TEXAS ENGINEERING EXPERIMENT STATION

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March 30, 2009.

U.S. Nuclear Regulatory Commission
Attn: Document Control Desk
Washington, D.C. 20555

Subject: 2008 Annual Report (Facility License R-83) 2009-0008

To Whom It May Concern:

Enclosed please find the 2008 Annual Report for the Texas Engineering Experiment Station Nuclear Science Center, Texas A&M University, College Station, TX 77843. If you have any questions regarding this, please feel free to call Latha Vasudevan or myself at (979) 845-7551.

Sincerely,

W. D. Reece, Director

Enclosure

LV/jg

Xc: 211/Central File
Annual Report File
Dr. Ken Hall, Deputy Director of TEES, Licensee and RSB Chairman
Jim Remlinger, Associate Director
Latha Vasudevan NSC RSO

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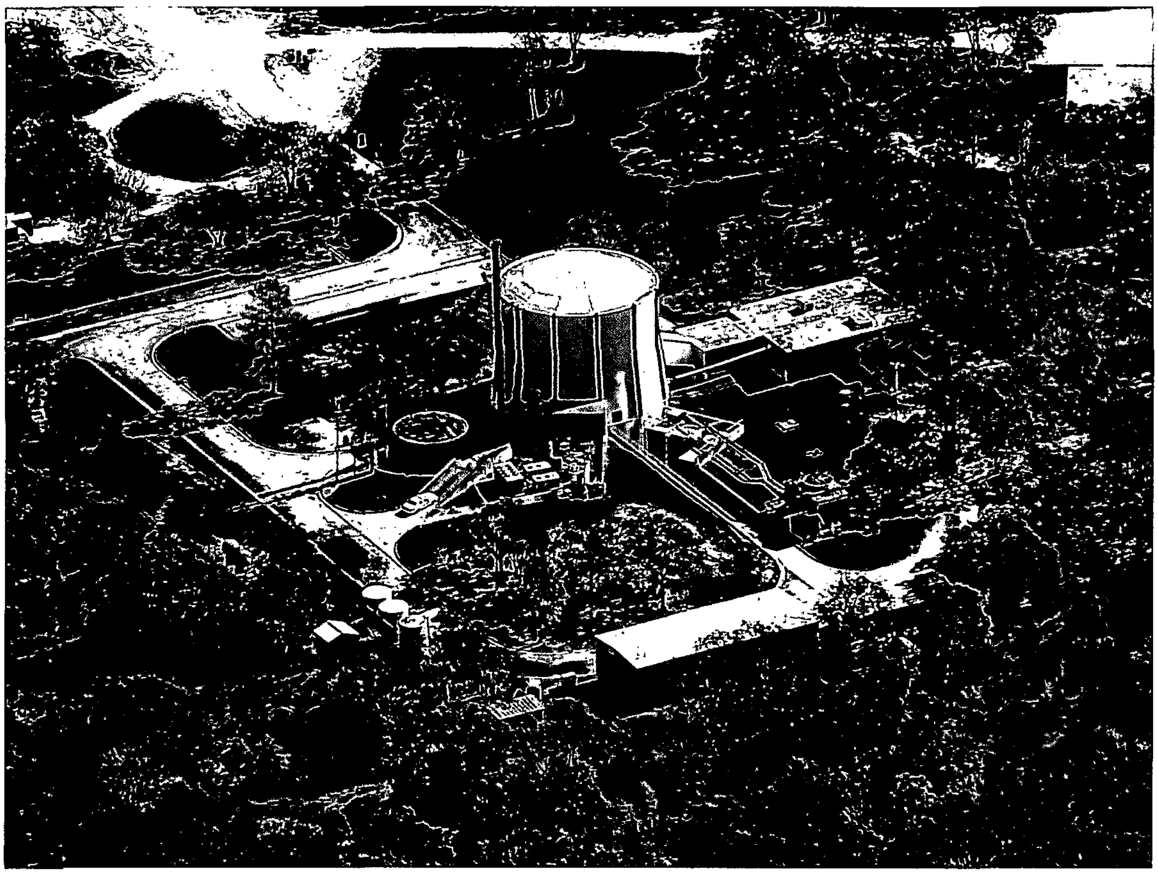
NRR

Texas A&M University

Nuclear Science Center

Annual Report-2008



Nuclear Science Center

Texas Engineering Experiment Station

Texas A&M University System

College Station, Texas 77843-3575

Texas A&M University System
Texas Engineering Experiment Station

2008 Annual Report

Facility Operating License R-83

Nuclear Science Center
1095 Nuclear Science Road
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Reviewed By: W. D. Reece, NSC Director

March 2009

CONTENTS

List of Tables

List of Figures

I. Introduction

The Texas A&M University (TAMU) Nuclear Science Center (NSC) is a multi-disciplinary research and education center supporting basic and applied research in nuclear related fields of science and technology as well as providing educational opportunities for students in these fields as a service to the Texas A&M University System and the state of Texas. The NSC also provides services to commercial ventures requiring radiation or isotope production services.

The NSC reactor is a 1 MW TRIGA research reactor in a large (108,000-gal.) pool. The size of the NSC reactor pool provides great flexibility in the experiments that may be conducted near the reactor. The Science Center has a calibration facility using a Cs-137 calibrator, a large-object irradiation cell, a film neutron radiography system, a large neutron/gamma irradiation cell, and two neutron beam ports, hot cells and manipulators, and other supporting facilities.

Laboratory facilities include counting laboratories with gas flow proportional detectors and High Purity Germanium detectors, a two-station pneumatics sample transfer system, a fast neutron irradiation system, a delayed neutron detection system and a prompt gamma neutron activation analysis system.

The NSC reactor design allows for easy loading/unloading of various types of samples. The NSC actively produces a variety of radioisotopes for industry, hospitals, and academic users. The NSC provides nationally recognized neutron activation analysis (NAA) services to many research and academic institutions in the United States. The Nuclear Engineering Department on campus is a major user of the NSC reactor. The NSC is also one of the major attractions on campus. Last year, the NSC hosted about 1957 visitors including: elementary, middle school, high school and college students as well as faculty members, national laboratory scientists and industrial clients. Through these tours, the NSC taught people with widely varying backgrounds about nuclear science.

With strong support from the University, the NSC is continuously increasing the diversity of its facilities and services. The NSC and the Nuclear Engineering Department are collaborators of the Innovations in Nuclear Infrastructure and Education Grant. As part of this grant, the NSC supported the graduate student projects on the delayed neutron counting system and continued to produce the prototype for distance learning modules. Moreover, Texas Work Force Commission provides support for operator training program.

With the DOE instrumentation grant, NSC has pursued the development of a prompt gamma neutron activation analysis (PGNAA) system that will be utilized for research and teaching in future. NSC continues to improve on the detection capabilities of the HPGe system and upgrade the software that is being used for the PGNAA system.

NSC management has been working on the LEU conversion Safety Analysis Report that was submitted to NRC as an amendment to the R-83 license renewal process. NSC license will be amended to incorporate an increase in the special nuclear material so as to make room for new fission detectors in future.

This annual report has been prepared to satisfy the reporting requirements of Technical Specification 6.6.1 of the facility operating license R-83 and of the Department of Energy University Reactor Fuel Assistance Program subcontract No. C87-101594 (DE-AC07-76ER02426).

1.1 Nuclear Science Center Staff

The staff at the Nuclear Science Center consists of four major groups: Reactor Operations, Health Physics/Technical Coordination, Reactor Maintenance, and Administrative Services. Personnel directly involved with the operation and maintenance of the reactor are NRC-licensed operators. The NSC is committed to its educational responsibilities and many members of the staff are part or full-time students at Texas A&M University. Appendix A shows the Nuclear Science Center Organization Chart.

The Texas Engineering Experiment Station (TEES) of the Texas A&M University System operates the NSC. The Director of the NSC is responsible to the Deputy Director of the TEES for the administration and the proper and safe operation of the facility. The NSC Radiation Safety is responsible for the Director of NSC for matters relating to safety and for maintaining a proper radiation safety program. In addition to the internal structure, the Reactor Safety Board (RSB) advises the Deputy Director of the TEES and the Director of the NSC on issues or policy pertaining to reactor safety. The Texas A&M University Environmental Health and Safety Department (EHSD) provide assistance when it is required for emergencies and for special operations as agreed. The Texas A&M University Police Department provides security support on a daily basis and is a key support group in the event of a security incident. The College Station Fire Department and the College Station Medical Center provides offsite emergency support when it is required as per agreement.

2. Reactor Utilization for 2008

The Nuclear Science Center (NSC) reactor has been in operation since 1962. The reactor is a 1 MW MTR-converted TRIGA reactor. Until the refueling in September 2006, the reactor used highly enriched uranium fuel (70%), but now uses low enriched uranium fuel (20%). Core VIII-A is the current core configuration and has been in use since March 1986. The NSC reactor is pulse operational and is pulsed up to powers of approximately 1,100 MW for nuclear engineering laboratories, staff training, and public tours.

The NSC reactor operated for 1914.5 hours in 2008 with a total integrated power of 76.4 MW-days. There were 474 "Requests for Irradiation" processed at the NSC during the reporting period. The NSC provided services to TAMU departments, other universities, research centers, and secondary schools in and outside the state of Texas. The cumulative total energy output since initial criticality of the LEU fuel is 166.63 MW-days. Table 2 shows the reactor utilization summary in 2008 and Figure 2 shows the annual reactor utilization in MW-hrs of operation.

Table 2: Reactor Utilization Summary in 2008

Days of Reactor Operation	245
Integrated Power (MW-days)	76.4
Number of Hours at Steady-State	1914.5
Number of Pulses	54
Number of Reactor Irradiations (RFS)	474
Beam Port/Thermal Column Experiment Hours	757.2
Hours Irradiation Cell Use	109.18
Number of Visitors	1957
Unscheduled Shutdowns	3

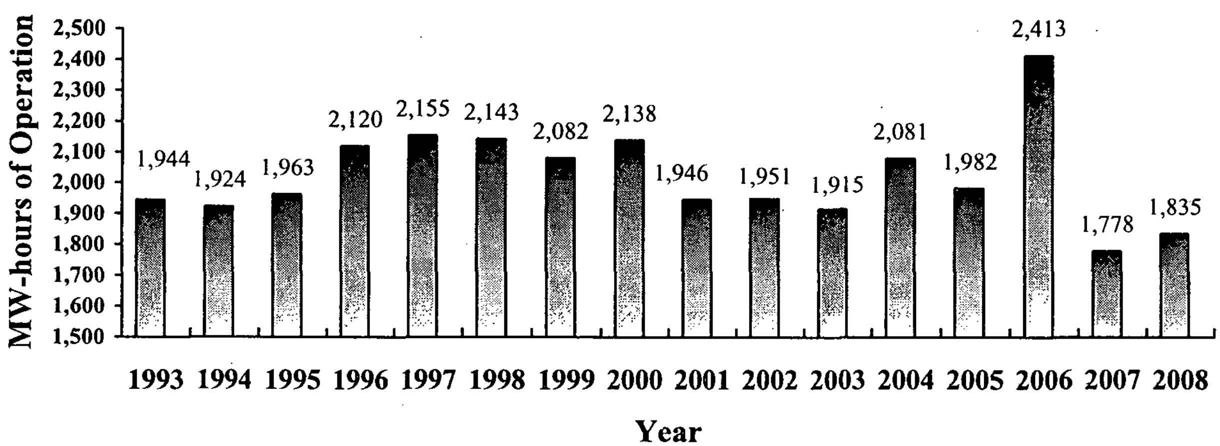

Figure 2. Annual Reactor Utilization in MW-hrs of Operation

2.1 TAMU Academic Support Program

Texas A&M University provides funding for the reactor for such academic activities as nuclear engineering laboratories, neutron activation analysis demonstrations and laboratories, graduate student thesis and dissertation research, and undergraduate research projects. The program has been very successful and is crucial for many graduate students who use the NSC reactor for research and have not received research grants. The wide range of academic users from the university reflects in the NSC's reputation as a multi-disciplinary institution.

2.2 DOE University Reactor Sharing Program

The DOE University Reactor Sharing Program that was providing support for those institutions that do not normally have access to a research reactor ended in the year 2007. There was no work done under reactor sharing program in 2008.

2.3 Commercial Activity and External Research

The NSC provides services to a variety of users that provide their own funding. The majority of commercial activities focus on production of radioactive tracers for the Texas petroleum and chemical industries. Another commercial activity uses the converted Thermal Column area to produce micropore filters used in ultra-pure water systems in the semiconductor industry. Outside research grants fund a significant amount of the NSC's research. The NSC is involved with neutron activation analysis and radioassays for a wide variety of samples for outside customers. The NSC has many years of experience producing radioisotopes and has developed several customer-specific methods for radioactive sample production and handling. The production of radioisotopes generally involves handling radioactive material with high activities. The NSC staff takes precautions to minimize the exposures during the transfer of radioactive materials to shipping shields.

3. Facility and Procedure Changes

3.1 Facility Modifications

New cabinets and counter top were installed in the facility lunch room.

NSC built and installed a new service platform for the large propane tank.

NSC built and replaced the Log Channel detector canister with one that attaches to the reactor frame work more securely. The Log Channel detector cables were replaced with stainless steel jacketed triax with mineral insulation. The new cable is radiation resistant and significantly reduces the noise on the channel.

The pitot tube diameter was adjusted to correct for the new exhaust system air flow rate.

The NSC Reactor Building, Hyperbaric Lab, Machine Shop, Liquid Waste system, and Cooling Tower were all connected to the Texas A&M sanitary sewer waste treatment system.

3.2 Experiment Authorization and Modification Authorization

There were no new Experiment Authorizations (EA) or Modification Authorizations (MA) covered in 2008.

4. Reactor Maintenance and Surveillance

4.1 Scheduled Maintenance

NSC personnel performed regular maintenance on the Fuel Element Temperature Channel, Area Radiation Monitors and the Linear, Log, and Safety Power Channels as required by the Technical Specifications. They also performed all surveillance required by the reactor license. Control rod worth and scram time measurements performed in July 2008 gave the following results.. The total rod worth was $15.453. The most reactive control rod was Shim Safety #4 with a worth of <u>$4.307</u>. The shutdown margin was <u>$3.167</u> and core excess was <u>$6.051</u>. Scram times on all rods were less than 1.2 seconds. In addition, operators performed calorimetric calibration following each maintenance period, and fuel inspections with no abnormalities noted (as required by the Technical Specification). The cold critical reactivity worth, performed for each reactor experiment, shows that the most reactive fixed experiment is the Fast Flux Irradiation Device (-$1.141).

4.2 Unscheduled Maintenance

Table 4-2 lists the unscheduled maintenance performed in year 2008.

Table 4-2: Unscheduled Maintenance

01-03-2008	The Re-circulating Pump switch was found to be defective. The switch, switch housing, and conduit were replaced.
01-10-2008	A defective encoder was replaced on the Transient Rod to restore its position indications.
01-16-2008	The remote control unit in the Reception Room for opening the

	front gate was replaced.
03-06-2008	The Thermal Column scram interlock switch failed and was replaced.
03-07-2008	The rod down switch for Rod 4 was replaced.
03-21-2008	The magnet faces for Rod 4 were cleaned after it failed to lift the rod.
04-30-2008	A defective relay that actuates the panel alarm was found defective and replaced.
05-08-2008	The acid pump used regenerate the de-mineralizer bed failed and was replaced.
06-03-2008	The drive chain for the front gate was replaced.
06-08-2008	Zener diodes were installed in the fire alarm panel to act as surge limiters to help eliminate the false alarms that occur during lightening storms.
06-20-2008	The hot cell manipulators in the MHA were adjusted for proper operation.
08-29-2008	The primary pump flow indication was showing a low flow rate. The meter and sensor were checked for proper calibration. Then the nearly clogged inlet screen was cleaned restoring normal flow.
09-22-2008	The magnet wires were repaired and the magnet faces were cleaned on Rod drive 2.
10-02-2008	The rod down switch for ROD 1 was replaced.
10-20-2008	A universal joint connecting the reactor bridge jacks failed and was replaced.
11-17-2008	A defective hydraulic cylinder for the MHA portable fork lift was replaced.
11-18-2008	The drain pipe from the Lab Building to the heat exchanger sump was repaired.
12-10-2008	The reactor console clock quit working and was replaced.

4.3 Unscheduled Shutdowns

There were three unscheduled reactor shutdowns during 2008. The cause is detailed below in Table 4-3.

Table 4-3: Unscheduled Shutdowns

3/26/2008	Malfunctioning equipment caused period meter to indicate improperly during startup. Period scram point was reached at 2% of maximum reactor power. Equipment was repaired prior to the next start up.
8/1/2008	Reactor scrammed due to the manual SCRAM button being accidentally pressed.
8/14/2008	Reactor scrammed due to reading on Safety Power Channel #2 of over 124%. Safety Power Channel #2 indicated higher than actual power due to neutron reflection from the Thermal Column while operating against the Thermal Column; actual reactor power was 42.5% and did not exceed 100%.

4.4 Emergency Plan and Review

The Nuclear Science Center Management and the RSB reviewed the NSC Security and Emergency Plans. The Emergency Plan is undergoing a revision to incorporate minor changes in the plan. The update on the Security Plan to include the Compensatory Measures and finger printing requirements were discussed. There has been no mandate to update the security plan by the NRC.

4.5 Reactor Safety Board

The Reactor Safety Board is responsible for providing an independent review and audit of the safety aspects of the NSC reactor. The Reactor Safety Board (RSB) met once in the year 2008 as per the Technical Specifications requirement and there were no pending items. Appendix B provides the reactor safety board membership.

4.6 Inspections and Audits

The Reactor Safety Board sub- committee performed the required audits and inspections as per the Technical Specifications requirement. The results of the audit will be submitted to the RSB during 2009 meeting.

4.7 Notice of Violation

There was no "Notice of Violation" in 2008.

5. Health Physics Surveillance

The purpose of Health Physics surveillance is to ensure safe use of radioactive materials in the Nuclear Science Center's research and service activities and to fulfill the regulatory requirements of U.S. Nuclear Regulatory Commission and State agencies. The NSC maintains a Health Physics group as an integral part of the organization. They are responsible for radiological as well as chemical, and physical safety concerns. The radiation safety team at the TAMU Environmental Health and Safety Department provides additional support to the NSC Health Physics group upon request.

5.1 Radioactive Shipments

The Health Physics monitoring and technical support that was provided in 2008 assured minimal exposure during sample handling, shipment of radioactive material, and normal reactor operation. The radiation exposures were maintained ALARA. During 2008, about 386 radioactive samples were handled of which 362 samples were released to various research facilities including Texas A&M University campus and the rest were retained at the Nuclear Science Center facility. A total of 307 curies were handled in 2008.

5.2 Personnel Monitoring

Personnel Monitoring was provided to approximately 34 personnel. All measured doses to personnel were below the limits set forth in 10 CFR 20. Five individuals received whole body dose greater than 10% of the annual limit in 10 CFR 20. Their deep dose equivalent (DDE) recorded were 562, 588, 859, 629, and 724 mrem for the year. Airborne monitoring during sample handling continued to show no significant airborne activity. Therefore, total effective dose equivalent will equal deep dose equivalent for 2008. A total of 6.5 manrem was recorded for the year 2008. When total manrem/curie was determined for 2008, the dose per curie equaled 0.024 (manrem/Ci).

During 2008, about 1957 visitors toured the Nuclear Science Center. Minimal exposures were measured with pocket ion chambers worn by these visitors and the pocket ion chamber readings of their respective tour guides.

NSC employees who were likely to exceed 10% of their total annual dose wore whole body badges (Luxel dosimeter) and extremity badges (TLD dosimeters) that were provided by Landauer, a NVLAP accredited supplier. Landauer also provides the reports of the doses received.

5.3 Facility Monitoring

Surveys of the Nuclear Science Center facilities were performed to assess radiological hazards to NSC workers. Radiation levels and sources of radioactive contamination were routinely monitored. Approximately 350 smear samples were collected and evaluated each month. All accessible areas at the NSC wear surveyed for radiation and contamination levels monthly. Areas where contamination is expected, access/egress controls are in place and are evaluated on shorter intervals. Area monitors were placed at strategic locations in the reactor facility, this provides dose equivalent (mrem) on a monthly basis. Table 5-3 summarizes the annual accumulated dose equivalent (mrem) recorded on the area monitors for 2008.

Table 5-3: Total Dose Equivalent (mrem) Recorded on Area Monitors

Monitor ID	Location	Accumulated Dose Equivalent (mrem)
BLDG MNTR 1	Upper Research Level Mezzanine	1472
BLDG MNTR 2	Lower Research Level Mezzanine	798
BLDG MNTR 3	Lower Research Level	36
AREA	Control Room	108
AREA	Upper Research Level	919
AREA	Room next to MHA	2321*

*Radioactive materials were stored in the temporary locations in MHA.

5.4 Particulate Effluent Monitoring

Radioactive particulates were monitored at the base of the central exhaust stack and summarized on a monthly basis. The annual average release concentration was 4.3×10^{-15} μCi/cc. The total radioactivity activity released for 2008 was 0.5 μCi. Table 5-4 summarizes monthly particulate effluent releases during 2008. The most common isotope noted during particulate effluent releases were Ir-192 and Sb-124.

Table 5-4: Particulate Effluent Releases

Quarter	Month	Activity from FAM channel 1 (μCi)	Exhaust Volume*3 (cc)	Average release concentration (μCi/cc)	Additional releases (μCi)	Total activity released (Ci)
	January	1.17×10^{-1}	9.32×10^{12}	1.26×10^{-14}		1.17×10^{-7}
	February	<BG	9.96×10^{12}	<BG		<BG
I	March	<BG	9.96×10^{12}	<BG		<BG
	Average:	**3.90×10^{-2}**	**9.74×10^{12}**	**4.19×10^{-15}**		**3.90×10^{-8}**
		1.17×10^{-1}	**2.92×10^{13}**	**1.26×10^{-14}**	**0.00E+00**	**1.17×10^{-7}**
	April	8.29×10^{-2}	9.64×10^{12}	8.60×10^{-15}		8.29×10^{-8}
	May	4.03×10^{-2}	9.96×10^{12}	4.05×10^{-15}		4.03×10^{-8}
II	June	5.63×10^{-2}	9.64×10^{12}	5.85×10^{-15}		5.63×10^{-8}
	Average:	**5.99×10^{-2}**	**9.74×10^{12}**	**6.17×10^{-15}**		**5.99×10^{-8}**
		1.80×10^{-1}	**2.92×10^{12}**	**1.85×10^{-14}**	**0.00E+00**	**1.80×10^{-7}**
	July	<BG	9.96×10^{12}	<BG		<BG
	August	2.05×10^{-1}	9.96×10^{12}	2.06×10^{-14}		2.05×10^{-7}
III	September	<BG	9.96×10^{12}	<BG		<BG
	Average:	**6.82×10^{-2}**	**9.96×10^{12}**	**6.85×10^{-15}**		**6.82×10^{-8}**
		2.05×10^{-1}	**2.99×10^{13}**	**2.06×10^{-14}**	**0.00E+00**	**2.05×10^{-7}**
	October	<BG	9.96×10^{12}	<BG		<BG
	November	<BG	9.64×10^{12}	<BG		<BG
IV	December	<BG	9.96×10^{12}	<BG		<BG
	Average:	**0.00E+00**	**9.85×10^{12}**	**0.00E+00**		**0.00E+00**
		0.00E+00	**2.96×10^{13}**	**0.00E+00**	**0.00E+00**	**0.00E+00**
Annual	**Average:**		**9.82×10^{12}**	**4.30×10^{-15}**	**0.00E+00**	**4.18×10^{-8}**
Summary			**1.18×10^{14}**	**5.16×10^{-14}**	**0.00E+00**	**5.01×10^{-7}**

notes:

1. Average Release Concentration equal to: Activity from FAM (facility air monitoring) Channel 1 divided by volume of air going through the stack
2. Exhaust Volume equal to: (# days/month)*(24hrs/day)*(60min/hr)*(7875 ft^3/min)/ (3.53×10^{-5} cc)
3. Additional Release equal to: (Individual releases calculated from facility air monitoring data)
4. Total Release equal to: (activity for channel 1+(Additional Release))* 10^{-6}
5. <BG indicates that the monthly count rates were less than the background count rates.

5.5 Gaseous Effluent Monitoring

Argon-41 is the major gaseous effluent produced and released at the Nuclear Science Center. This effluent is monitored at the central exhaust stack. Total Argon-41 released during 2008 was 8.97 mCi with an annual average release concentration of 7.54×10^{-11} μCi/cc.

Table 5-5 summarizes monthly gaseous effluent (Ar-41) releases during 2008.

Table 5-5: Gaseous Effluent (Ar-41) Releases

Quarter	Month	Activity from channel 3 (µCi)	Exhaust Volume (cc)	Average release concentration (µCi/cc)	Additional releases (µCi)	Total activity released (Ci)
	January	$4.02x10^{2}$	$9.32x10^{12}$	$4.31x10^{-11}$		$4.02x10^{-4}$
	February	$5.11x10^{2}$	$9.96x10^{12}$	$5.13x10^{-11}$		$5.11x10^{-4}$
I	March	$3.97x10^{2}$	$9.96x10^{12}$	$3.99x10^{-11}$		$3.97x10^{-4}$
	Average:	$\mathbf{4.37x10^{2}}$	$\mathbf{9.74x10^{12}}$	$\mathbf{4.48x10^{-11}}$		$\mathbf{4.37x10^{-4}}$
		$\mathbf{1.31x10^{3}}$	**2.92x1012**	$\mathbf{1.34x10^{-10}}$	**0.00E+00**	$\mathbf{1.31x10^{-3}}$
	April	$7.01x10^{2}$	$9.64x10^{12}$	$7.28x10^{-11}$		$7.01x10^{-4}$
	May	$4.67x10^{2}$	$9.96x10^{12}$	$4.69x10^{-11}$		$4.67x10^{-4}$
II	June	$4.03x10^{2}$	$9.64x10^{12}$	$4.19x10^{-11}$		$4.03x10^{-4}$
	Average:	$\mathbf{5.24x10^{2}}$	$\mathbf{9.74x10^{12}}$	$\mathbf{5.38x10^{-11}}$		$\mathbf{5.24x10^{-4}}$
		$\mathbf{1.57x10^{3}}$	$\mathbf{2.92x10^{12}}$	$\mathbf{1.62x10^{-10}}$		$\mathbf{1.57x10^{-3}}$
	July	$7.32x10^{2}$	$9.96x10^{12}$	$7.35x10^{-11}$	$4.24x10^{1}$	$7.74x10^{-4}$
	August	$7.21x10^{2}$	$9.96x10^{12}$	$7.24x10^{-11}$		$7.21x10^{-4}$
III	September	$1.06x10^{3}$	$9.96x10^{12}$	$1.06x10^{-10}$		$1.06x10^{-3}$
	Average:	$\mathbf{8.37x10^{2}}$	$\mathbf{9.96x10^{12}}$	$\mathbf{8.41x10^{-11}}$		$\mathbf{8.51x10^{-4}}$
		$\mathbf{2.51x10^{3}}$	$\mathbf{2.99x10^{13}}$	$\mathbf{2.52x10^{-10}}$	$\mathbf{4.24x10^{1}}$	$\mathbf{2.55x10^{-3}}$
	October	$7.43x10^{2}$	$9.96x10^{12}$	$7.47x10^{-11}$		$7.43x10^{-4}$
	November	$6.00x10^{2}$	$9.64x10^{12}$	$6.22x10^{-11}$		$6.00x10^{-4}$
IV	December	$2.19x10^{3}$	$9.96x10^{12}$	$2.20x10^{-10}$		$2.19x10^{-3}$
	Average:	$\mathbf{1.18x10^{3}}$	$\mathbf{9.85x10^{12}}$	$\mathbf{1.19x10^{-10}}$		$\mathbf{1.18x10^{-3}}$
		$\mathbf{3.54x10^{3}}$	$\mathbf{2.96x10^{13}}$	$\mathbf{3.57x10^{-10}}$	**0.00E+00**	$\mathbf{3.54x10^{-3}}$
Annual	**Average:**		$\mathbf{9.82x10^{12}}$	$\mathbf{7.54x10^{-11}}$		$\mathbf{7.48x10^{-4}}$
Summary			$\mathbf{1.18x10^{14}}$	$\mathbf{9.05x10^{-10}}$	$\mathbf{4.24x10^{1}}$	$\mathbf{8.97x10^{-3}}$

notes:

1. Average Release Concentration equal to: Activity from Channel 3 divided by volume of air going through the stack
2. Exhaust Volume equal to: (# days/month)*(24 hrs/day)*(60 min/hr)*(7875 ft^3 /min)/ ($3.53x10^{-5}$ cc)
3. Additional Release equal to: (Individual releases calculated from facility air monitoring data)
4. Total Release equal to: (activity for channel 3+(Additional Release))* 10^{-6}

5.6 Liquid Effluent Monitoring

Radioactive Liquid effluents are maintained in collection tanks before release from the confines of the Nuclear Science Center. Sample activity concentrations and isotope identifications were determined before each release. The concentration values for each isotope were compared with the effluent concentrations in water (10 CFR 20) and were determined to be in compliance. On September 2008, a new sewer system was tied into the Texas A&M waste treatment plant for release of liquid waste and NSC started releasing liquid waste through the sewer system effective September 2008. Sample activity concentrations were then compared with Sewer line concentrations (10 CFR 20) and were determined to be in compliance. There were 20 releases in 2008, totaling 5.57×10^5 gallons including dilution. The total radioactivity released was 2.68 mCi with an annual average concentration of 1.27×10^{-6} μCi/cc. The annual dose to the public calculated from liquid effluents is about 1 mrem. Summary of the release data are presented in the following Table 5-6. Radioactivity concentrations for each isotope found were below the Effluent Concentration limits specified in 10 CFR 20, Appendix B. Some of the major radionuclides identified in the waste stream were Na-24, Sc-46, Cr-51, Mn-54, Co-58, Co-60, Zn-65, Sb-122, Sb-124, Cs-137, etc.

Table 5-6: Liquid Effluent Releases

Quarter	Month	Number of Releases	Volume Released (cc)	Total Radioactivity (Ci)	Average Concentration (μCi/cc)
I	January	*	*	*	*
	February	*	*	*	*
	March	*	*	*	*
	Quarter Total:				
II	April	2	3.44×10^8	2.07×10^{-4}	6.02×10^{-7}
	May	3	4.15×10^8	3.27×10^{-4}	7.87×10^{-7}
	June	4	3.76×10^8	4.62×10^{-4}	1.23×10^{-6}
	Quarter Total:	**9**	$\mathbf{1.13 \times 10^9}$	$\mathbf{9.95 \times 10^{-4}}$	
III	July	3	3.71×10^8	3.36×10^{-4}	2.84×10^{-6}
	August	2	3.53×10^8	1.42×10^{-4}	7.54×10^{-7}
	[a]September	1	1.84×10^7	5.65×10^{-5}	3.07×10^{-6}
	Quarter Total:	**6**	$\mathbf{7.42 \times 10^8}$	$\mathbf{5.35 \times 10^{-4}}$	
IV	[a]October	3	1.14×10^8	4.07×10^{-4}	3.57×10^{-6}
	[a]November	*	*	*	*
	[a]December	2	1.18×10^8	7.44×10^{-4}	6.26×10^{-6}
	Quarter Total:	**5**	$\mathbf{2.33 \times 10^8}$	$\mathbf{1.15 \times 10^{-3}}$	
Annual Summary	**Total:**	**20**	$\mathbf{2.11 \times 10^9}$	$\mathbf{2.68 \times 10^{-3}}$	$\mathbf{1.27 \times 10^{-6}}$

* No releases

[a] **sewer releases**

6. Environmental Monitoring

In conjunction with representatives from the Texas Department of State Health Services (TDSHS) Radiation Control, a quarterly environmental survey is conducted to insure compliance with federal regulations. This program consists of TLD monitors located at various locations on the NSC site and two background monitors; one located at 3.84 miles NW of facility and the other at 0.25 miles SE of facility. A quarterly sampling and analysis of NSC creek sediment were included in the program. Effective September 2008, NSC no longer discharges liquid waste through the creek but through the newly added sewer system. TDSHS no longer require the collection of a quarterly sediment sample. A letter from TDSHS to this effect is on file.

6.1 Environmental Samples

The environmental samples were collected for the first three quarters in accordance with the cooperative surveillance program established between the TDSHS Environmental Monitoring, Division of Regulatory Services, Austin, Texas, and the Nuclear Science Center. The agreement is for isotopic analysis of NSC creek sediment samples. The creek samples were analyzed using the High Purity germanium detector system at NSC. A second set of sediment samples were analyzed by the TDSHS for comparison. The 4th fourth quarter creek sample was not collected as there were no discharges through the creek. The concentrations of environmental samples determined for each quarter are listed below in Table 6-1. The most common isotopes were Mn-54, Co-58, Co-60, Fe-59, Zn-65, Pb-214, Tl-208 etc. The concentrations were less than 1×10^{-6} µCi/g.

Table 6-1: Environmental Sample Analysis

Quarter	Sediment	µCi/g
I	NSC creek	$< 8.9 \times 10^{-6}$
II	NSC creek	$< 8.2 \times 10^{-6}$
III	NSC creek	$< 6.8 \times 10^{-6}$
IV	No longer required	No longer required

6.2 Site Boundary Dose Rate

The environmental survey program measures the integrated radiation exposures at the exclusion area boundaries. These measurements are made for periods of approximately 91 days using TLDs. Monthly measurements of direct gamma exposure rate in µR/h are also made at each of the TLD locations. The dosimeters were provided and processed by Texas Department of State Health Services, Environmental Monitoring, Division of Regulatory Services, Austin, Texas. Total TLD dose is multiplied by the occupancy factor (1/16) to determine total deep dose to the general public. To determine internal exposure to individuals outside the site area the EPA's approved code, COMPLY was used. The exposure calculated via COMPLY was 1.2×10^{-4} mrem/yr. This exposure is added to the deep dose to calculate total dose. The total calculated dose to the general public was 0.2 mrem. Table 6-2 summarizes the site boundary dose rates.

Table 6-2: Site Boundary Dose Rates

Site #	Location	Quarterly Exposure rates (mrem/91 days)				TLD Dose	Deep Dose	Internal Dose (mrem)	Total Dose (mrem)
2	300 ft. W of reactor building, near fence corner	3.3	3.1	3.2	**	9.6	0.60	0.00012	0.60
3	250 ft WSW of reactor building, on SW chain link fence	1.1	0	0.8	**	1.9	0.12	0.00012	0.12
4	200 ft NW of reactor building, on chain link fence, near butane tank	4.4	3.1	4	**	11.5	0.72	0.00012	0.72
5	225 ft NE of reactor building, on fence N of driveway	0	1	1.6	**	2.6	0.16	0.00012	0.16
10	190 ft SE of reactor building, near fence corner	0	1	2.4	**	3.4	0.21	0.00012	0.21
11	300 ft NE of reactor building, near fence corner	1.1	0	1.6	**	2.7	0.17	0.00012	0.17
18	375 ft NE of reactor building	2.2	3.1	2.4	**	7.7	0.48	0.00012	0.48

19	320 ft NE of reactor building	0	0	0.8	**	0.8	0.05	0.00012	0.05
*14	3 miles NW of facility	2.2	0	0		2.2	0.14	0.00012	0.14
*23	0.25 miles SE of facility	0	0	0		0.0	0.00	0.00012	0.00

* 14 and 23 are background TLD's
** Results pending with TDSHS. 4^{th} quarter results will be added to Table 6-2 when it becomes available.

7. Radioactive Waste Shipments

During the year 2008, there were no solid wastes shipped to a final disposal facility. However, dry solid wastes with short half-lives (<120 d) were properly stored for decay. These will eventually be segregated, sorted and disposed as non-radioactive waste. Low specific activity wastes that contain long lived isotopes will be quantified, packaged and sent it for final disposal through an authorized contracting service.

APPENDIX A

NSC ORGANIZATION CHART-2008

Dr. Warren D. Reece
Director

Jim Remlinger
Associate Director

VACANT
Manager of Operations

- Jerry Newhouse, Reactor Supervisor
- Jared Porter, NSC Senior Nuclear Reactor Operator
- Wes Cullum, NSC Senior Nuclear Reactor Operator
- Sarah Schwartz, NSC Senior Nuclear Reactor Operator
- Dustin LeClair, NSC Nuclear Reactor Operator
- Jesse Johns, NSC Nuclear Reactor Operator
- Jane Lucas, NSC Nuclear Reactor Operator Apprentice

Tom Fisher
Supervisor
Reactor Maintenance

- Alfred Hanna, Scientific Instrument Maker II
- Chad Everett, Scientific Instrument Maker I
- Joe Snook, Foreman Mechanical Shop
- Jim Reynolds, Machinist I

Latha Vasudevan
Radiological Safety Officer
Health Physics

- VACANT, Health Physics Supervisor Duty HP
- Albert Tijerina, Engineering Research Associate
- Robert Pack, Technician II
- Matthew Stilley, NSC Radioactive Shipper
- Robert Miller, NSC Health Physics Apprentice
- VACANT, NSC Health Physics Apprentice
- VACANT, Central Receiving Supervisor

Elise Blaha
Administrative Coordinator
Business Administrative Services

- Wen Hsing Hsu, Senior Research Associate
- Jenna Homeyer, Business Coordinator I
- VACANT, Office Assistant
- Chris Rutledge, Computer System Manager
- Maria Lazo, Student Worker II

APPENDIX B

Reactor Safety Board Membership (2008)

Chairman/Licensee:

Dr. Ken Hall, Deputy Director
Texas Engineering Experiment Station

Members:

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Nuclear Engineering Department

Dr. Marvin Adams, Associate Professor
Nuclear Engineering Department

Dr. Bill Charlton, Associate Professor
Nuclear Engineering Department

Dr. William Dennis James, Research Chemist
Chemistry Department

Dr. John Hardy, Professor
Physics Department

Dr. Teruki Kamon, Professor
Physics Department

Dr. Sean McDeavitt, Assistant Professor
Nuclear Engineering Department

Dr. Karen Vierow, Associate Professor
Nuclear Engineering Department

Ex-Officio Members:

Dr. Warren Reece, Director
Nuclear Science Center

Dr. Latha Vasudevan, NSC RSO
Nuclear Science Center

Mr. Jim Remlinger, Associate Director
Nuclear Science Center

Dr. Raymond Juzaitis, Professor and Head
Nuclear Engineering Department

Mr. Daniel Menchaca, RSO
Environmental Health and Safety Department