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Subject: NIST Test Reactor (NBSR) Annual Report

Ref: Docket #50-184, TR-5 Facility License

Gentlemen:

Transmitted herewith is Operations Report No. 66 for the NBSR. The report covers the period January 1, 2013 to December 31, 2013.

Sincerely,

Robert 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

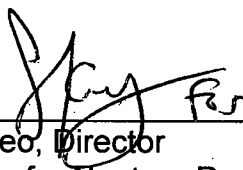
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January 1, 2013 - December 31, 2013

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 January 1, 2013 to December 31, 2013.

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

March 31, 2014

A handwritten signature in black ink, appearing to read 'R. Dimeo', is written over a horizontal line.

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, 2013 through December 31, 2013 the reactor was critical for 5,069.8 hours with an energy output of 100,304.5 MWH (thermal). Major activities during this period included; replacing # 1-4 shim arms; refurbishing the # 1-4 shim arm drives, continuing the Control Room upgrade project; rebuilding the refueling cannon, and replacing and testing the SF-19 absolute filters.

6.7.1(2) Unscheduled shutdowns, including reasons therefore

1. There was an unscheduled SCRAM due to failure of two relays. The nuclear logic relays PR2 and IR2 were replaced. The troubleshooting and replacement of the relays was not completed before Xenon peaked and delayed the reactor restart. The reactor was returned to 20 MW approximately 37 hours after the SCRAM.
2. There was a shutdown from an intentional manual SCRAM. The operations shift intentionally scrammed the reactor in order to switch the critical power UPS from the one that failed to the standby UPS. The Station Battery was supplying the critical power after the failure until the standby UPS was put on line. The reactor was scrammed rather than shutting down by driving the shims in order to save time and avoid a longer shutdown from peak Xenon. The reactor was returned to 20 MW 23 minutes after the SCRAM.
3. There was a shutdown from an intentional manual SCRAM. The operations shift intentionally scrammed and secured the reactor after a thermal shield lower header supply valve controller failed. The troubleshooting and replacement of a fuse for the valve controller was not completed before Xenon peaked and delayed the reactor restart. The reactor was returned to 20 MW approximately 32.2 hours after the SCRAM.

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

Note: Additional corrective maintenance or activities that were not deemed safety significant but were reviewed or screened under 10CFR50.59 are included here for completeness. Some of these items may be also listed as Engineering Change Notices (ECN) in section 6.7.1(4).

<u>Date</u>	<u>Action</u>
Jan 5	Replaced He gas holder makeup control switches.
Jan 19	Aligned #1 shim clutch plate and adjusted current and replaced nuclear logic relays PR2 and IR2.
Feb 7	Replaced drop out chute extension.
Feb 8	Repaired #3 main D ₂ O pump soft start.
Feb 9	Replaced A&B diesel batteries.
Feb 11	Replaced B diesel under frequency relay.
Feb 12	Replaced reg rod control relay K50A, and replaced control relays IR-Rundown and IR-Scram.
Mar 21	Replace fission product monitor detector tube.
Mar 29	Replaced DWV-4's shuttle valve and replaced DWV-14's shut indicator.
Apr 2	Replaced power demand pot and digital display and repaired FTV-1 open button on fuel transfer panel.
Apr 3	Replaces storage pool booster pump mechanical seal.
Apr 10	Replaced cannon valve box hold valves.
May 21	Replaced cooling tower fan #1 time delay relay.
May 23	Waste pit dehumidifiers replaced.
May 25	Replaced storage pool IX resin.
May 28	Replaced fuel transfer panel 115 VAC power module.
Jul 12	Replaced SF-3 contactors.
Jul 15	Replaced #2 main D ₂ O pump soft start.
Jul 19	Replaced #1 shim clutch plate and gear.
Jul 19-21	Replaced the # 1-4 shim arms.
Aug 12	Replaced A diesel fuel supply solenoid.
Aug 21	Replaced #2 secondary aux booster pump breaker bucket.
Aug 24	Replaced thermal column flow loop power regulator(#7)
Oct 3	Replaced #1 main D ₂ O pump D/P cell.
Oct 18	Replaced SF-2 contactor.
Oct 22	Replaced A thermal shield educator pump mechanical seal.
Oct 23	Replaced #3 shim position indication pot.
Nov 23	Replaced and tested the SF-19 absolute filters.
Nov 29	Replaced B thermal shield circulator pumps mechanical seal.
Dec 11	Replaced RM3-3 N-16 detector.
Dec 13	Repaired storage pool cannon telescopic cylinder.
Dec 31	Repaired DWV-4 air control valve.

Reactor Instrumentation Group performed the following:

44 instrument calibrations were performed during 2013. The calibrations ensure that the measurements, indications and controls of the NBSR safety systems are accurate and fully operational. In addition, the Group, with the aid of the reactor operators and engineering personnel, made 25 corrective actions to some of the systems at NBSR throughout the year. The following were the most significant:

The Thermal Column (TC) flow system improvement was performed. The TC measurement and control process loop was modified increasing reactor reliability and reducing liquid waste.

Through research with LND Incorporated, repairs were made to the stack monitor system adjusting the High Voltage (HV) to the optimal setting. This eliminated spikes in the system indication.

The secondary system N-16 monitors GM tubes were replaced to repair signal failure.

New ultrasonic flow sensors in the secondary cooling system were installed to repair failing outdated units that were no longer supported by the manufacturer.

The alarm function on the stack monitor failed to actuate the major scram during a startup check list procedure. The system for the stack monitor is no longer supported and is in the process of being replaced. As a repair to the system until the new equipment is installed an alarm module was created and installed allowing the system to cause a major scram in an event of a high radiation level.

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

The following facility changes, identified as Engineering Change Notices (ECN), were completed in 2013. None required a license amendment or a change to the technical specifications. The first two ECNs (Nos. 613 and 727) were determined to be Level II and the required evaluation under 10 CFR 50.59 was performed. For the remaining ECNs the applicability determination of each found that further evaluation under section 10 CFR 50.59 was not needed (i.e. screened out).

ECN #	Action
613	C-100 to G-100 Line of Sight Wall Penetrations, Level II
727	Shim Control Switch Replacement, Level II
494	Modification of Existing Secondary Piping to Improve Main Pump(s) Performance, Level I
530	Motor Control Center (MCC) Replacement, Level I
534	Battery Room Exhaust Fan, Level I
536	Input Transformer/Feeder Switchgear Replacement, Level I
550 Rev 2	Remove Thermal Column check valve DTCV-18; change diaphragm valve DTCV-19 to a flow controlled globe valve and install bypass line, Level I
554	Install flow meter to monitor D ₂ O cooling to RT-4, Level I
580	Circuit Breaker for Cooling Tower Deicing System, Level I
582	Corrections to HIC Drawings , Level I
587	Adding 2nd Floor to C-202 Conference Room Office (Reyenga/Sprow), Level I
604	Corrections to I&C Loop Drawings , Level I
610	Pneumatic Rabbit System Critical Power Wiring Feed, Level I
614	D-200 Floor Modification , Level I
615	Cold Source Ballast Tank Move , Level I
624	Data Acquisition Network , Level I
625	K-Wing Door Changes, Level I
641	Expand Cooling Tower Level Detector Range, Level I
644	Control Room Video Relocation, Level I
645	Anchor stanchions for A-D Neutron Guides in C100, Level I
646	Anchor stanchions for A-D Neutron Guides in Highbay, Level I
654 Rev A	Relocate Emergency Cooling Spool Piece, Level I
655	Digital Recorder and Reactor Network Modifications for Modbus TCP protocol, Level I
657	Install Modbus Firewall for console and data storage systems, Level I
661	Network Process Controllers, Level I
666	MACS Floor Anchor, Level I
667	Install Temporary Stanchions in C-100 , Level I
675	Network Annunciators, Level I
679	Correct Mislabeling of TIA-31 on DWG D-60-006, Level I
681	Loop Regulator Modification, Level I
685	Neutron and Gamma Ray Shielding in G100 for NG-A thru NG-D South Wall to G-2 Column Line, Level I

686	Neutron and Gamma Ray Shielding in G100 for NG-A thru NG-D North of G-2 Column Line, Level I
689	Network Time Source, Level I
694	C100 Line of Sight Cover, Level I
695	Modifications to Helium Bulk Tank Fill, Level I
696	Network Data Acquisition System to Reactor Network, Level I
697	Network Data Storage and Display to Reactor Network, Level I
705	Thermal Shield Monitor and Annunciator Upgrade, Level I
717	Server Room UPS Refurbished Breaker, Level I
718	Server Room UPS Panel A Replacement, Level I
720	D100 Wall Mount Stanchions, Level I
722	Drilling holes in N & W walls for cryostat load line pipe supports, Level I
732	Remote Indication of Helium Compressor Secondary Cooling Heat Exchanger Temperature, Level I
736	Plating out of Cu Ions to Mg in the Thermal Shield, Level I
737	Replace SCV-20 Equipment Enclosure, Level I
741	Flex-O Rabbit Power, Level I
742	Thermal Shield Line Booster Pump, Level I
744	SAR Chapter 17, Level I
746	Modification of D-Wing Staircases , Level I
747	Thermal Shield HMI Software Update, Level I
750	Change line up of condensate trap (DT-5) and remove tank pressure switch (PIC-102), Level I
752	Tritium Monitor Valve Timing Change, Level I
753	Thermal Shield PV1006 Modification, Level I
754	Remove Thermal Column Pressure Switch (PIC-102) & Bypass Valve (DTCV-15), Level I
756	Thermal Shield PV-1006 Operation Procedure Change, Level I
759	Thermal Shield Software, TV-1002, PV-1003, Max Valve Pressure Environment Variable Change, Level I
760	Modification to Secondary Blowdown Line, Level I
761	Tritium Monitor User Selectable Flush Timing, Level I
766	C200 Mezzanine, Level I
768	Diesel B Underfrequency Relay Replacement, Level I
770	Shorten Length of Fuel Transfer Dropout Chute Cone, Level I
773	Clarification to Startup Prohibit Rung in 70-009-ED Sh 1, Level I

777	Revision correction for two fabrication drawings of Mark III Shim Safety Rod, Level I
780	Add indication to Power Demand Potentiometer, Level I
792	Remove abandoned piping and install dehumidifier in waste pit, Level I
795	Upgrade 24VDC Power Supply on Main D ₂ O pump controllers in MCC A3 & MCC B4, Level I
796	D ₂ O Storage Tank Pump Baseplate Grouting, Level I
798	Shim Arm Cavity Shielding, Level I
800	Revision to SAR Chapter 1, Level I
801	Revision to SAR Chapter 15, Level I
804	Remove Spare in Place Wiring to Shim Terminals, Level I
805	Temporary Core Fuel Configuration, Level I

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

Gaseous releases to the environs consisted of 1430 curies of Argon-41, 1386 curies Tritium, and 0.007 curies of other beta-gamma emitters. All NCNR gaseous radioeffluent releases were in compliance with 10 CFR 20.1101(d).

The table below summarizes the liquid radioeffluent releases to the sanitary sewer from Building 235 for calendar year 2013. All NIST releases comply with 10 CFR 20.2003.

H-3⁽¹⁾ (STDEV[2s%])	C-14⁽¹⁾ (STDEV[2s%])	Beta⁽²⁾ (STDEV[2σ])	Gamma⁽³⁾ (STDEV[2σ])
4.917 Ci (0.006 Ci)	1640 μCi (30 μCi)	128 μCi (9 μCi)	168 μCi (3 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: Co-60, Zn-65, Cr-51, Sb-124, Ag-110m, Na-24, Cs-137.
- (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.
- (5) The alpha activity detected in NCNR samples (this year, 4 μCi, STDEV[2σ]=2 μCi) is historically attributed to natural background.

All NCNR liquid radioeffluent releases were in compliance with 10-CFR-20.2003.

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

Environmental samples of the water, grass, and/or soil showed no licensed radioactive material. Results from thermoluminescent 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 to visitors for this reporting period.
2. There were no significant exposures to facility personnel for this reporting period.