ENVIRONMENTAL IMPACT APPRAISAL
FOR THE
TEXAS A&M UNIVERSITY NUCLEAR SCIENCE CENTER TRIGA REACTOR

Submitted to:

U.S. Nuclear Regulatory Commission

Texas A&M University
Nuclear Science Center
College Station, Texas 77843

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1.0 GENERAL

In accordance with the memorandum received from Robert W. Reid, Chief, Operating Reactors Branch #4, Division of Operating Reactors, NRC dated April 25, 1979, this Environmental Impact Appraisal (EIA) is submitted for the continued operation of the Texas A&M University TRIGA Reactor. As stated in this memorandum, research reactors of power levels 2 Mw(th) and less do not require an Environmental Impact Statement (EIS), but an EIA is necessary and sufficient. The Texas A&M University TRIGA Reactor is licensed for 1 Mw(th) operation and therefore requires only the EIA completion.

2.0 LOCATION OF FACILITY

The Texas A&M University Nuclear Science Center (NSC), housing a 1 Mw(th) TRIGA reactor, is situated on a rectangular six-acre site which is located 1,500 feet from the north-south runway of Easterwood Airport, six miles south of the City of Bryan, (est. pop. 46,600), three miles southwest of the main campus of Texas A&M University, two and one-half miles west-southwest of the City of College Station (est. pop. 42,500), and eight miles north-west of Wellborn (est. pop. 1,200), in Brazos County, Texas (See Figure 2-1).

The land adjacent to all sides of the site is owned and controlled by the University. The nearest non-university residential dwelling is located approximately one mile south-east from the site. The indemnity confines of the site are defined by a chain-link steel fence which provides reasonable restriction of access to the site (See Figure 2-2). The entire area inside the perimeter fence of the NSC is designated as a "Restricted Area". Located within the boundaries are the reactor confinement building, reception room and laboratory building, equipment room, liquid waste holding tanks and other storage and support buildings (See Figure 2-2).

3.0 PHYSICAL CHARACTERISTICS

The present core loading of the TAMU TRIGA reactor is a mixture of Standard and FLIP TRIGA fuel. The core is supported from a bridge structure in an open pool containing 105,000 gallons of deionized water. This water serves as shield, moderator and coolant for the core. The reactor is used for education, training, research, and industrial service.

4.0 ENVIRONMENT IN THE AREA

The NSC is located in the geological region known as the Gulf Coastal Plain. The site is approximately 100 miles inland from the Gulf Coast and is situated at an elevation of 304 feet. The surrounding terrain drains into several tributaries feeding the Brazos River which presents little danger of flooding the site due to differences in elevation. The subsurface formation of which the facility rests is easterwood shale. The thickness of the formation varies from 10-300 feet.

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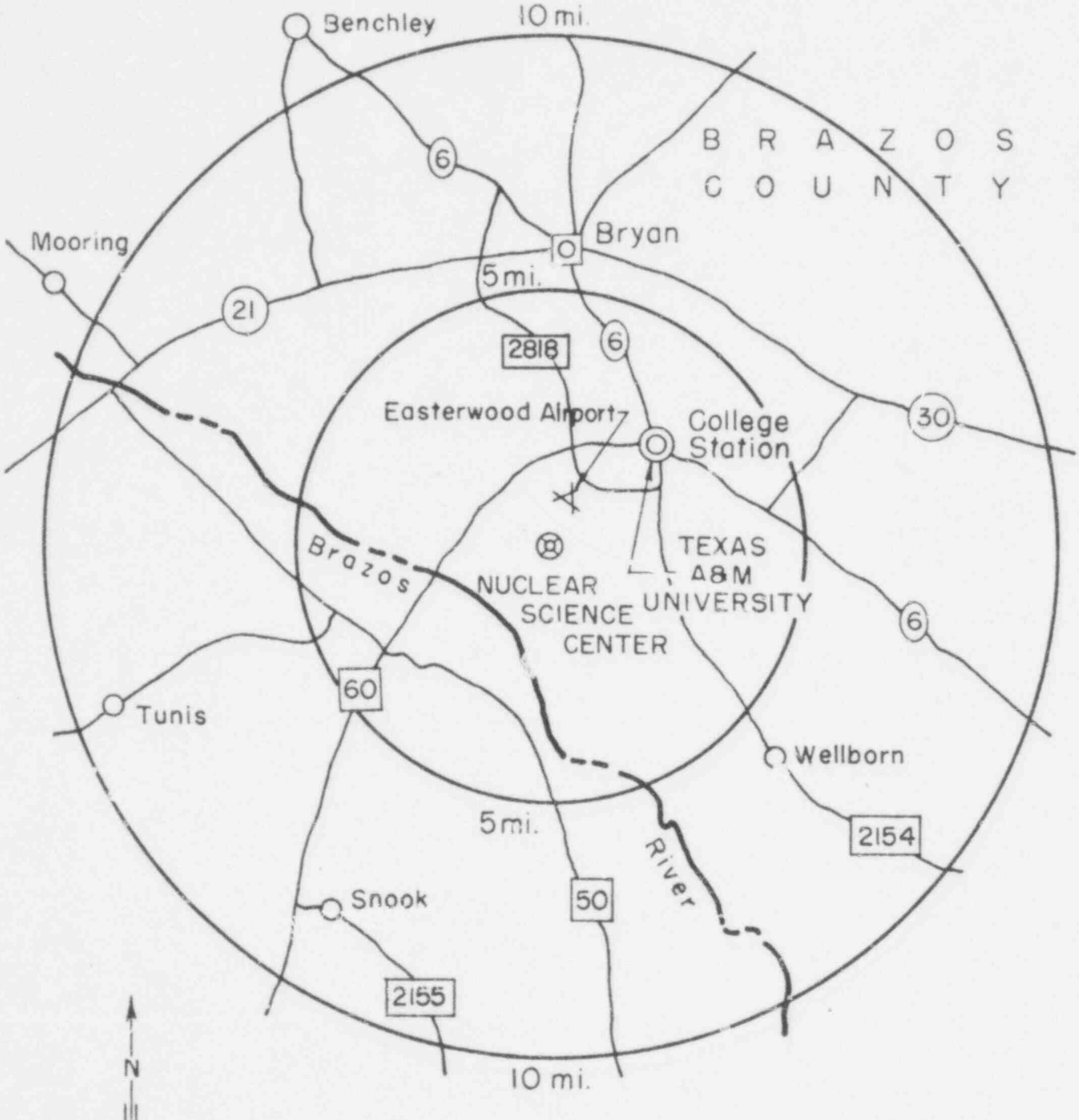

FIGURE 2-1 NUCLEAR SCIENCE CENTER REGIONAL MAP

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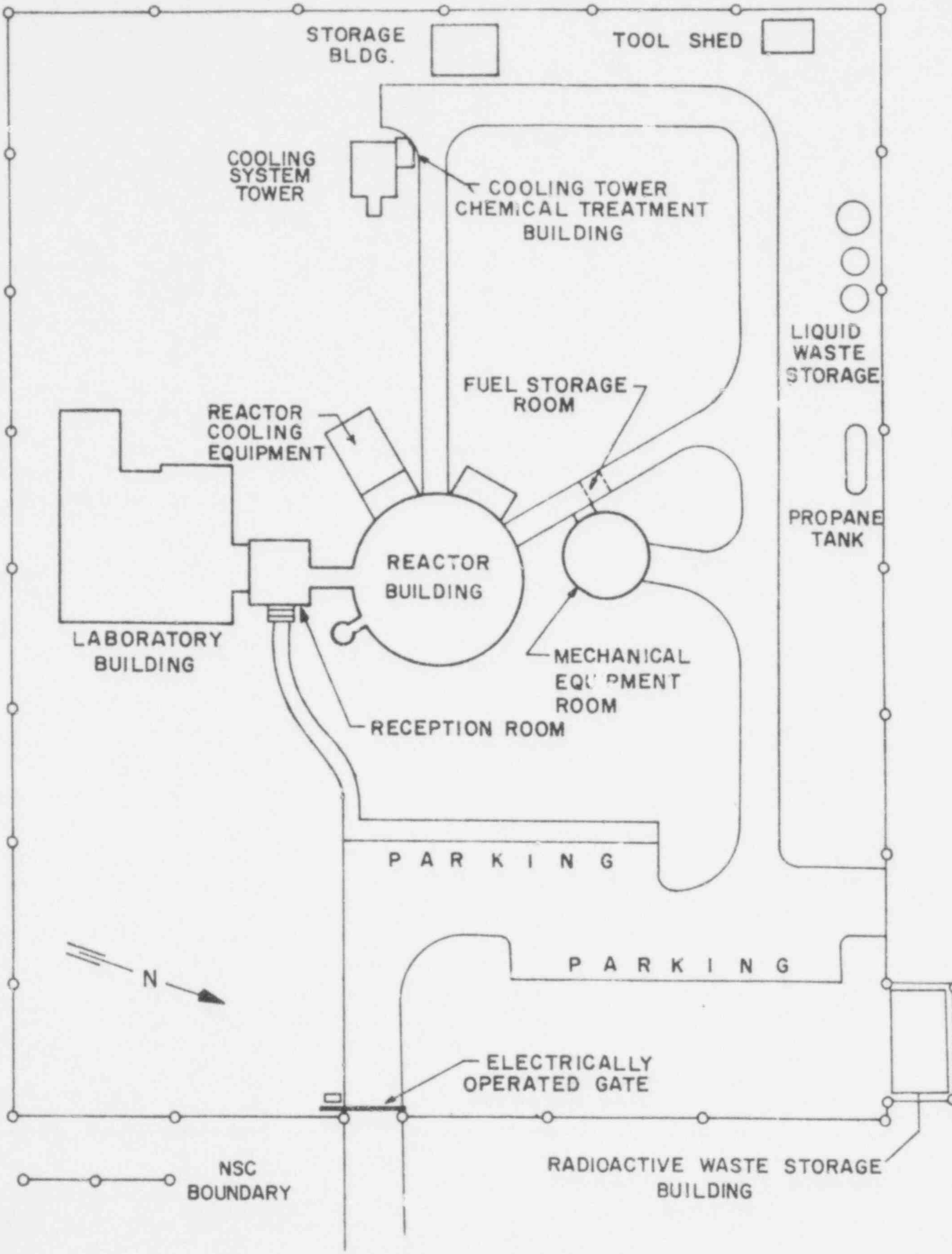

FIGURE 2-2 NUCLEAR SCIENCE CENTER SITE PLAN

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Texas lies in a region of minor seismic activity. Extreme West Texas, over 600 miles west of College Station is nearest the active belt along the west coast of Mexico and the United States. There are occasional minor shocks of very small magnitude in the state. Only one earthquake of any significance has ever been recorded in Texas. This shock was at 30.6 N and 104.2 W on August 16, 1931. This occurred near El Paso in extreme West Texas and was a Class C (6.4) shock.[1]

Due to high pressure areas which are predominant over the Gulf of Mexico, warm southeasterly winds occur a large majority of the time on an annual basis. Precipitation in the form of rain averages 30 to 35 inches annually and the occurrence of snow is rare.

The passage of frontal systems is normally accompanied by northwest winds as shown in the winter wind rose diagram which is shown in Figure 4-1. Calms occur an average of 10% of the time and wind speeds above 21 knots are seldom encountered. Tornadoes are fairly common in Texas; however, Brazos County is an area of relatively low tornado activity. From 1916 to 1950, nineteen tornadoes have been reported in a circular area of 50 miles radius about the Nuclear Science Center. These either originated in this area or moved into this area. This is an average of approximately one tornado every two years. The most probable path length is on the order of 25 miles. A study of the movement of 3,090 tornadoes from 1930 to 1950 indicates that there is a 6% probability that a tornado will have a westerly component to its direction of movement. Therefore, tornadoes developing in the eastern half section of the above mentioned area are potentially much less dangerous than those developing in the western half section. The southwest quadrant is the most dangerous because 61% of all tornadoes move to the northeast.

The months of May and June are rated first and second for the most occurrences of tornadoes over the period 1916-1950. Fall and winter months are the lowest in occurrence. The season usually starts in March, reaches a peak in May and falls off again starting in July. The greatest possibility of tornado occurrence is in the afternoon hours generally from 3:00 to 7:00 p.m. The hours of least occurrence are from 7:00 p.m. to 8:00 a.m. In Texas between 1916 and 1950, less than one-third of the tornadoes appeared between midnight and noon.

The probability of contaminating drinking water supplies is virtually eliminated since the Brazos River is not used as a source of water and there are no open reservoirs in the surrounding area. The public water supply is pumped from deep wells several miles from the Nuclear Science Center.

5.0 ENVIRONMENTAL EFFECTS OF CONSTRUCTION

At the present time no immediate plans for construction which would affect the environment are foreseen. Minor modifications for upkeep of the facility will probably occur, but no impact to the terrain, ground waters, wildlife or vegetation should occur from such actions.

1. Seismicity of the Earth, B. Gutenberg and C. F. Richter.

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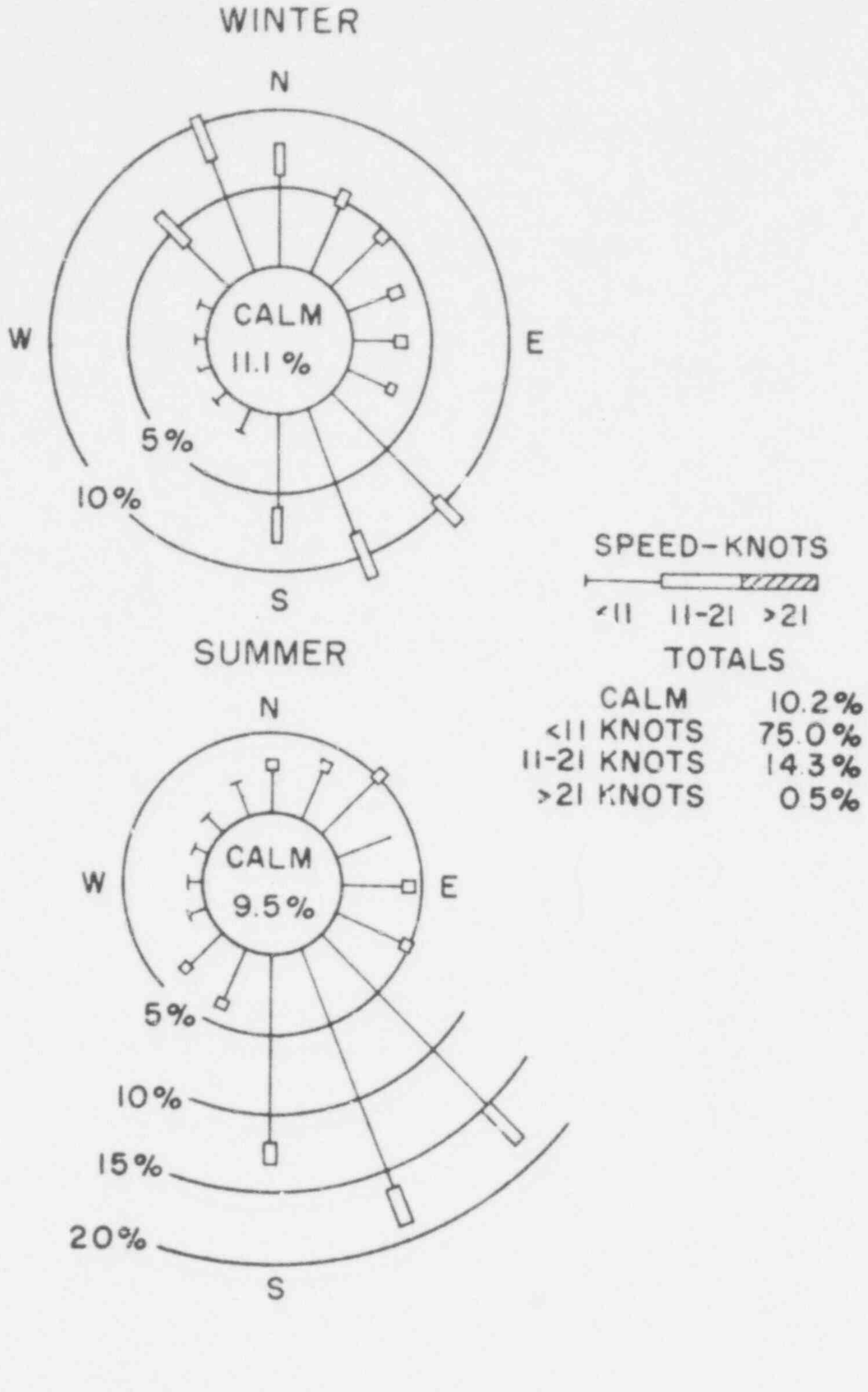

FIGURE 4-1 AVERAGE WIND FREQUENCY DISTRIBUTION AT THE NUCLEAR SCIENCE CENTER

6.0 ENVIRONMENTAL EFFECTS OF FACILITY OPERATION

6.1 Water Use Consumption

The water supply for the NSC is provided by Texas A&M University. The University obtains its water from wells separate from the cities of Bryan and College Station. Use of this readily available water supply by the NSC would not present an appreciable impact on the environment or effect public water supplies. The reactor pool which has an inventory of approximately 105,000 gallons requires an average of 100 gallons of make-up water per day to allow for evaporation from the pool.

6.2 Heat Dissipation

The heat produced by the 1 Mw(th) reactor is transferred through a heat exchanger to a secondary cooling tower loop for final dissipation of the heat to the atmosphere. Water evaporated to the atmosphere is approximately 470 gallons per Mw hour of reactor operation. The cooling tower has a 2 Mw(th) design heat removal capability with a maximum flow of 1650 gpm. The amount of moisture dispersed into the atmosphere by the cooling tower is insignificant compared to the annual precipitation of 30 to 35 inches.

6.3 Chemical Discharges (non-radioactive)

The non-radioactive chemical discharges from the Nuclear Science Center are released to the NSC Creek. These discharges are related to conventional chemical laboratory operations at the site and the treatment of make-up water for the cooling tower and associated heat exchanger. The chemical discharges represent a small fraction of the discharge limits of the Texas Water Control Board; thus, the environmental effects related to chemical discharges created by the operation of the reactor are not significant.

6.4 Radioactive Discharges

6.4.1 Gaseous

The main radioactive gas produced is ^{41}Ar. Its source is the dissolved Argon in the pool water, irradiation of air in beam ports, dry tubes, pneumatic irradiation systems, and the irradiation cell. Nuclear Science Center Technical Report No. 32, "Determination of Argon-41 Production at the Texas A&M Nuclear Science Center Reactor" documents that approximately 4.7 Ci of ^{41}Ar are released on an annual basis.[2] Applying the dilution factor of 5.0×10^{-3}, the releases are approximately 0.8 percent of the permissible concentration specified in Appendix B, Table II, Column 1 of 10 CFR Part 20.[3] The results of 4.7 Ci was based on 100 Mw-day operation

2. Walker, K. L., et.al., Determination of Argon-41 Production at the Texas A&M Nuclear Science Center Reactor, Technical Report No. 32, NSC, July 1975.

3. SAR, Pages 103-105, August 1967.

which is an approximate annual average for operation of the NSC reactor.

Due to presence of dueterium in the pool water, small amounts of tritium are produced by the reactor. The University of Arizona received samples of the NSC pool water along with samples from other research reactors and a tritium inventory of the NSC pool water was determined. The results are reported in the August 1976 Volume 31 of Health Physics, page 170. A similar study performed by the NSC Health Physics staff showed a content of 6.6×10^{-2} μCi/L which is in agreement with the findings of the University of Arizona. Through evaporation, a fraction of the tritium is transferred to the atmosphere via the stack. The activity released to the atmosphere based on a 100 gallon/day evaporation from the reactor pool and an exhaust rate of 5000 CFM is 1.23×10^{-10} μCi/cc which is well below the limit of 2.0×10^{-7} μCi/cc as stated in Appendix B, Table II, Column 1 of 10 CFR Part 20.

6.4.2 Liquids

Radioactive liquid waste is generated on a daily basis at the Nuclear Science Center. This waste originates from laboratory sinks, decontamination showers, laundry room, floor drains, demineralizer system, pool skimmer pump drain, cooling equipment room valve pit sump, condensate from reactor building exhaust, and pool liner leakage. These sources of liquid waste are collected in the demineralizer room sump where it is pumped to the hold-up tanks for storage and analysis before release to the unrestricted environment. Averaged over the previous year the concentration of radioactive liquid releases to the environment were approximately 1.3% of the limits specified in Appendix B, Table II, Column 2 of 10 CFR Part 20.

These liquid releases are further monitored by an environmental survey program established by a cooperative agreement between Texas A&M University and the Texas State Department of Health. Through this program, vegetation and water samples are collected from NSC Creek, White Creek, the upper and lower Brazos River and the Sanitary Outflow. These samples are analyzed for gross, gamma, and beta radioactivities and radioisotope identification. Data from these samples have remained basically unchanged since 1974 and no results which would have a significant impact on the environment have been found.

6.4.3 Solids

Radioactive waste in solid form is produced by the NSC reactor on a daily basis. The bulk of this waste is in the form of paper, poly gloves, rags and expendable laboratory items. The solid waste is collected in plastic lined containers and stored in the radioactive waste storage building (See Figure 2-2). The wastes are transferred to the Radiological Safety Office, for disposal.

6.5 Radiation Levels

The TAMU Radiological Safety Office employs an Environmental Survey Program which was expanded to include measurements of the integrated radiation exposures at locations around the perimeter of the facility. These measurements are made for a period of approximately 90 days using commercially available thermoluminescent dosimeters (TLD's) of lithium fluoride chips in glass encapsulated bulbs. These dosimeters are provided and processed by the Texas Department of Health, Division of Occupational Health and Radiation Control. Ambient background for these measurements is determined from a control dosimeter located southeast of Easterwood Airport and approximately 800 meters east of the facility. This location is at a right angle to the prevailing southeasterly winds which occur a large majority of the time on an annual basis. Table 1 lists the values of the exposure rates for various positions at the site boundary from November 10, 1977 to December 31, 1978.

TABLE 1

ENVIRONMENTAL RADIATION MONITORING PROGRAM

INTEGRATED RADIATION EXPOSURE

November 10, 1977 - December 31, 1978

Station Number	Location	Exposure (Gross MR)	Exposure (Net MR)	Exposure Rate (Micro R/hr)
1	Background	68	68	-
2	NSC Fence North-West	73	5	0.5
3	NSC Fence West	110	42	4.2
4	NSC Fence North	116	48	4.8
5	NSC Fence East	89	21	2.1
6	Radioactive Waste Storage Building	488	420	41.7
7	100 Meters East of NSC Boundary	73	5	0.5

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In 1975 a study entitled "The Environmental Impact of Radioactive Effluents from a University Reactor", were performed. The results of this study was published in NSC Technical Report No. 33.[4] The maximum annual dose as a result of liquid effluents was calculated to be 9.8×10^{-7} rem. The annual population doses due to gaseous effluents were found to remain below 4.0×10^{-4} manrem through 1990 based on population projections for the reactor environs. From these results no significant impact on the environment attributable to radioactive effluents should occur through the continued operation of the Texas A&M Nuclear Science Center Reactor.

7.0 JUSTIFICATION FOR CONTINUED OPERATION OF THE FACILITY

The benefits which are realized by the operation of the NSC reactor warrant its continued operation. The facility not only proves to be valuable to the TAMU system but other schools capitalize in the education of their students. Technological advancements, applications of radioisotopes in medical applications, and the use of isotopes as various trace elements are achieved through the continued operation of the facility. The NSC conducts educational tours for the general public, averaging over 4,000 visitors per year for the past ten years. These tours familiarize the people with the concepts of nuclear power and provide a foundation which an understanding of nuclear applications may be based.

8.0 SHORT TERM EFFECTS VERSUS LONG TERM GAIN OF FACILITY OPERATION

The long term gains from operation of the NSCR are considered to be beneficial as a result of the contribution to scientific knowledge and training. These long term benefits far outweigh the minimal impact on the environment associated with continued operation of the NSCR.

9.0 COST BENEFIT ANALYSIS

The TAMU reactor facility represents a multi-million dollar investment. The continued operation of the NSCR will mean continued educational benefits and the expansion of research projects in the future. From these observations, the environmental effects appear negligible compared to the benefits recognized by the continued operation of the facility.

4. Hamiter, F. O., Neff, R. D., The Environmental Impact of Radioactive Effluents from a University Reactor, Technical Report No. 33, NSC, May 1975.