Annual Report for the Nuclear Science Center Reactor at the Texas A&M Engineering Experiment Station; CY2024

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0 INTRODUCTION

0.1 Facility Information

The Nuclear Science Center Reactor (NSCR) is a 1000-kilowatt TRIGA®-conversion reactor housed at the Nuclear Engineering & Science Center (NESC), which is a part of the Texas A&M Engineering Experiment Station (TEES). The reactor is licensed by the U.S. Nuclear Regulatory Commission (NRC), license number R-83, docket number 50-128, and it achieved first criticality in December of 1961. The NSCR license has been renewed several times, the most recent renewal was granted as Amendment 17 on 1 October 2015. There have been two successive amendments since the license renewal and the reactor operated under Amendment 19 throughout calendar year 2024. Amendment 19 to license R-83 was issued on 22 July 2021.

The NESC has 16.5 FTE professional staff, and nominally around 20 student employees. The student employees are primarily split among the operations and radiation safety departments, with one student currently working in NESC administration. As of December 2024, the NSCR had eleven (11) licensed Senior Reactor Operators (one of which was a graduate student) and ten (10) Reactor Operators (nine of which are undergraduate students).

The organization chart for the NSCR, as presented in Technical Specification (TS) 6.1 is shown in Figure 1. A new Director of TEES, Dr. Robert Bishop, began in that position on 1 April 2024, replacing the interim Director, Dr. Joseph Elabd. This was the only change in the Level 1 or Level 2 positions in the calendar year.

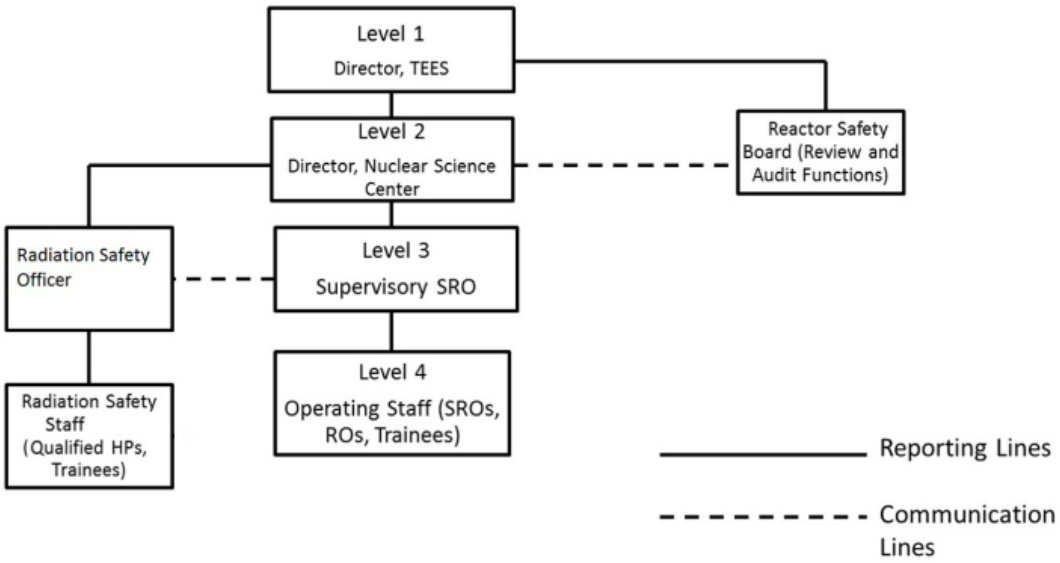

Figure 1: NSCR Organization Chart as shown in TS 6.1.

0.2 Reporting Requirements

This annual report for the NSCR is produced as required by the reactor Technical Specifications §6.7.1 under license R-83 to be submitted by March 31 of the year following the calendar year reporting period. It is submitted to the U.S. Nuclear Regulatory Commission (NRC) in accordance with 10 CFR 50.4(a).

1 OPERATIONS SUMMARY FOR CY 2024 (TS 6.7.1(1))

1.1 Operating Experience

No pulsing operations were performed due to issues with the Transient Rod discovered in June 2023. A new Transient Rod was ordered in August of 2023 with a promised delivery from the vendor of March/April of 2024. As of the date of this document, manufacturing has still not started, and we do not have a revised promised delivery date.

The NSCR fulfilled 140 “Request For Services” (RFS). Ninety-eight of these RFSs were isotope production requests, 9 were for pneumatics irradiations or neutron activation analysis requests, 11 for radiation-based experiment requests, 11 for Texas A&M University Nuclear Engineering Laboratory requests, and 11 for internal operations. The RFS summary is tabulated below in Table 1

Table 1: 2024 Request for Services Summary

Request for Service Summary	
Total Request for Services Performed	140
Isotope Production Requests	98
Pneumatics/Neutron Activation Analysis Request	9
Radiation Experiment Requests	11
Laboratory/Educational Requests	11
Internal Operations	11

More information about operations experience, such as hours and powers, can be found in Section 2.

1.1.1 Isotope Production

The 98 isotope production requests were a mix of internal (TAMU/TAMUS) and external end-users. Thirteen unique isotopes were included in the 2024 production for a total of 74.03 Curies transferred to licensed end-users. For a detailed breakdown of the production by isotope, please refer to Table 2.

Table 2: 2024 Isotope Production at NSCR

Isotope	Curies Produced
Ar-41	4
Au-198	2.08E-05
Br-82	0.66
Co-60	1.35E-03
Cu-64	3.50E-06
Ir-192	11.5
La-140	1
Mn-56	2.54E-04
Na-24	1
P-32	1.29E-01
Sb-124	3.2
Sc-46	52
Ta-182	5.44E-01
Total	**74.03**

1.1.2 Operations Under Approved Experiments

Reactor operations for the 140 Request for Services described in Table 1 all utilized existing approved experiment authorizations.

1.1.3 Operations Under New Experiments

There were no new experiments requested, reviewed. or approved in 2024.

1.2 Changes in Facility Design, Performance Characteristics, and Operating Procedures Related to Reactor Safety

1.2.1 Changes in Facility Design

There were no changes to the Facility Design in calendar year 2024. There was a shuffling of fuel pins as a result of two pins not passing the annual surveillance testing. The two rods that did not pass were placed in used fuel storage, two in-core pins were moved to fill the empty locations, and two spare rods were placed in the location of the pins that were moved. A safety analysis was performed in accordance with procedures and 10 CFR 50.59. There analysis demonstrated that there were no performance changes to the analyzed core from the Final Safety Analysis Report (FSAR) as a result of the change, and low-power physics testing after the change confirmed that.

1.2.2 Changes in Performance Characteristics

There were no changes in performance characteristics noted during calendar year 2024.

1.2.3 Changes in Procedures Related to Reactor Safety

There were no changes to procedures related to Reactor Safety in calendar year 2024.

1.3 Results of Surveillance Tests and Inspections

Results of surveillance tests and inspections can be found in the following tables.

Table 3: Annual Surveillances Performed in 2024 for NSCR

Surveillance	Date	Description
Calorimetric Calibration and Linear Power Channel Maintenance	07/16/24	Performance of the annual calorimetric calibration of the Linear Channel following SOP-III-C as required by T.S. 4.1.1.
Safety Power Channel Maintenance and Surveillance	07/17/24	Performance of the annual Safety Channel calibration for Safety Channels 1 and 2 following SOP-III-E as required by 4.1.1.
Pulse Power Channel Maintenance and Surveillance	-	The NSCR is currently not capable of pulsing due to the damaged Transient Rod, so this surveillance has been deferred until pulsing can resume. This would normally follow SOP-III-F and is required for pulsing operation as per 4.1.1 and 3.2.1.
Fuel Element Surveillance and Inspection	07/12/24	All fuel elements were inspected following SOP-III-H satisfying the requirements in T.S. 4.1.5. Only one fifth of the core is required to be inspected annually, however due to the identification of two damaged fuel elements (failed transverse bend test), the full core was inspected.
Control Rod Scram Time Surveillance	07/12/24	Scram time tests were performed for each scram-able rod following SOP-III-I as required by T.S. 4.2.3.
Transient Rod Drive Maintenance and Surveillance	07/12/24	Preventative maintenance was performed on the shock absorber following SOP-III-J.
Control Rod Drive Maintenance	08/05/24	Preventative maintenance was performed on the Control Rod Drives following SOP-III-L.
Control Rod Calibration and Determination of Shutdown Margin	07/25/24	Low power physics testing and control rod calibrations were performed following SOP-III-M as required by T.S. 4.1.3 and 4.1.6.
Reactor Bridge and Pool Light Maintenance	07/12/24	Preventative maintenance was performed on the Reactor Bridge and Pool Lights following SOP-III-N.
Multimeter Maintenance and Surveillance	05/23/24-05/31/24	Both multimeters used for equipment calibrations (SN:4061010 and SN:1322159) were sent out for calibration following SOP-III-P.

Surveillance	Date	Description
Crane Maintenance	06/04/24	Inspection and preventative maintenance of the Upper Research Level overhead crane were performed.
Biennial Control Rod Inspection	07/12/24	Due to the discovery of a damaged fuel element, full inspection of all control rods was performed following SOP-III-K, required biennially by T.S. 4.2.3.
Biennial Control Rod Drive Location & Height Measurement	07/12/24	The control rod heights and locations were measured before core disassembly and after reassembly and checked against previous measurements to verify correct reinstallation.

Table 4: Semiannual Surveillance Performance List

Surveillance Title	Dates Performed	Description
Semiannual Fuel Element Temperature Measuring Channel Maintenance	08/05/24 01/10/25	The Fuel Element Temperature Channel was calibrated following SOP-III-B as required by T.S. 4.2.2.
Semiannual Linear Power Measuring Channel Maintenance	07/16/24 01/10/25	The linearity of the different Linear Channel Range Modes was tested and confirmed accurate following SOP-III-C.
Semiannual Log Power Measuring Channel Maintenance	07/19/24 01/10/25	The Log Channel was calibrated following SOP-III-D, meeting the annual requirement set by T.S. 4.1.1.
Semiannual Reactor Pulse Power Surveillance	-	The NSCR is currently not capable of pulsing due to the damaged Transient Rod, so this surveillance has been deferred until pulsing can resume. This would normally follow SOP-III-G and is required for pulsing operation as per T.S. 4.1.2.
Semiannual Transient Rod Drive Maintenance	07/12/24	Preventative maintenance was performed on the Transient Rod Drive cylinder following SOP-III-J as required by T.S. 4.2.3.
Semiannual Scram Circuit Surveillance	07/12/24 01/12/25	The operability of manual scrams throughout the facility were tested and confirmed operational following SOP-III-I.
Semiannual Evacuation Horn System Surveillance	07/12/24 01/10/25	The Emergency Evacuation Horn and the Emergency Evacuation Horn bypass valve were tested following SOP-III-R.

Surveillance Title	Dates Performed	Description
Semiannual Pool Temperature Measuring Channel Maintenance	08/05/24 01/10/25	The Primary Coolant Temperature Measuring Channel was calibrated following SOP-III-B as required by T.S. 4.8.3.

Table 5: Quarterly Surveillance Performance List

Surveillance Title	Dates Performed	Description
Quarterly Transient Rod Drive Maintenance	03/28/24 07/12/24 10/07/24 01/10/25	Preventative maintenance was performed on the Transient Rod following SOP-III-J.

An additional 34 corrective maintenances were performed. 29 of these corrective maintenances were classified as like-for-like replacements and were performed under the NESC AP-12 Maintenance/Repair procedure. The AP-12's are tabulated below in

Table 6: Table of Corrective Maintenance Items

AP-12 Number	Date Work Completed	Description of Work Performed
2024-01	1/4/2024	Replacement of Reverse Osmosis system carbon tank and feed hoses. The tank was replaced due to normal degradation and the hoses were replaced due to small leaks.
2024-02	3/12/2024	Installation of new mylar film covering for the FAM 1 plastic scintillator. Old mylar was damaged and was loosely affixed.
2024-03	4/16/2024	Maintenance and repair on the Lower Research Level Repack Area hot cell right manipulator arm. Maintenance consisted of cleaning and replacement of damaged cables and connectors.
2024-04	3/19/2024	Replacement of Safety Channel 2 Test Current Switch. Switch had been observed to have faulty connections and to induce noise when not engaged. Noise was shown to be corrected with the installation of the new switch.
2024-05	4/3/2024	The mechanical indicator for the Log Channel Test Current potentiometer and the potentiometer itself was offset to where a "zero" indication did not line up with a zero current setting. The indicator was mechanically reset to re-align the zero readout with zero current, and the setscrew was tightened.

AP-12 Number	Date Work Completed	Description of Work Performed
2024-06	3/28/2024	Installation of new pneumatic hoses for the in-core D-2 rabbit irradiation system. Old hose had a kink in the line which could cause a sample to get stuck in travel to the D-2 location or when returning to the rabbit system receiver.
2024-07	4/3/2024	Repair of the connector connecting the Regulating Rod Drive Drawer to the Regulating Rod Drive due to noise induced into other console channels by the Regulating Rod Drive Drawer.
2024-08	4/4/2024	Adjustment to the FAM 4 paper drive mechanism. The tensioner was observed to be too tight, and the motor chain was out of alignment.
2024-09	4/16/2024	Repair of poor ground connection in the Safety Channel 2 Drawer which was causing low level noise when the reactor was shut down.
2024-10	4/18/2024	Replacement of the Ortec Model 478 FAM Channel 6 high voltage power supply with a Canberra Model 300D2. This was due to the inaccuracy of the analog voltage display in the Ortec Model 478.
2024-11	5/2/2024	Replacement of out of calibration and worn RMC-105 air flow meters for the FAM system with new, calibrated ones.
2024-12	5/2/2024	Replacement of FAM pump hose fitting connecting the pump to the FAM system due to detected leaks and poor connection.
2024-13	5/2/2024	Removal of old ICAM hose taps and non-operational hoses in the FAM system. Connection positions were plugged with NPT pipe plugs.
2024-14	6/13/2024	Replacement of cracked brass coupling in the Transient Rod Air Supply System.
2024-15	6/17/2024	Re-application of Teflon tape to the Demineralizer System water test port nipple to resolve a minor leak.
2024-16	-	Lower Research Level Access Lockdown Switch Repair. Project not started in 2024 and was terminated to be performed in 2025 as a new AP-12.
2024-17	7/23/2024	Replacement of the sheave coupler and installation of new B38 belts on FAM pump #3. Sheave coupler had been loosened due to vibration over time, which caused belt to also break.
2024-18	8/1/2024	Replacement of FAM pump #1 cooling fan and vanes in pump, as well as installation of new A38 belt. The pump had been making loud noises due to the damaged vanes, and the belt needed to be replaced as part of preventative maintenance.
2024-19	7/30/2024	Replacement of Facility Air Compressor discharge hose following a rupture in the hose due to general wear.

AP-12 Number	Date Work Completed	Description of Work Performed
2024-20	8/30/2024	Replacement of FAM pump #2 vanes in pump, as well as installation of new A38 belt. The pump had been making loud noises due to the damaged vanes, and the belt needed to be replaced as part of preventative maintenance.
2024-21	8/26/2024	Movement of the Log Channel Fission Chamber 2 cm closer to the Reactor Core following SOP-III-D. This was to resolve issues in obtaining the T.S. required 2 cps with the source installed and the reactor shutdown during calibration.
2024-22	9/13/2024	Replacement of the CRDM engaged switch on CRDM-E due to a failed seal on the switch.
2024-23	10/8/2024	Replacement of HVAC Differential Pressure Sensors (RPM-1BD4E) for Zone AB and Zone C due to failed calibration check.
2024-24	10/7/2024	Replacement of HVAC expansion board, calibration of flow sensors, and repair of electrical connection for AHUA.RA.DMP to resolve HVAC Exhaust suction points not responding to computer commands and staying shut.
2024-25	1/6/2025	Changing the Building Pressure alarm setpoint from -0.15 inch WC to -0.1 inch WC, which is within T.S. 3.3.2 requirements. This was done to minimize the rate of false alarms for the loss of Central Exhaust.
2024-26	11/26/2024	Replacement of Control Room Reactor Console UPS battery due to battery failure.
2024-27	-	Safety Channel 1 Circuit Board Inverter IC Replacement. Project elevated to AP-11 due to need to repair traces on circuit board as well (AP-11-2024-09).
2024-28	12/10/2024	Replacement of FAM Channel 1 SHV (KINGS 1705-1) connector due to poor grounding and noise in circuit.
2024-29	12/20/2024	Replacement of FAM Channel 3/5 BNC, SHV, and 9-Pin cables due to noise caused by pinched wires. New wires were rerouted to prevent future pinching.
2024-30	1/10/2025	Replacement of Control Rod Drive drawer up and down control switches (OSLO DPST) to resolve poor response from switches that has developed from general wear.
2024-31	1/10/2025	Replacement of Safety Channel 1, Safety Channel 2, and Log Channel drawer Test and Reset control switches (OSLO DPST) to resolve poor response from switches that has developed from general wear.

2 ENERGY OUTPUT FOR CY 2024 (TS 6.7.1(2))

During calendar year 2024, the NSCR operated at steady state for 773.7 hours, which resulted in a total integrated power of 23.02 MWD. This brings the total cumulative energy output of the NSCR since 2006, the year of the conversion from HEU to LEU, to 1122.3 MWD.

Table 7: 2024 Reactor Operation Summary Table

2024 QTR	Hours at Full-Power	Steady-State Hours	Avg. Power (kW)	Total Energy (MW-hr)	Total Energy (MWd)
Q1	148.50	209.38	655.25	137.20	5.72
Q2	176.93	234.37	751.01	176.01	7.33
Q3	141.48	174.28	768.50	133.94	5.58
Q4	112.15	155.68	676.04	105.25	4.39
Year Total	**579.07**	**773.72**	**712.70**	**552.40**	**23.02**

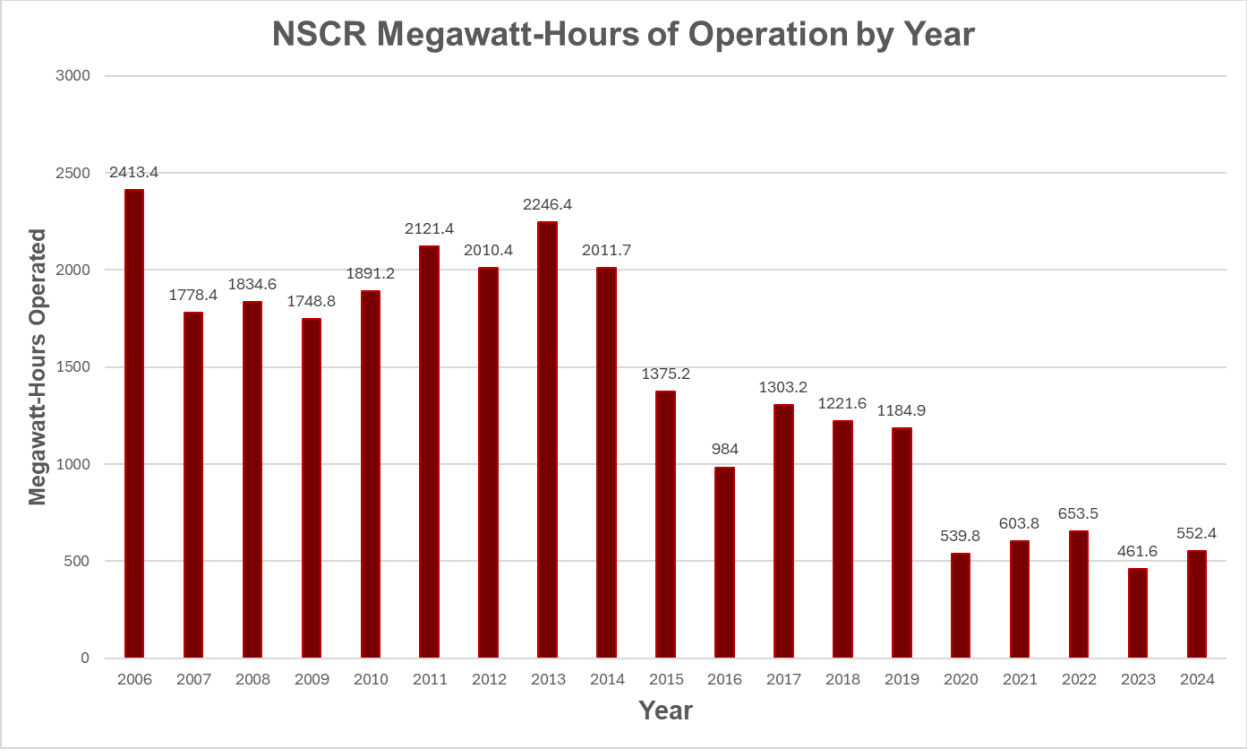

Figure 2: NSCR Megawatt Hours of Operation by Year

Table 8: Other Operation Items

Operation Summary	
Total Mega-Watt Days of Energy Production Since 2006	1122.3
Number of Pulses for 2024	0

3 UNSCHEDULED SHUTDOWNS AND SCRAMS FOR CY 2024 (TS 6.7.1(3))

3.1 Safety System SCRAMs

There were no SCRAMs that were actuated by the console safety systems for 2024.

3.2 Manual SCRAMs

There were three (3) manual SCRAMs during operations of the NSCR in 2024. They are summarized in Table 9 below.

Table 9: List of Unplanned Manual SCRAMs for 2024.

Date	Cause	Resolution
04/01/2024	During reactor startup SS-1 jammed at 45.5%. Records are in conflict here, the log book shows that the reactor was shut down normally, however a SCRAM log was created (number 679).	SS-1 CRDM was realigned and confirmed to be unobstructed. SCRAM time test was performed and SS-1 passed and cleared for resumption of reactor operations
09/11/2024	The reactor was operating at steady state by the irradiation cell at 50 kW. A count rate spike on FAM-5 (Xenon-125) cause the air handling system to shut down. The reactor operator scrammed the reactor.	Xenon-125 production no longer occurs at the NESC; however, the facility air monitor required for that work was not removed from the Technical Specifications. All other FAM channels were clear during the observed spike. The reactor returned to normal operations.
09/17/2024	During reactor startup the Transient Rod was being raised and had reached 20%. Startup was halted when a hissing was heard from the bridge, which indicated a bad seal in the transient rod CRDM. The operator scrammed the reactor.	It was determined that the seal on the Transient Rod is degraded. General Atomics is unable to provide a suitable replacement part, nor are they able to provide exact specifications for a replacement since they were procured by GA from a third-party and they do not have suitable records. Regular operations resumed after the issue was determined to not present a safety concern while a suitable replacement is sought.

3.3 Unscheduled Shutdowns

There were nine (9) unscheduled shutdowns in 2024 which are detailed in Table 10 below.

Table 10: List of Unscheduled Shutdowns for 2024.

Date	Cause	Resolution
03/11/2024	During FAM checks, FAM-1 mylar was observed to require replacement. Reactor was shut down normally.	FAM-1 was rerouted to FAM-2 temporarily while FAM-1 was repaired. FAM-1 was repaired and tested, then returned to normal operation.
04/01/2024	During reactor startup SS-1 jammed at 45.5%. Reactor was shut down normally. This is a duplicate report for an even noted in Table 9 above.	SS-1 CRDM was realigned and confirmed to be unobstructed. SCRAM time test was performed and SS-1 passed and cleared for resumption of reactor operations
04/08/2024	Smoke was observed in Chase Level of reactor building; compressor was determined to be running hot. Reactor was shut down normally.	Resolution of compressor issue was not logged; however, the issue was resolved and the reactor resumed normal operations the next day.
04/09/2024	Small power oscillations were observed occasionally by both DSRO and DRO during steady state operations at 900 kW. At 11:32 a power oscillation hit a high power of 950 kW. Reactor was shut down normally to investigate.	Upon investigation it was suspected that the flow from the primary coolant system (PCS) discharge on the west side of the pool was causing an underwater current of cooler water that the servo-controller was overcompensating for. The PCS discharge was changed to the east end of the pool. The reactor was restarted three hours later, and the issue did not recur.
04/25/2024	The reactor data logging computer lost connection during operation. The reactor was shut down normally to investigate.	The computer was restarted and connection was reestablished. The reactor resumed operations the next day.
05/30/2024	Shim-Safety-1 dropped due to an accidental bump of the upper control rod drive mechanism during sample change. The reactor was shut down normally.	SS-1 was raised to 100% to ensure unobstructed operation. A SCRAM time test was conducted and passed. The reactor resumed normal operations within an hour.

Date	Cause	Resolution
08/06/2024	Stack argon alarm, and short spike on all FAM channels. During full-power operations (900 kW), FAM-3 alarmed and a spike was noted on all other FAM channels. The spike only lasted a second, then all channels returned to normal. The reactor was shut down normally to investigate.	Due to the short duration of the spike and the return to normal, and the absence of any elevated radiation measurements on the Area Radiation Monitors, it was suspected that the FAM spikes were related to electronic noise in the measurement system. All FAMs were placed in bypass so samples of the filter paper from the particulate channels could be measured for confirmation. There were no further indications of radiation activity. The filter papers measured clean. Normal reactor operations resumed the next day.
09/23/2024	SS-2 jammed during planned reactor shutdown. The operator turned off magnet power to SS-2 and the rod dropped, the rest of the rods were lowered to the 0% lower-limit normally.	The Control Rod Drive Mechanism (CRDM) for SS-2 was disconnected and reconnected. The problem did not repeat. CRDMs 1 and 2 were swapped, tested, then returned to normal configuration. The problem did not repeat. The reactor resumed operation the next day.
09/26/2024	During reactor shutdown, SS-2 jammed at 63.6%. The rod was able to raise but could not be lowered below 63.6%. Magnet power was cut off for SS-2 and the rod dropped. All other rods were lowered normally.	SS-2 was taken out of service for repairs. The CRDM was serviced from 10/2 to 10/7. The rod was reinstalled and tested, passing all tests. The reactor resumed normal operations on 10/7.
12/06/2024	During steady state operations at full-power (900 kW), FAM-1 spiked and caused a shutdown of the Air Handling System. The spike was short and there were no other indications of radiological trouble. The reactor was shut down normally.	During the investigation it was determined that the FAM System NIM Bin was moved by facility personnel moving a desk in the FAM room, which disturbed the cables and cause electronic noise in the system. The FAM room was returned to the original configuration and normal reactor operations resumed the next day.

4 MAJOR MAINTENANCE FOR CY 2024 (TS 6.7.1(4))

There were three (3) items that could be considered major maintenance items, which are summarized in Table 11 below.

Table 11: Summary of Major Maintenance Items for Calendar Year 2024.

AP-11 Number	Date Work Completed	Description of Work Performed
2024-01	03/06/2024	Pool fill valve (CW-1) was relocated approximately 2 feet lower and 4 feet to the right of its original location to give plant operators' more direct access during emergencies. The rubber hose attached was replaced by an identical hose of greater length to reach the new location. Project screened out of a 50.59 review.
2024-03	2/28/2024	Jacks previously being used for raising and lowering the bridge replaced due to mismatched equipment and observable stress on jacks during raising and lowering of the reactor bridge. Jacks were replaced with Torin 1.5-ton scissor jacks (T10152), which abide by ANSI/ASME PASE safety standards. Project screened out of a 50.59 review.
2024-08	10/02/2024	Replacement of fission chamber on the log channel.

5 SAFETY EVALUATIONS OF CHANGES TO THE FACILITY, PROCEDURES, TESTS, AND EXPERIMENTS FOR CY 2024 (TS 6.7.1(5))

There were three (3) changes managed by AP-11 that screened into 50.59 evaluations in 2024. They are described in Table 12 below.

Table 12: List of Safety Evaluations Performed Under 50.59 Requirements in 2024.

AP-11 Number	Date Work Completed	Description of Work Performed
2024-05	7/15/2024	Replacement of damaged fuel elements 11420 and 11391 and shuffling of new fuel (elements 11442 and 11444) into the core. Project screened into a 50.59 review and was approved as not needing a license amendment request.
2024-08	11/20/2024	The fission chamber used as the detector for the NSCR Log Channel had failed and was replaced with a like-for-like replacement (RS-C3-2510-114). During this replacement, the aluminum extensions used for the old fission chamber were removed and the channel cables were connected directly to the detector, following the original manufacturer's specifications. This project screened into a 50.59 review and was approved as not needing a license amendment request.
2024-09	11/20/2024	Safety Channel 1 was not producing an audible or visible alarm when a scram signal from the channel was induced due to a damaged inverter IC chip (7406) in the Safety Channel 1 drawer circuit board position U9. This Inverter IC chip was replaced with a like-for-like chip, however, traces on the circuit board had to be repaired as part of the maintenance. This project screened into a 50.59 review and was approved as not needing a license amendment request.

6 RADIOACTIVE EFFLUENTS RELEASED OR DISCHARGED FOR CY 2024 (TS 6.7.1(6))

NSCR Technical Specifications state that "a summary of the nature and amount of radioactive effluents released or discharged to the environs beyond the effective control of the licensee as measured at or before the point of such release or discharge." The liquid and solid waste and gaseous and particulate effluents are discussed in the sub-sections below.

6.1 Liquid Waste (TS 6.7.1(6)(a))

6.1.1 Radioactivity Discharged in Liquid Waste

Table 13: Monthly Summary of Liquid Waste Released to the Sanitary Sewer

	Cr-51 (Ci)	Mn-54 (Ci)	Co-58 (Ci)	Co-60 (Ci)	Zn-65 (Ci)	Sb-122 (Ci)	Sb-124 (Ci)	Ir-192 (Ci)	Monthly Total All Isotopes
Jan		2.21E-06		3.57E-06					5.78E-06
Feb		4.02E-07		5.49E-07					9.51E-07
Mar		7.53E-07		2.02E-06					2.77E-06
Apr		4.09E-07		2.38E-06					2.79E-06
May		1.57E-06		1.69E-06					3.26E-06
Jun		9.44E-07		2.30E-06			4.84E-07	1.23E-06	4.96E-06
Jul				1.23E-06					1.23E-06
Aug				1.19E-06					1.19E-06
Sep				5.93E-06				1.15E-06	7.08E-06
Oct	2.64E-05	7.82E-05	2.59E-05	7.35E-05		4.05E-06	7.62E-07		2.09E-04
Nov		4.72E-06	1.73E-06	7.09E-06	1.56E-06				1.51E-05
Dec		6.98E-07		1.45E-06					2.15E-06
Yr Total by Isotope	**2.64E-05**	**8.99E-05**	**2.76E-05**	**1.03E-04**	**1.56E-06**	**4.05E-06**	**1.25E-06**	**2.38E-06**	

Table 14: Effluent Concentration for Detectible Radionuclides Greater Than 1x10^{-7} µCi/cc

	Cr-51	Mn-54	Co-58	Co-60	Zn-65	Sb-122	Sb-124	Ir-192
January								
February								
March								
April								
May								
June								
July								
August								
September				1.92E-07				
October	3.84E-07	1.20E-06	3.96E-07	1.14E-06				
November		1.27E-07		1.91E-07				
December								

6.1.2 Total Volume of Effluent Water

The total volume of liquid effluent discharged to the sanitary sewer by the NSCR and NESC is summarized by month in Table 15 below.

Table 15: 2024 Total Volume of Liquid Effluent Discharged by NESC Including Diluent

Month (2024)	Gallons Discharged
January	1.57E+04
February	1.13E+04
March	2.17E+04
April	2.07E+04
May	2.29E+04
June	3.35E+04
July	3.48E+04
August	3.34E+04
September	2.69E+04
October	4.13E+04
November	1.93E+04
December	9.46E+03
Total	2.91E+05

6.2 Airborne Waste (TS 6.7.1(6)(b))

6.2.1 Argon-41 Discharge

Argon-41 effluents from the reactor facility are monitored at the base of the central exhaust stack by the reactor stack gas monitor. Monitoring is continuous during operation of the reactor. The annual argon-41 discharge limit as specified in TS 3.5.2 is 30 Ci/year. The total argon-41 discharge for 2024 was 6.17E-04 Curies, or 0.002% of the allowed discharge limit. Table 16 below provides a monthly summary of argon-41 effluents during the 2024 reporting period.

Table 16: Monthly Summary of Argon-41 Activity Discharged from the Facility for 2024

Month	Argon-41 Discharged (Ci)
January	1.51E-04
February	<Background
March	<Background
April	<Background
May	<Background
June	<Background
July	1.92E-04
August	9.18E-05
September	<Background
October	<Background
November	<Background
December	1.82E-04
Total	**6.17E-04**

6.2.2 Particulate Discharge (Greater Than 8-Day Half-life)

Potential radioactive particulate effluents are monitored at the base of the central exhaust stack by the stack particulate monitor. Technical Specification 6.7.1.6.b.i.2 requires a record of the "Particulates with half-lives greater than eight days" to be summarized on a monthly basis for the annual report. There were no releases of particulate effluents with a half-life greater than eight days during the reporting period.

6.3 Solid Waste (TS 6.7.1(6)(c))

6.3.1 Total Volume of Waste Transferred

There were no solid waste disposals during this reporting period.

6.3.2 Total Activity

There were no solid waste disposals during this reporting period.

6.3.3 Shipment Dates and Disposition of Offsite Transfers

There were no solid waste disposals during this reporting period.

7 RADIATION EXPOSURE SUMMARY (TS 6.7.1(7))

The NSCR annual reporting requirements specify that the licensee shall include a summary of radiation exposures received by facility personnel and visitors. The summary includes all NESC personnel and visitors who may have received exposure to radiation. These personnel are categorized by the following groups: full-time employees, student technicians, visiting researchers, and visitors.

- Full-time employees consist of NESC staff in operations, health physics, engineering, facilities/maintenance, and administration. The individual dosimetry requirements for these personnel will vary depending on the type of work being conducted but generally include monthly OSL film badge and TLD (finger) extremity dosimeters.
- Student Technicians consist of student employees in both the operations and health physics departments. These personnel are monitored using OSL film badge and TLD (finger) dosimeters.
- Visting researchers are individuals who perform research, tests, or experiments using the reactor, reactor-activated materials, or other radioactive material and facilities at the NESC. The individual dosimetry requirements vary for these individuals depending on the type of work being performed but will generally include OSL film badge and TLD (finger) extremity dosimeters.
- Visitors to the NESC consist of students attending lab and do not handle radioactive materials, and tour groups. These individuals are monitored by pocket ion chambers.

An annual summary of radiation doses received by the personnel and visitors listed above is shown in Table 17. There were no personnel radiation exposures exceeding the limits in 10 CFR 20 during the reporting period.

Table 17: Annual Summary of Personnel Radiation Dose Received at NESC for 2024

	Average Individual Annual Dose		Greatest Individual Total Dose for the Year 2024	
Personnel Group	**Whole Body (mrem)**	**Extremities (mrem)**	**Whole Body (mrem)**	**Extremities (mrem)**
Full-Time Employees	32	123	138	638
Student Technicians	20	81	107	401
Visiting Researchers	1	7	6	133
Visitors	0	N/A	0	N/A

8 ENVIRONMENTAL SURVEYS (TS 6.7.1(8))

The NSCR Technical Specifications state that “a description and summary of any environmental surveys performed outside the facility” be included in the annual report.

Monitors used in the environmental radiation monitoring program consists of TLD dosimeters at eleven environmental monitoring stations. The eleven stations consist of nine stations on or near the site fence and two “background” stations off-site (stations 14 and 23). Standard practice has been that quarterly dosimeters are issued, received, and reported by the Texas Department of State Health Services (TDSHS) Radiation Control Division. Service by TDSHS on these dosimeters has been inconsistent and undependable, and NESC is not given the actual dosimetry reports from the vendor, but instead we are given reports generated by the State office. For example, the reports from TDSHS for quarters three and four of 2024 have not been received to date.

In the fourth quarter of this reporting period, the NESC added a second set of quarterly TLD dosimeters using the NESC dosimetry vendor’s product, which is the same as the one used by TDSHS. at the same eleven locations to be placed with the dosimeters issued by TDSHS. The purpose of this modification was to have faster reports and redundancy the program and offer the opportunity to discontinue utilizing TDSHS’s environmental monitoring service.

Dose reports from Landauer for the fourth quarter of this reporting period for the NESC dosimeters all reported below the minimum detectable limit (MDL) for the quarter. A summary of the TLD data is shown in Table 5. NESC concludes that all doses recorded by site and off-site dosimeters can be attributed to natural background radiation which is about 75 mrem per year for Texas.

Table 18: Summary of Dose Recorded on Environmental Monitoring Dosimeters

Station Number	Location	Quarterly Gross Exposure (including background) (mrem)				Total Dose (mrem)
		Q1	Q2	Q3[1]	Q4[2]	2024
2	300 ft. NW of reactor building	51	52	N/A	<MDL	103
3	250 ft. NW of reactor building	40	42	N/A	<MDL	82
4	200 ft. NW of reactor building	47	44	N/A	<MDL	91
5	225 ft. NE of reactor building	32	34	N/A	<MDL	66
10	190 ft. SE of reactor building	32	33	N/A	<MDL	65
11	300 ft. SE of reactor building	32	34	N/A	<MDL	66
14	3.0 miles NW of facility	33	35	N/A	<MDL	68
18	375 ft. NE of reactor building	33	34	N/A	<MDL	67
19	320 ft. NE of reactor building	44	66	N/A	<MDL	110
23	0.25 miles SE of the facility	32	33	N/A	<MDL	65
24	350 ft. W of reactor building	33	35	N/A	<MDL	68

[1] Quarter 3 results have not been made available by TDSHS.
[2] Quarter 4 results are based on NESC provided Landauer dosimeters.