



UNITED STATES DEPARTMENT OF COMMERCE
National Institute of Standards and Technology
Gaithersburg, Maryland 20899-

April 13, 2016

U.S. Nuclear Regulatory Commission
Document Control Desk
Washington, DC 20555-0001

Subject: Docket #50-184

Gentlemen:

Transmitted herewith is Operations Report No. 68 for the NBSR. The report covers the period
January 1, 2015 to December 31, 2015.

Sincerely,

Robert M. Dimeo, Director
NIST Center for Neutron Research

Enclosure

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**NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY REACTOR
(NBSR)**

Docket #50-184

Facility License No. TR-5

Operations Report

-- #68--

January 1, 2015 - December 31, 2015

This report contains a summary of activities connected with the operations of the NBSR. This report fulfills the requirements of section 6.7.1 of the NBSR Technical Specifications for the period from January 1, 2015 to December 31, 2015.

The section numbers in the report (such as 6.7.1(1)) correspond to the sections in the Technical Specifications.

April 13, 2016

A handwritten signature in black ink, appearing to read 'Robert M. Dimeo', is positioned above a horizontal line.

Robert M. Dimeo, Director
NIST Center for Neutron Research

TABLE OF CONTENTS

- 6.7.1(1) Summary of plant operations including the energy produced by the reactor and the hours the reactor was critical
- 6.7.1(2) Unscheduled shutdowns, including reasons therefore
- 6.7.1(3) Tabulation of major preventative and corrective maintenance operations having safety significance
- 6.7.1(4) A brief description, including a summary of the safety evaluations, of changes in the facility or in procedures and of test and experiments carried out pursuant to 10 CFR 50.59
- 6.7.1(5) Summary of the nature and amount of radioactive effluents released or discharged to the environs and the sewer beyond the effective control of the licensee as measured at or prior to the point of such release or discharge
- 6.7.1(6) Summary of environmental surveys performed outside the facility
- 6.7.1(7) Summary of significant exposures received by facility personnel and visitors

6.7.1(1) Summary of plant operations including the energy produced by the reactor and the hours the reactor was critical

During the period January 1, 2015 through December 31, 2015 the reactor was critical for 5716 hours with an energy output of 114,166 MWH (237.84 full power equivalent megawatt days). Major activities during this period included:

1. Refurbished and replaced the O-rings for the pneumatic operators of DWV-3,4,5, and 6 primary coolant pump discharge valves;
2. Replaced the diaphragms for DWV-3,4,5, and 6 primary coolant pump discharge valves;
3. Repaired the # 2 primary coolant pump;
4. Replacing the fan for the #2 cell of the coolant tower;
5. Replaced the mechanical seal for the P100B thermal shield circulating pump and the P101B thermal shield eductor pump;
6. Replaced 13 motor control center breaker contactors with updated models to prevent premature failure; and
7. Replaced the termini for the pneumatic sample (rabbit) systems, RT-1 and RT-2.

In addition, 2 operator trainees received their senior reactor operator licenses.

6.7.1(2) Unscheduled shutdowns, including reasons therefore

1. There was a reactor scram at 1655 on June 3, 2015 from low auxiliary flow when DWV-22 failed open. The micro controller for DWV -22 was rebooted and the reactor was quickly returned to 20 MW in less than an hour.
2. The reactor was intentionally shutdown at 1700 on June 4, 2015 to swap out the Regulating Rod drive system. The reactor was returned to 20 MW at 0855 June 6, 2015.
3. There was a reactor scram at 1318 on July 30, 2015 from loss of primary flow due to a momentary loss off site power. All primary, secondary flow and ventilation was lost. As soon as those systems were restored to operation the reactor was restarted. The reactor was returned to 20 MW at 1339 on July 30, 2015.
4. On December 19, 2015 at 1904 there was a rundown due to loss of the cold source PLC communications. Even with almost immediate response by the cold source team they were not able to restore functionality of the cold source before the buildup of Xenon prevented the restart of the reactor. Management decided

to end the cycle because the planned schedule for the cycle end was at 2350 on December 21, 2015, before the Xenon decay would allow a restart.

6.7.1(3) Tabulation of major preventative and corrective maintenance operations having safety significance

Note: Some of these items may be also listed as Engineering Change Notices (ECN) in section 6.7.1(4).

| | |
|--------|---|
| Jan 2 | Tested CO ₂ blow off valve high level set point. |
| Jan 3 | Changed and tested position indicators for DWV-32, 33, 34, and 35. |
| Jan 4 | Replaced contactor for #1 thermal column pump. |
| Feb 7 | Replaced PLC for rack #4 for the cold source. |
| Feb 16 | Replaced contactor for SF-11. Replaced contactor for #1 storage pool pump. Replaced contactor for CO ₂ purge fan. |
| Feb 25 | Replaced storage pool pumps check valves. |
| Feb 26 | Replaced contactor for #1 He blower. Replaced contactor for rabbit blower. Replaced secondary makeup meter. Installed thermal shield educator pump piping support. |
| Feb 27 | Replaced seal housing bolt for #1 main D ₂ O pump. |
| Mar 1 | Replaced contactor for #1 experimental D ₂ O pump. |
| Mar 2 | Replaced contactor for #1 AC shutdown pump. Replaced contactor for #1 experimental Demin pump. |
| Mar 3 | Replaced contactor for #1 AC shutdown pump again. Replaced contactor for #1 experimental Demin pump again. |
| Mar 8 | Replaced contactor for #2 experimental Demin pump. Replaced contactor for #2 experimental D ₂ O pump. |
| Mar 10 | Cooling tower wet door track heaters repaired. Replaced #3 shim arm shaft seal. |
| Mar 12 | Installed new thermal shield dosing system. Ducting between ACV-10 and EF-3 repaired. |
| Mar 14 | Completed RT-2 installation. |
| Mar 15 | Changed out storage pool IX resin. |
| Mar 19 | Replaced O-ring for P101B thermal shield educator pump. |
| Mar 20 | Removed standby UPS batteries. |
| Mar 24 | Replaced all 72 standby UPS batteries. |
| Mar 25 | Replaced open limit switch for DWV-21. |
| Apr 16 | Repaired HCSC pump VFD. |
| Apr 17 | Received diesel fuel delivery. |
| May 8 | Replaced secondary bag filter DP switch. |
| May 12 | Repaired #1 cooling tower east dry door. |
| May 17 | Cut and capped abandoned thermal shield lines under reactor top decking. |

| | |
|--------|--|
| | Replaced diaphragm for DWV-37. |
| May 19 | Painted #4 and #5 cooling tower fan gear boxes with rust inhibitor. All secondary building chain operated valves open/shut stops set. |
| May 20 | Repaired leaking biocide addition piping. Set open/shut stops on all manual operated secondary valves in the pump house. |
| | Cooling tower gear box #1, 2, and 3 drain lines replaced. |
| Jul 13 | Repaired supply breaker for MCC A2. Replaced contactor for DWV-19. |
| Jul 14 | Replaced vibration switch on #1 CT fan. Repaired #2 D ₂ O shutdown pump. |
| Jul 21 | Repaired #1 CT fan breaker. |
| Aug 27 | New Demin water system installed. |
| Sep 2 | Replaced DP switch for DWV-5. Installed new SCV-7 operator. |
| | Repaired CT fan #1, 2, and 3 gear box oil drain line. Changed oil. |
| Sep 8 | Load tested backup UPS. |
| Oct 21 | Replaced process room tritium detector on B1. |
| Oct 26 | Replaced secondary bag filter housing. |
| Oct 30 | Tightened flange bolts for DCV-22, 49, and 52. |
| Nov 1 | Aligned HCCP pumps. Replaced DWV-80. |
| Nov 23 | Set dip switches for #1 thermal column pump contactor. Contractor performed maintenance on diesel generators. |

Note: the following tabulation of major preventative and corrective maintenance operations are grouped by shutdown periods. There may be some duplication in the by date tabulation above.

February-March:

Modifications to Secondary Auxiliary Booster Cooling Pumps (replaced #2 Pump)
 Replaced secondary isolation valve (SCV-367) to aux. booster pumps
 Replaced Track Heaters on Cooling Tower Wet Rolling Doors
 Repaired EF-5 and EF-6 Ductwork (B1 Level)
 Replaced the mechanical seal for the Thermal Shield Eductor Pump "B"
 Replaced RT-1 and RT-2
 Changed Storage Pool IX Resin and Filters
 Replaced Storage Pool Cooling System Check Valves
 Modified Thermal Shield Level Indication System (Process Room)
 Installed New Primary Relief Valve
 Installed Wire and Test New Enclosure for Major SCRAM Relays
 Installed Thermal Shield Dosing System (C100 West side of Catwalk)
 Repaired Automatic Blowdown Valve PAV-2D

May:

Removed SOLA Transformer Number 1
Removed SOLA Transformer Number 2
Cut and cap abandoned Thermal Shield Cooling Lines under Reactor Top
Added N16 Detectors RM 3-1 and RM 3-3 to Critical Power
Replaced Differential Pressure Switch on Secondary Bag Filter Housing
Replaced the mechanical seal for the Thermal Shield Circulator Pump "B"
Replaced Secondary MHX'ers Thermocouples
Inspected and Verify Accuracy of Primary MHX'ers RTDs

July:

Leak Detector Monitoring System Hardware and Software Upgrade
Installed Startup Prohibit Annunciator AN 5-47
Installed NC-7 Detector
Installed NC-7 Drawer and Calibrate
Replaced Cooling Tower Fan Switches (Control Room)
Replaced Light Sockets on Cooling Tower Rolling Door Switches (Control Room)
Replaced Ultrasonic FR-20
Replaced Ultrasonic FR-21
Replaced Emergency Cooling Sump Pump Lockout Switch
Replaced Storage Pool UV Unit and Isolation Valves
Repaired #2 D₂O Shutdown Pump
Installed CO₂ Level Indicator (Process Room)
Repaired Leaking Thermal Shield Valve PV-1004
Installed I/P Controller on DWV-22
Replaced #1 Blower for RM 3-4 & RM 3-5
Repaired #4 Shim Arm Drive (replaced anti-backlash gear)

September:

Replaced Helium Make-up Pressure Low Alarm
Modified Oil Drain Lines on Cooling Tower Fan Gear Boxes (Cells 1-3)
Installed Cannon Pool Water System
Installed Backflow Preventer between FTV-23 and Cannon Pool Water System
Replaced BT-4 Shutter Solenoid
Delivery and Installation of Helium Tank (South Side of South Compressor Building)
Cleaned Deicing Nozzles on Cooling Tower Wet Doors
Installed SCV-7 valve operator, cooling tower by-pass
Replaced DP cell for DWV-5
Repaired 48V Annunciator AN 5-43

October-November:

Replaced FIA-6 Transmitter and Calibrate

Replaced Thermal Shield Ring Header Flow Meters: 1292, 1314, 1330, 1362, 1364, & 1383

Replaced Secondary Cooling Bag Filter Housing

Refurbished Helium Bulk Tanks (includes two 200 psig regulators for cold source)

Replaced Helium Regulator in A133

Replaced #2 Cooling Tower Fan

Installed New DWV-22 Diaphragm Valve

Repaired RM 4-2 indication in ECS

Replaced diaphragm and rebuilt air operator on DWV-3

Replaced diaphragm on DWV-6

Repaired micro switch mounts on DWV-4

Repaired Shim Arm Drive in cavity #1

Repaired #2 Main D₂O Pump

December-January:

Installed Signal Conditioner for FIA-6 and Calibrate

Installed Helium Level Indication

Rebuilt Air Operator on DWV-6

Rebuilt Air Operators and Replace Diaphragms on DWV-4 and DWV-5

Replaced Flux Controller on NC-5

Replaced RTDs for BTUR measurement

In addition to the mechanical and electrical The Reactor Instrumentation Group performed 62 instrument calibrations and 25 corrective maintenance operations during 2015. The calibrations were done using procedures that ensure that the sensors, indication, and controls of the NBSR safety systems are accurate and fully operational. In addition, the Reactor Instrument Group with the support of the reactor operations and engineering personnel have made corrective actions to some of the instrumentation and control systems at NBSR during 2015. One such project was improving the gas holder indication and control with more robust and reliable components.

6.7.1(4) A brief description, including a summary of the safety evaluations, of changes in the facility or in procedures and of test and experiments carried out pursuant to 10 CFR 50.59

There was one Level II ECN that required a license amendment: ECN 778, Replace T-9 and T-10 UPS. The NRC issued Amendment No. 10 to the NBSR Technical Specification on September 10, 2015.

There were three Level II ECNs for which further evaluation was performed using 10 CFR 50.59. None of these required a license amendment.

Level II
ECN #

TITLE

634 Electrical Substation

This ECN covered the installation of the new electrical substation that provides power to loads that do not affect reactor safety, e.g. cold source compressor and secondary cooling.

This change improved power distribution for the facility with increased supply and redundancy of offsite power. The change did not require an amendment to the Technical Specifications.

861 Install I to P Converter on DWV-22

DWV-22 is one of the valves used to control the flow of D₂O water in the auxiliary system. This system provides flow for cooling to auxiliary systems such as the cold source cryostats and the pneumatic system (rabbit) termini. It also provides circulation of the primary water for filtration and ion exchange. This ECN replaced the electronic positioner on DWV-22 with an I/P controller with the intention to provide better control of the flow.

The change did not require an amendment to the Technical Specifications.

936 Change DWV-22 to a Diaphragm Valve

This change is a continuation of ECN 861. It was found that the I/P controller did not work as expected because the DWV-22 was a 1-1/2" ball valve, which was not proportionally controlled. The I/P controller could only open and close DWV-22. Throttling was achieved by the manually operated 3" diaphragm valve (DWV-185) located next to DWV-22.

Originally DWV-22 was a 3" diaphragm valve controlled by an I/P controller. Over time other plant changes reduced the flow thru DWV-22 making accurate control with a 3" valve difficult. To alleviate this problem ECN-409 changed the 3" diaphragm valve to a 1-1/2" ball valve which created the problem addressed in ECN 861. Changing the current 1-1/2"

ball valve to a 1-1/2" diaphragm valve with an I/P controller restored accurate and reliable control to DWV-22.

The change in the valve is to a design that was installed originally and has improved performance over the valve change with ECN-409. The change did not require an amendment to the Technical Specifications.

6.7.1(5) Summary of the nature and amount of radioactive effluents released or discharged to the environs and the sewer beyond the effective control of the licensee as measured at or prior to the point of such release or discharge

During 2015 the gaseous releases to the environs consisted of 1566 Curies of Argon-41, 1241 Curies of Tritium, and 0.01 Curies of other beta-gamma emitters. All NCNR gaseous radioactive effluent releases were in compliance with 10 CFR 20.1101(d).

The table below summarizes the liquid radioactive effluent releases to the sanitary sewer from Building 235 for calendar year 2015.

| H-3⁽¹⁾ (STDEV[2s%]) | C-14 ⁽¹⁾ (STDEV[2s%]) | Beta⁽²⁾ (STDEV[2σ]) | Gamma ⁽³⁾ (STDEV[2σ]) |
|---|---|---|---|
| 5.00 Ci (0.005 Ci) | 4300 μCi (100 μCi) | 370 μCi (10 μCi) | 1900 μCi (10 μCi) |

- (1) Via Liquid Scintillation Spectroscopy (TRI-CARB).
- (2) Via Tennelec instrument (Series 5); includes contributions from gamma radionuclides.
- (3) Gamma isotopes were identified using ~750 ml samples in Marinelli beakers. The following isotopes were identified, in approximate decreasing order of importance: Zn- 65, Co-60, Cr-51, Ag- 110m, Sb-124, Na-24, Sb-122.
- (4) STDEV refers the average propagated standard deviation of the instrument concentrations using an Excel[®] function. For Alpha and Beta activity, 2σ is the standard sigma function. For H-3 and C-14, 2s% refers to an industry standard function defined by Packard/Perkin Elmer. 2s% is the percent uncertainty in a gross count value (with 95% confidence limits), or $2s\% = (100 \times 2 \times \sigma) / (\text{Total Counts})$
- (5) The alpha activity detected in NCNR samples (this year, 16 μCi, STDEV[2σ]=4 μCi) is historically attributed to natural background.

All NCNR liquid radioactive effluent releases were in compliance with 10-CFR-20.2003

6.7.1(6) Summaries of environmental surveys performed outside the facility

Environmental samples of the water, grass, and/or soil showed no licensed radioactive material. Results from thermo-luminescent dosimeters located at the NIST fence line showed no statistically significant dose above background levels.

6.7.1(7) Summaries of significant exposures received by facility personnel and visitors

Dosimetry results:

1. There were no significant exposures (exceeding regulatory limits) to visitors for this reporting period.
2. There were no significant exposures (exceeding regulatory limits) to facility personnel for this reporting period.