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Subject: Docket #50-184

Gentlemen:

Transmitted herewith is Operations Report No. 69 for the NBSR. The report covers the period January 1, 2017 to December 31, 2017.

Sincerely,

Robert Dimeo, Director  
NIST Center for Neutron Research

Enclosure

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A020  
NRR

**NIST**

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

Docket #50-184

Facility License No. TR-5

Operations Report

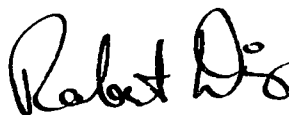
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January 1, 2017 - December 31, 2017

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, 2017 to December 31, 2017.

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

April 2, 2018



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Robert Dimeo, Director  
NIST Center for Neutron Research

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### **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, 2017 through December 31, 2017 the reactor was critical for 4190.0 hours with a thermal energy output of 84505.1 MWH (176.1 equivalent full power days). Major activities during this period included:

1. Implemented LOTO program
2. Converted portion of C002 to Reactor Instrumentation room
3. Installed new analog and digital cabling for C002 to Control Room for instrumentation signals. Started using this wiring for the storage pool section, eventually this will replace all old wire runs  
Installed Storage Pool section of CRU utilizing C002
4. Removed Asbestos and PCB's from the control room
5. Shim arm test stand creation and use for finding fastest/ repeatable mechanical and electronic drop time settings.
6. Changed the thermal shield system individual tube flows from meters to more reliable switches
7. Added PID control to #3 and #4 secondary pumps for BTUR power measurement smoothing
8. Replaced Effluent (3-4/3-5) sampling blower
9. Replaced emergency lighting panels and moved from DC emergency lighting to AC reactor UPS powered emergency
10. Moved our Drop Time calculation to the newest model of Yokogawa "scope-corder"
11. Replaced shim arm drive power and signal wiring from shim cavities to control room
12. Replaced Shim arm drive power transformer from "SCOTT-T" style to standard 208V
13. Replaced capacitor banks for Guide Hall and Building UPS systems.
14. Conducted a thorough vessel inspection in which it was determined that the hold-up pan would no longer hold water indefinitely. A 50.59 evaluation via ECN 1057 was performed and the SAR updated to reflect the outcome. Discussed in section 6.7.1(4).
15. Replaced N-16 detection system
16. In addition, 1 operator trainee received a senior reactor operator license.

### **6.7.1(2) Unscheduled shutdowns, including reasons therefore**

There were three unplanned shutdowns as of December 31, 2017:

1. On March 1, 2017 at 2006 power was reduced to 200kW to replace a cold source PLC. Its replacement took longer than the 36 minutes available before Xenon preclusion. Shim were withdrawn to full out and a reactor power of 400kW was reached the reactor was not critical. The reactor was shut down and secured to wait for Xenon to decay. Reactor power was restored to 20 MW on March 3, 2017 at 0946 (38 HOURS)

2. On May 16, 2017 at 0308 the reactor was shut down due to the cold source compressor shutting down due to a breaker failure. The cold source trouble alarm came in. Reactor rundown occurred due to high pressure in the cold source and BT-9. Power level was reduced and held at 200kW. The breaker could not be repaired in time to recover from the prevailing rundown before the Xenon preclusion and the reactor was shut down. Reactor power was restored to 20 MW on May 17<sup>th</sup>, 2017 at 1626 (36 HOURS)

3. On August 28, 2017 at 2232 reactor power was reduced to 100 kW in response to a Thermal Shield PLC connection failure that caused loss of flow indication on sections one and two of the ring header. The PLC could not be replaced in time and the reactor was shut down at 2311 due to the Xenon preclusion. Reactor Power was restored to 20 MW on August 30, 2017 at 0954 (34 HOURS)

### **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).

The following list is significant I &C maintenance and repair tasks:

Jan 9	Replaced BTUR inlet RTD.
Feb 18	Replaced contactor for air dryer on B2.
Feb 19	Replaced open/supply solenoid valve for BT-2.
Feb 20	Repaired fuse holder/wiring for BT-2 control panel.
Feb 21	Replaced ACV-4 air hoses.
Feb 23	Replaced HEV-41 operator.
Feb 26	Replaced TRCA-3.

Mar 2	Replaced NC-3 HV disconnect NI relay.
Apr 13	Replaced elevator breaker on MCC A5.
Apr 15	Replaced elevator breaker on MCC A5 with 100A breaker.
Apr 22	Installed thermal well for TRC-3.
Apr 25	Replaced contactor for EF-4.
May 5	C100 and C200 O <sub>2</sub> deficiency alarms placed in service.
May 17	Page phone system replacement completed.
Jun 9	Replaced starting batteries for both diesels.
Jul 28	Replaced 28V power supply. Replaced TIA-8 action pack.
Aug 3	Replaced FIA-9 helium flow transmitter. Replaced coil on RWV-13.
Aug 6	Replaced SCV-722 and SCV-724.
Aug 8	Replaced thermal wells and RTD's for TRCA-3 and BTUR inlet.
Aug 10	Installed surge protector modules for the 24V power supply, cooling tower level, and cooling tower temperature instruments.
Aug 11	Installed drain trap on 'A' diesel intercooler.
Aug 15	Installed secondary bag filter d/p switch and inline snubbers. Replaced motor operator on breaker A-1.
Oct 2	Replaced repaired operator for SCV-7.
Oct 17	Repaired reactor console annunciator test switch.

The follow may contain duplications in other sections of this report but this listing is work during the designated scheduled reactor maintenance shutdown.

January-February:

Installed VFD controller for secondary pumps #3 & #4 (to maintain flow during strainer back washing) per ECN 994  
 Installed test equipment and wired regulating rod position to DAQ per ECN 1006  
 Replaced fuel element pickup tools (A4 and L3) per ECN 957

March-April:

Installed secondary flow PID in control room console per ECN 1008  
 Installed helium blow off valve open alarm relay per ECN 1011  
 Replaced normal air EF-3 fan and motor

May-June:

Installed conduit and pull wires for the control room upgrade per ECN 1014  
 Installed new normal air monitoring system RM3-5 per ECN 1009  
 Replaced RWV-13 (process room sump #1 discharge valve) per ECN 977  
 Modified helium level transmitter to 24V per ECN 1025

Changed out nuclear relays per ECN 960  
Installed CO<sub>2</sub> seal flush system to thermal shield pump seals per ECN 981

July-August:

Installed conduit and wiring for storage pool data acquisition and display system per ECN 985  
Replaced #1 and #3 cooling tower fans  
Replaced irradiated air EF-4 filter housing

September-January:

Replaced thermal shield ring header flow meters per ECN 949  
Replaced critical power panel #3 and emergency lighting panels X1 & X2 per ECN 1018  
Brought new 7 KW cold source refrigerator online per ECN 755  
Installed sub-pile room jib crane  
Replaced epoxy coating on cooling tower basin  
Replaced plywood cooling tower cell dividers  
Replaced vessel isolation valve DWV-19 per ECN 757  
Replaced main D<sub>2</sub>O pumps, installed nozzle check and LOCA valves per ECN 834  
Installed storage pool data acquisition and display system per ECN 985  
Installed AN2-32 from simplex fire alarm per ECN 1022  
Vessel Inspection  
Replaced makeup water nozzle to cooling tower basin  
Modifications to N16 monitoring system per ECN 998  
Installed new shim arm drive units per ECN 1038, 1035 and 1043  
Installed hand stacked shielding & shields at cavities 3 & 4 per 1034  
Replaced fuel element pickup tools (D1, F1, H1, J1, F5 and H5) per ECN 957  
Replaced VFD on EF-27 process room ventilation exhaust fan  
Completed control room and C002 asbestos abatement  
Replaced the following secondary cooling valves (SCV): 22, 23, 307, 364, and 723  
Replaced secondary cooling check valve on blowdown line  
Replaced the following water system valves (WTV): 32, 34 and 35  
Replaced the manometers for SF-19, EF-5, and EF-6

The Reactor Instrumentation Group performed 39 instrument calibrations and 31 corrective maintenance operations during 2017. 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 engineering personnel have made corrective actions to some of the instrumentation and control systems at NBSR during 2017. One such project was the implementation of an upgrade to the storage pool system.

**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 were six Level II Engineering Change Notifications (ECN) for which further evaluation was performed using 10 CFR 50.59. ECN 952 did require a license amendment.

Level II  
ECN #

TITLE

757 Replacement Valve for DWV-19 Located Suction Loop of Primary Coolant System.

D<sub>2</sub>O Primary Cooling

Replaced DWV-19 as part of the Aging Reactor Management Program. This change was necessary and part of the primary pump replacement job because the valve was original construction and due for replacement.

A 10 CFR 50.59 Evaluation was performed. It was found that a Technical Specification was not changed nor an amendment required for this ECN.

834 Replace Main D<sub>2</sub>O Pumps and Install Nozzle Check Valves and LOCO Valves

D<sub>2</sub>O Primary Cooling

Replacement Main D<sub>2</sub>O Pumps, Install Nozzle Check Valves and LOCO Valves as part of the Aging Reactor Management Program. This change was necessary and part of the primary pump replacement job and because the components were original construction and due for replacement.

A 10 CFR 50.59 Evaluation was performed. It was found that a Technical Specification was not changed nor an amendment required for this ECN.



- 894 Replacement Pressure Relief Valve (PRV) and Corresponding Piping Change
- D<sub>2</sub>O Primary Cooling
- Replacement of the Pressure Relief Valve. This change was necessary and part of the primary pump replacement job. The replacement of this valve was necessary as part of the Aging Reactor Management Program. The relief valve was original construction and due for replacement.
- A 10 CFR 50.59 Evaluation was performed. It was found that a Technical Specification was not changed nor an amendment required for this ECN.
- 952 Technical Specification Change for Low Power Testing
- Technical Specifications Change.
- Technical Specification Change was approved to allow subcritical and critical startup testing with natural convection flow and not all the grid positions filled.
- A 10 CFR 50.59 Evaluation was performed. It was found that an amendment was necessary because of the required Technical Specification change. Amendment 11 was submitted to the NRC and approved.
- 1044 Thermal Shield Rundown Check Interface
- Thermal Shield
- Thermal Shield rundown check interface was changed to aid in pre-startup checks.
- A 10 CFR 50.59 Evaluation was performed. It was found that a Technical Specification was not changed nor an amendment required for this ECN.
- 1057 Changes to SAR Chapters 4 and 6 For Clarification of the Holdup Pan

## Safety Analysis Report (SAR)

Update of the NCNR SAR corresponding to Vessel and Internals. Changes included chapter 4 and chapter 6 for clarification that the hold-up pan is not part of the emergency core cooling system.

Reactor Operations performed an inspection of the Reactor Vessel and Vessel internal components on December 8, 2017 and December 9, 2017. During the inspection, it was found that there were defects in the materials that make up the holdup pan.

The ECN shows that BNL did not take the holdup pan in consideration for any of the accident analyses.

A 10 CFR 50.59 Evaluation was performed. It was found that a Technical Specification was not needed nor an amendment required for this ECN.

### **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 2017 the gaseous releases to the environs consisted of 1405 Curies of Argon-41, 1596 Curies of H-3, and 0.00396 Curies of other beta-gamma emitters. All NCNR gaseous radioactive effluent releases complied 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 2017.

<b>H-3 (STDEV[2s%])</b>	<b>C-14 (STDEV[2s%])</b>	<b>Beta (STDEV[2<math>\sigma</math>])</b>	<b>Gamma (STDEV[2<math>\sigma</math>])</b>
4.407 Ci (0.006 Ci)	3190 $\mu$ Ci (60 $\mu$ Ci)	109 $\mu$ Ci (9 $\mu$ Ci)	62 $\mu$ Ci (2 $\mu$ Ci)

1. Via Liquid Scintillation Spectroscopy (TRI-CARB).
2. Via Tennelec instrument (Series 5); includes contributions from gamma radionuclides.
3. Gamma isotopes were identified using from - 675 to -1000 ml samples in Marinelli beakers. The following isotopes were identified, in approximate decreasing order of importance: Co-60, Zn- 65, Sb-125, Sb-124, and Br-82.

4. STDEV refers the average propagated standard deviation using an Excel© function. For Alpha and Beta activity, 2cr is two times 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 limit s), or  $2s\% = \{100 \times 2 \times cr\} / \{\text{Total Counts}\}$ .
5. For 2017 the activity detected via Tennelec was 11  $\mu\text{Ci}$  (with  $\text{STDEV}[2cr] = 3 \mu\text{Ci}$ ), and is historically attributed to natural background.

All NCNR liquid radioactive effluent releases complied 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.