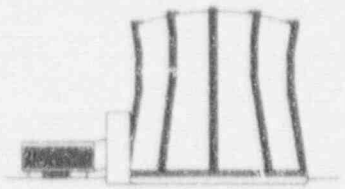
TEXAS ENGINEERING EXPERIMENT STATION

TEXAS A&M UNIVERSITY

COLLEGE STATION, TEXAS 77843-3575



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Reference: Docket No. 50-128
Facility License No. R-83

Subject: Submittal of the NSCR Annual Report for the Period January 1, 1991 - December 31, 1991

Gentlemen:

In accordance with the reporting requirements of Technical Specification 6.6.1 for the Nuclear Science Center Reactor, Texas Engineering Experiment Station, Texas A&M University System, we hereby submit three copies of our annual report for the period of January 1, 1991 - December 31, 1991.

Sincerely,

Bruce S Carlisle for

Warren D. Reece
Director

WDR/ym

Enclosures

IE47
1/1

Form AEC-427
(6/70)
AECM 3201

U.S. ATOMIC ENERGY COMMISSION
UNIVERSITY-TYPE CONTRACTOR'S RECOMMENDATION FOR DISPOSITION OF SCIENTIFIC AND TECHNICAL DOCUMENT

(See Instructions on Reverse Side)

1. AEC REPORT NO.

ORO-4207-24

2. TITLE

Twenty-Eighth Progress Report of the Texas Engineering Experiment Station

Texas A&M University System, Nuclear Science Center
Contract No. DE-AC05-76ER04207
Subcontract No. C87-101594

3. TYPE OF DOCUMENT (Check one):

- [ ] a. Scientific and technical report
- [ ] b. Conference paper not to be published in a journal:
  - Title of conference
  - Date of conference
  - Exact location of conference
  - Sponsoring organization
- [X] c. Other (Specify) Facility Annual Progress Report (1991)
  USNRC License R-83, Docket No. 50-128

4. RECOMMENDED ANNOUNCEMENT AND DISTRIBUTION (Check one):

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- [ ] b. Make available only within AEC and to AEC contractors and other U.S. Government agencies and their contractors.
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5. REASON FOR RECOMMENDED RESTRICTIONS:

6. SUBMITTED BY: NAME AND POSITION (Please print or type)

Warren D. Reece, Director

Organization

Nuclear Science Center
Texas Engineering Experiment Station
Texas A&M University System

Signature W. D. Reece

Date 2 Apr '92

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7. AEC CONTRACT ADMINISTRATOR'S COMMENTS, IF ANY, ON ABOVE ANNOUNCEMENT AND DISTRIBUTION RECOMMENDATION:

8. PATENT CLEARANCE:

- [ ] a. AEC patent clearance has been granted by responsible AEC patent group.
- [ ] b. Report has been sent to responsible AEC patent group for clearance.
- [ ] c. Patent clearance not required.

I. INTRODUCTION

The Nuclear Science Center (NSC) is operated by the Texas Engineering Experiment Station (TEES) as a service to the Texas A&M University System (TAMU) and the State of Texas. The Nuclear Science Center reactor and laboratories are available to students, researchers and faculty from Texas A&M University, other colleges and universities, government agencies, and private industry.

The Nuclear Science Center is comprised of a 1 mega-watt TRIGA reactor operating under license by the U. S. Nuclear Regulatory Commission (NRC): license R-83 currently extends through March, 2003. The nuclear fuel for the reactor is provided to TEES by the U. S. Department of Energy (DOE) under contract #DE-AC05-76ERO4207 (formerly EY-76-C-05-4207).

This report is prepared by the staff of the NSC in accordance with the requirements of the reactor Technical Specifications, US DOE Contracts and 10 CFR50.59. The report covers the period from January 1, 1991 through December 31, 1991.

II. REACTOR USE

The NSC reactor operated for 2574 hours in 1991 for a total integrated power of 101.9 MW-days. During this period, 723 requests for reactor services were fulfilled. These requests are classified in four groups: Academic Use - services for primary, secondary and higher education programs, Internal Research - service to TAMU system researchers, Research Contracts - access provided to other colleges, universities or private firms for research, and Commercial Use - requests by private firms for isotopes or reactor byproducts used in commercial activities.

A. Academic Use

The reactor was used by faculty and staff from 3 departments at Texas A&M University. In addition, faculty and students from 12 other educational institutions used the facilities. Also 3,523 visitors were provided escorted tours during 1991. The following summary is provided:

TAMU Animal Science Department
Faculty: Dr. Ellis

TAMU Chemistry Department
Faculty: Dr. Kolar

McClennan Community College - Waco, Texas
Faculty: Mr. D. Tatum, Instructor of Physics

Miami University - Oxford, Ohio
Faculty: Dr. K. Crowley

Southern Methodist University - Dallas, Texas
Faculty: Dr. S. Kelley

Sul Ross State University - Alpine, Texas
Faculty: Dr. D. Nelson

Texas State Technical Institute - Waco, Texas
Faculty: Mr. R. Wheet, Instructor

University of Houston - Houston, Texas
Faculty: J. Liu

University of Illinois - Chicago, Illinois
Student: M. Flower

University of New Hampshire - Durham, New Hampshire
Faculty: A. Conners

University of Oklahoma - Norman, Oklahoma
Faculty: Dr. B. Weaver

University Southwestern Louisiana - Lafayette, Louisiana
Faculty: Dr. J. Meriwether

University of Texas - Austin, Texas
Faculty: Dr. F. Iskander

University of Texas - El Paso, Texas
Faculty: Dr. E. Anthony

Groups Receiving Educational Tours
Middle Schools - 3
High Schools - 26
Community Colleges - 2
University/College - 3
Society/Civic Groups - 6

B. Internal Research

Research was performed at the NSC by personnel from the TAMU System during 1991. The following summary is provided:

Animal Science Center
Faculty: Dr. W.C. Ellis, Professor

Anthropology Department
Faculty: Dr. D.B. Dickson, Professor

Center for Chemical Characterization and Analysis (CCCA)
Staff: Dr. E. Schweikert, Professor

Chemistry Department
Faculty: Dr. M.W. Row, Professor

Geology Department
Faculty: Dr. T. Tieh, Professor

Horticulture Science Department
Faculty: Dr. C.F. Gonzalez, Associate Professor

Nuclear Engineering Department
Faculty: Dr. J.W. Poston, Professor

Oceanography Department
Faculty: Dr. P. Boothe, Research Scientist

Physics Department
Faculty: Dr. J.A. McIntyre, Professor

Range Science
Faculty: Dr. R. Knight

Veterinary Physiology and Pharmacology
Faculty: Dr. D. Hightower, Professor

C. Research Contracts

Research was performed using NSC reactor facilities by other academic institutions and private firms. The following summary is provided:

AAE/BSC Traders - Globe, Arizona
Principal: Mr. D. Williams

M.D. Anderson Hospital - Houston, Texas
Principal: Dr. J. Cundiff

D. Commercial Use

A total of 17 private firms used NSC reactor services for commercial activities.

AAE/BSC Traders - Globe, Arizona
Principal: Mr. D. Williams

Brown and Associates - College Station, Texas
Principal: Mr. J. Fares

Gulf Nuclear - Houston, Texas
Principal: Mr. M. Skinner

Kearfott Guidance and Navigation - Little Falls, N.J.
Principal: Mr. L. Breen

Methodist Hospital - Houston, Texas
Principal: Dr. W. Cole

Poretics Corporation - Bryan, Texas
Principal: Mr. E. Hubbard

Racon - Tyler, Texas
Principal: Mr. R. Heine

R/A Services - Odessa, Texas
Principal: Mr. D. Hicks

Shell Development Company - Houston, Texas
Principal: W. Stringfellow

Pro-Technics II, Inc. - Houston, Texas
Principal: Mr. M. Brewer

Texas Instruments - Dallas, Texas
Principal: Mr. C. Blackburn

Tracerco, Inc. - Houston, Texas
Principal: Mr. R. Gilman

TRW-EDS - Redondo Beach, California
Principal: Mr. D. Randall

Tru-Tec - LaPorte, Texas
Principal: Mr. C. Winfield

III. FACILITY AND PROCEDURE CHANGES

In accordance with the requirements of 10CFR50.59, changes to the facility and procedures were reviewed and documented. During 1991 no changes were performed that required additional safety analysis or changes to the Technical Specifications. The following changes were implemented as not representing an unreviewed safety question, and not increasing the probability of an accident previously analyzed in the Safety Analysis Report.

A. Facility Modifications

Addition of a radioactive gas holdup tank.
Upgraded fuel temperature chart recorder.
Upgraded Facility Air Monitor chart recorder.
Upgraded Reactor Power chart recorder.
Replace Post Accident Fuel Temperature Meter.

B. Procedure Changes

Eleven Standard Operating Procedures were changed.

IV. FACILITY MAINTENANCE

All required maintenance as set forth in the Technical Specifications was performed annually, semi-annually, or weekly as required. Pre-startup checklists are performed daily prior to reactor operation to assure reactor facility readiness.

V. TECHNICAL SPECIFICATION SURVEILLANCE ACTIVITIES

The Technical Specification requirements for maintenance and surveillance were completed for all required channels as follows:

A. Calibrations

Fuel Element Temperature Measuring Channel
Linear Power Channel
Log Power Channel
High Power (Safety) Channels
Facility Air Monitoring Channels
Area Radiation Monitoring Channels

B. Compliance Testing

Control rod worth, and time measurements were performed in January, 1991. Total rod worth was measured at $15.96; providing a shutdown margin of $3.02. The rod scram time is within the Technical Specification limit of 1.2 seconds. The maximum allowable pulse reactivity insertion is $2.09 for Core VIII-A as determined by a pulse test program. An administrative limit of $1.90 is imposed for pulse operations.

The power level (linear) channel was calibrated by the calorimetric method on 1/2/91. The pulse measuring channel was calibrated on 2/21/91. Pulse operation parameters are verified semi-annually by pulsing the reactor for comparison of pulse energy and fuel temperature to previous pulse operation values.

All Fuel elements were inspected in January 1991. Two fuel elements failed the transverse bend criteria for reinstallation. No fuel failures have occurred.

The reactivity worth for each experiment was measured or estimated before initially performing an experiment. The most reactive ($0.83) fixed experiment is the Thermal Column coupler with a 1/2 inch spacer.

C. Readiness Review and Emergency Planning

A review of the NSC security plan and emergency plan was conducted by the NSC staff on 2/4/91. The annual facility evacuation drill and staff emergency response was conducted on 4/30/91. Also, a review of the NSC ALARA program was conducted by the NSC staff on 2/4/91.

VI. REACTOR OPERATIONS

A. Availability

Number of Days Reactor Operated - 240

Reactor Operation (MW-Days) - 101.9

Number of Hours at Steady State - 2574

Average Number of Operating Hours Per Week - 49.5

Total Number of Pulses - 28

Total Pulse Reactivity Insertion - $46.45

Number of Irradiations - 723

Beam Port Experiment-Hours - 308

Irradiation Cell Experiment-Hours - 29

Number of Visitors - 3,523

B. Unscheduled Outages

A total of 12 unscheduled shutdowns occurred during 1991. The unscheduled shutdowns were caused by the following:

Loss of Facility Electrical Power - 8 occurrences

Control Rod Drive Mechanism Faults - 4 occurrences

C. Reportable Occurrences

Reportable Occurrence 91-01, "Abnormal Degradation of Reactor Fuel", The annual Technical Specification Surveillance identified 2 fuel assemblies with excessive transverse bend.

Reportable Occurrence 91-02, "Violation of Technical Specification 3.5.1", The reactor was operated without the Facility Air Monitoring system in operation.

VII. ADMINISTRATION

The reporting structure and reactor organizational requirements are contained in the Technical Specifications. The complete Nuclear Science Center Organization is identified in chart format on Figure 1.

VIII. HEALTH PHYSICS SURVIELLANCES

A dedicated Health Physics group is maintained at the NSC reactor facility as an integral part of the line organization. Additional support is provided on request by the TAMU Radiological Safety Office.

A. Irradiation Support

Health Physics monitoring and technical support provided both quality assurance and hazards reduction during the processing of 697 irradiation requests and shipping 369 shipments of radioactive material. Of these 93 shipments were sent to other locations on the Texas A&M campus.

B. Personnel Monitoring

Radiation safety training was provided to 75 NSC employees and experimental personnel using the facilities. A new personnel dosimetry plan was implemented; radiation exposures to personnel in 1991 were below the limits set forth in 10CFR20.101. The maximum exposure received by any individual for the year was 460 mrem. A total of 3.6 man-rem was recorded for 1991. All employees at the Nuclear Science Center were changed to neutron badges to reduce the potential for unrecorded exposure from neutrons sources at the NSC.

During 1991, 3,523 persons visited the Nuclear Science Center. No detectable exposures were measured by film badges. Dosimetry results were provided by a NVLAP accredited supplier.

C. Facility Monitoring

Surveys of the Nuclear Science Center facilities are performed to assess radiological hazards to NSC workers. The radiation levels and sources of radioactive contamination are monitored; approximately 200 smear samples are collected, analyzed and evaluated each month. Radioactive effluents and waste shipments were also monitored for isotopic content and activity; there were 41 planned releases of radioactive liquid effluents totaling 1.71E+6 liters.

Additionally, the isotopic material loading of the facility was reduced with the disposal of over 300 sources of unneeded radioactive material stored at the Nuclear Science Center between 1977 and 1989. In association with the reactor coolant demineralizer system maintenance, six barrels of resins, activated charcoal and waste was packaged and transferred to the Office of Radiological Safety for disposal.

D. Particulate Effluent Monitoring

Radioactive particulate are monitored at the base of the central exhaust stack and are summarized on a monthly basis. The annual average release rate was 4.92 E-14 uCi/cc. Total activity release for 1991 was 3.28 E-4 Ci.

Month	Exhaust Volume (cc)	Average Concentration (uCi/cc)	Total Release (Ci)
January	6.31 E12	9.95 E-12	6.27 E-05
February	5.70 E12	1.63 E-16	9.29 E-10
March	6.31 E12	6.50 E-12	4.10 E-05
April	6.12 E12	9.68 E-13	5.92 E-06
May	6.31 E12	9.91 E-13	6.25 E-06
June	6.12 E12	2.25 E-12	1.37 E-05
July	6.31 E12	1.25 E-11	7.88 E-05
August	6.31 E12	1.71 E-11	1.07 E-04
September	6.12 E12	9.48 E-14	5.80 E-07
October	6.31 E12	1.43 E-13	9.02 E-07
November	6.12 E12	1.29 E-12	7.89 E-06
December	6.31 E12	5.90 E-13	3.72 E-06

Total Central Exhaust Air Volume: 7.44 E13 (cc)
Central Exhaust Annual Average Release Rate: 4.92 E-14 uCi/cc
Total Central Exhaust Annual Release: 3.28 E-4 Ci

E. Gaseous Effluents 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 release during 1991 was 12 curies at an annual release rate of 9.62 E-8 uCi/cc with no dilution factors applied. Release rates are also determined using the dilution factors for the release rate at the exclusion area boundary. The total amount released is determined from the undiluted release rate. These data are summarized below:

Month	Exhaust Volume (cc)	Average Release Rate (uCi/cc)	Diluted Concentration (uCi/cc)	Total Release (Ci)
JANUARY	6.31E12	8.2E-08	4.1E-10	5.2E-1
FEBRUARY	5.70E12	5.1E-08	2.6E-10	2.9E-1
MARCH	6.31E12	1.2E-07	6.0E-10	7.4E-1
APRIL	6.12E12	1.5E-07	7.5E-10	9.0E-1
MAY	6.31E12	7.9E-08	4.0E-10	5.0E-1
JUNE	6.12E12	1.7E-07	8.5E-10	1.1E+0
JULY	6.31E12	1.4E-07	7.0E-10	8.9E-1
AUGUST	6.31E12	9.5E-08	4.8E-10	6.0E-1
SEPTEMBER	6.12E12	3.9E-07	2.0E-09	2.4E+0
OCTOBER	6.31E12	4.0E-07	2.0E-09	2.5E+0
NOVEMBER	6.12E12	1.7E-07	8.5E-10	1.0E+0
DECEMBER	6.31E12	9.5E-08	4.0E-10	6.0E-1

Total Air Volume : 7.44E+13 cc
Central Exhaust Average Release Rate: 7.9E-9 uCi/cc
Total Ar-41 Activity Released : 12.0 Ci

F. Liquid Effluents Monitoring

Radioactive liquid effluents are collected in liquid holdup waste tanks prior to release from the confines of the Nuclear Science Center. Sample activity concentrations and isotope identification was performed prior to each release. There were 69 releases in 1991 totaling 1.71E+6 liters excluding dilutents from the Nuclear Science Center. The total radioactivity released for 1991 was 2.14E-1 Ci with an average concentration of 3.19E-6 uCi/cc. Summaries of the radioisotopic data are presented below. Radioactivity concentrations for each isotope were below the limits specified in 10 CFR20, Appendix B Table II, Column 2.

Isotope	No of Releases	Measured uCi/cc	MPC uCi/cc	Activity Curies
Co-60	20	4.8E-7	3E-5	8.86E-3
Cr-51	8	2.8E-6	2E-3	7.48E-4
Ir-192	2	1.4E-6	4E-5	5.90E-5
Au-198	4	2.7E-5	5E-5	3.39E-3
Mn-54	30	8.3E-7	1E-4	8.88E-2
Ti-51	3	1.6E-6	3E-5	1.24E-3
Nb-97	2	2.2E-7	9E-4	1.18E-3
Sb-124	4	4.0E-7	2E-5	1.20E-3
Sc-46	48	2.2E-6	4E-5	1.07E-1
Sr-85	1	4.8E-7	1E-4	1.45E-5
Zn-65	1	5.2E-7	1E-4	5.43E-6
I-124	2	4.6E-7	3E-5	1.74E-3

Total Number of Releases : 69
Total Liquid Volume: 1.71 E+6 liters (4.73 E+5 gallons)
Average Release Rate: 3.19E-6 uCi/cc
Total Activity: 2.14 E-1 Curies

IX. ENVIRONMENTAL MONITORING

In conjunction with representatives of the State of Texas Department of Health a quarterly environmental survey program was implemented. This program consists of TLD monitors located around the NSC site and the collection, analysis and evaluation of soil, water, vegetation and milk samples.

A. Site Boundary Doserate

The environmental survey program measures the integrated radiation exposures at the exclusion area boundaries. These measurements are made for periods of approximately 90 days using fluoride chips in glass encapsulated bulbs. The dosimeters are provided and processed by Texas Department of Health, Bureau of Radiation Control, Division of Environmental Programs. The state background monitor (survey point 14A) is located at a point 5.25 miles west-southwest of the NSC facility and generally at right angles to the prevailing southeasterly winds.

Site #	Location	Exposure Rate (mR/182 days)	Annual Exposure 1990 (mR)
2	300 ft. W of reactor building, near fence corner	41.4	83
3	250 ft WSW of reactor building, on SW chain link fence	124.2	250
4	200 ft NW of reactor building, on chain link fence, near butane tank	51.3	103
5	225 ft NE of reactor building, on fence N of driveway	45.9	92
6	300 ft NNE reactor building, near fence corner	102.6	206
10	190 ft SE of reactor building, on SE chain link fence	31.3	63
11	300 ft E of reactor building, near fence corner	31.9	64
12	375 ft. NE of reactor building, near source building	87.0	349
13	320 ft. NE of reactor building, near waste storage shed	76.8	154
14A	5.25 miles WSW of reactor building, at FM 60 bridge over Brazos River	31.6	64

The highest exposure point was determined to be at Site #12 (349 mR/yr) which is on the NSC Site Boundary fence northeast of the reactor building near the TAMU Office of Radiological Safety, Waste Storage Building. The closest off-site point of extended occupancy is located just beyond the Site Boundary fence directly behind the Site #10 monitoring location; those occupants continue to received only background exposure.

B. Environmental Survey Samples

The environmental survey samples were collected in accordance with the schedules of the cooperative surveillance program between the Texas State Department of Health and the Texas A&M University. These samples were analyzed for gross gamma and beta activities and isotope identification. Data from these samples reflect the continued use of retention facilities and sample analysis for laboratory effluents prior to their release.

Summaries of the environmental survey program for 1991 are presented in the four tables below for total gamma or beta activity as reported to the NSC or as determined by the NSC when data from the state was unavailable.

Vegetation Samples -

1991 Qtr	Sample Location	Concentration (uCi/gal)
1st	TAMU dairy	< MDA
2nd	TAMU dairy	< MDA
3rd	TAMU dairy	< MDA
4th	TAMU dairy	< MDA

Water Samples -

1991 Qtr	Sample Location	Concentration (uCi/ml)
1st	Brazos River	8.49E-7
1st	White Creek	3.18E-7
2nd	Brazos River	< MDA
2nd	NSC Creek	3.08E-7
3rd	Brazos River	< MDA
3rd	NSC Creek	9.18E-7
4th	Brazos River	< MDA
4th	NSC Creek	< MDA

Milk Samples -

1991 Qtr	Sample Location	Concentration (uCi/gal)
1st	TAMU dairy	< MDA
2nd	TAMU dairy	1.76E-6
3rd	TAMU dairy	< MDA
4th	TAMU dairy	< MDA

Soil Samples -

1991 Qtr	Sample Location	Concentration (uCi/ml)
1st	NSC Soil	< MDA
2nd	NSC Soil	1.59E-4
3rd	NSC Soil	< MDA
4th	NSC Soil	4.68E-5

X. RADIOACTIVE WASTE

A. Solid Waste

Approximately 79 kg of dry solid waste material was packaged in plastic bags for disposal during 1991. These plastic bags contained laboratory glassware, irradiation containers, decontamination materials, and expendable protective clothing (shoe covers, gloves). This material was transferred to the Texas A&M University Office of Radiological Safety, Texas License No. 6-448 for disposal. The radioisotopes identified in this waste are identified as follows:

Solid Waste -

Isotope	Activity (uCi)
Co-60	460.96
Co-57	14.9
Ce-141	29.4
Mn-54	1.9
Zr-65	49.0
Hf-181	2.6
Ce-139	2.5
Ag-110m	307.32
Ir-192	90.2
Ce-144	139.5
Sb-124	11.87
Zn-65	355.75
Nb-95	83.26

Total Activity: 1.5 E-3 Ci

During 1991 the reactor coolant deionizer resins were replaced. The waste resins were transferred to the Texas A&M University Office of Radiological Safety for disposal. The isotopic content in these barrels of waste resins is listed below:

Resin Waste -

Isotope	Activity(uCi)
Mn-54	2850.0
Co-60	1480.3
Co-58	324.9
Sc-46	1414.0
Co-57	120.8
Zn-65	300.1
U-235	0.9
Cr-51	372.8

Total Volume: 935 gallons
Total Activity: 6.86E-02 uCi

XI. Reactor Safety Board

A. Membership

Chairman: F. Jennings, Director, Office of University Research

Voting Members:

Dr. T. Parish, Professor, Nuclear Engineering

Dr. R. Kenefick, Professor, Physics

Dr. R. Koppa, Professor, Industrial Engineering

Dr. E.L. Morris, Professor, Veterinary Medicine

Dr. E.A. Schweikert, Professor, Chemistry

Ex-Officio Members:

D.E. Feltz, Director, Nuclear Science Center (January 1, 1991 - September 1, 1991)

W.D. Reece, Director, Nuclear Science Center (September 1, 1991 - December 31, 1991

Dr. M.E. McLain, University Radiological Safety Officer

J.W. Poston, Head, Nuclear Engineering

M.P. Brown, Senior Health Physicist, Nuclear Science Center

B. Activities

The Reactor Safety Board (RSB) met on February 8, 1991 and September 24, 1991. The RSB conducted audits of NSC activities on January 31, 1991, April 23, 1991, July 18, 1991, and August 8, 1991.