"  
DMP 4700-12; Post Maintenance Blowdown of Instrument Air Lines; Revision 0  
DOA 7400-01; Failure of the Stator Water Coolant System; Revision 20  
DAN 2252-7 B-1; Inlet Temperature High; Revision 3  
DAN 2252-7 B-2; Outlet Temperature High; Revision 4  
Work Order 526946-03; IMD-Post Outage Controller Tuning  
MA-AA-723-330; Electrical Testing of AC Motors Using Baker Instrument Advanced Winding Analyzer; Revision 0  
MA-AA-716-008; Foreign Material Exclusion Program; Revision 1  
Issue Report 229454; Review of Root Cause Reports Identifies Potential Post-Maintenance Testing Weakness  
Issue Report 222627; Equivalency Evaluation for Temperature Controller Technically Inaccurate  
M-12; Diagram of Main Steam Piping; Sheet 1; Revision PD  
M-12; Diagram of Main Steam Piping; Sheet 2; Revision ABD  
Document ID 5910585; Closure of 2-220-3; dated March 29, 1999  
Issue Report 216768; Unit 2 Reactor Scram  
DGP 02-01; Unit Shutdown; Revision 90  
Engineering Change 349338; Unit 2 Scram April 24, 2004: 1) Estimation of Water Droplet Deposition in Turbine Steam Lead During Low Power Operation, 2) Main Steam Lead Drain Line Capacity, and 3) Assessing Slug Water Hammer Pressure  
DAN 902-6 F-7; Reactor Feedpump Trip; Revision 16  
DEP 0040-27; Megger and Bridge Testing and Acceptance Criteria; Revision 3  
DES 0040-02; 600 Volt Butyl Cable EQ Surveillance; Revision 8  
Issue Report 264976; Weaknesses Identified by NRC in Common Cause Analysis for Unplanned Scrams  
LS-AA-125-1001; Root Cause Analysis Manual; Revision 4  
LS-AA-120; Issue Identification and Screening Process; Revision 2



LS-AA-125-1004; Effectiveness Review Manual; Revision 2  
LS-AA-125-1005; Coding and Trending Manual; Revision 3  
LS-AA-125-1006; CAP Process Expectations Manual; Revision 5

## LIST OF ACRONYMS

FME	Foreign Material Exclusion
IR	Inspection Report
DRP	Division of Reactor Projects
NRC	Nuclear Regulatory Commission
IMD	Instrument Maintenance Department
EC	Engineering Change