ENVIRONMENTAL IMPACT

University of Texas

TRIGA MARK II

July 1984

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This document deals with the environmental effects that are expected from the operation of a TRIGA Mark II research reactor at The University of Texas at Austin. The reactor is part of the Nuclear Engineering Teaching Laboratory.

A. Facility, Environmental Effects of Construction

The TRIGA reactor will be located in an engineering building at The University of Texas Balcones Research Center. Design of the building is intended for the reactor facility and other laboratories and offices associated with applications and research in nuclear technology. Approximately 30% of the 1800 square meter facility is designated for the reactor facility.

Areas of the research center site served as a magnesium manufacturing plant prior to 1950. Since 1950, a few areas of the site have been developed as part of University research programs while other areas remained undeveloped. By 1980 a major development program at the Research Center began with several research programs moved to the area. Development of the site areas into a major research park began after 1980 with several new facilities constructed and many original site structures removed. One such magnesium plant structure, an earthen and concrete tank structure approximately 50 meters in diameter, is located at the proposed site of the Nuclear Engineering Teaching Laboratory. The reactor facility building will be the fourth structure since 1980, fabricated in the immediate area of the proposed site. Three previous development projects adjacent to the proposed site consisted of 46,500 square meters of administrative, research and storage space. One structure fabricated prior to 1980 is also located adjacent to the proposed site. Additional construction

projects are planned or proposed for future development of other locations on the Balcones Research Center.

Utility construction projects such as chilled water, heated water and electricity, road construction and other support facilities for the center are provided and proposed for the continued development of the research center as a major research facility. Utility requirements and construction activities for the reactor laboratory and its related facilities will not be different substantially from those required by previous construction projects at the Balcones Research Center. Construction activities of the facility are expected to be less than those of the three previous projects constructed since 1980 and should have no impact on areas beyond the Research Center site.

Utilities required by the facility are communications, electricity, chilled water, domestic water and sanitary sewer. Some utilities such as hot water, compressed air, and liquid radioactive waste storage are generated at the reactor facility. All utilities on the Research Center site are maintained by the University.

B. Environmental Effects of Facility Operation.

The TRIGA reactor facility is designed for 1000 kW(t) steady-state operation. Environmental effects of the operation will include waste heat disposal, production of liquid and gas radioactive effluents, and the generation of liquid and solid radioactive wastes. None of these waste items are considered significant with respect to environmental impact although each is treated appropriately. No resources for the facility are considered significant to the environment.

Heat disposal from the reactor pool is provided by heat exchange with a central chilled water supply. Estimated chilled water requirements for dissipation of the peak facility heat load is 1000 kW for the reactor and 210 kW for the building. Total average heat rejection contributed by the reactor from actual operation hours is not expected to exceed 5% of the peak value. A central chilled water facility with multiple units as large as 4220 kW will provide the ultimate heat rejection source.

Radioactive gas effluents produced by the reactor are argon-41 and nitrogen-16. Production and release of these gases are controlled so that the short half-life of each product will further diminish the radiological impact. Release of argon-41 is a function of the reactor power level, operation time and quantity of air exposed to the reactor with some contribution from dissolved air in the coolant. Release of nitrogen-16 is related primarily to the reactor power level and coolant flow through the reactor. The respective argon-41 and nitrogen-16 half-lives of 109 minutes and 7 seconds respectively, affect the type of control applied to the release. Controls on both gases are applied to limit occupational exposures, although the short half-life of nitrogen-16 eliminates any significant environmental release compared to the longer half-life of argon-41 that is released to the environment. The upper limit for release of argon-41 from continuous single shift operation at full power for one year is 70 Curies. The actual value will be lower substantially and should be less than 30 Curies as indicated by the conservative estimate and data available from other facilities.

Production of activation products in the coolant water consists of activation of impurities and small quantities of deuterium and tritium. Activation of short-lived gaseous

products of oxygen and nitrogen are not considered significant environmental effects. Releases of radioactive hydrogen products to the environment would occur through the evaporation of pool water. These releases are projected to be a small fraction of the allowable concentrations for the hydrogen isotopes. Liquid waste releases typical of similar facilities are less than 0.01 Curies per year and should be less substantially for this facility.

Solid wastes released for waste burial and liquid waste released to sanitary sewer systems are expected to represent a fraction of the total University release amounts. Most of the waste activity is short-lived isotopes such as Na^{24}, Mg^{27}, Al^{28}, Cl^{38}, Cr^{51}, Mn^{56}, Ni^{65}, As^{76}, and others. A few longer-lived radioisotopes such as Co^{60} and small amounts of Cs^{137} are also created and disposed. Waste disposal includes gloves, paper, containers, samples, and resin. Activation products are accumulated in an ion exchange resin and removed on a periodic basis. The annual volume of resin required to control pool water quality is less than 0.1 cubic meters. Dose rates at the surface of the resin volume are typically 10-20 mrem/hr with intermediate and long half-life activation products present.Total volume is projected to be 1 or 2 cubic meters per year compared to the University volume of 30 cubic meters per year. Sanitary sewer disposal of liquid waste should also be a fraction of the University disposal constraints limited to 1 Ci/yr.

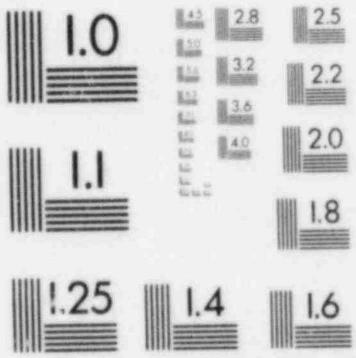
Storage, processing and disposal of fuel elements is not considered a significant activity of this facility. Projections from the operation schedules of similiar types of reactor facilities indicate that 750 MW-days of burnup would be accumulated after 40 years. Ultimate disposal and processing of the fuel is a function of the Department of Energy.

IMAGE EVALUATION
TEST TARGET (MT-3)

150mm

6"

IMAGE EVALUATION TEST TARGET (MT-3)



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Studies such as NUREG CR-1756 contain detailed information for the radionuclide inventories expected after operation of a typical research reactor facility. Major isotopes of concern identified are Co^{60}, Zn^{65}, and C^{14}, although several other isotopes and such rare earth radionuclides as Eu^{152} are expected to be present in reactor materials and shield concrete.

C. Environmental Effects of Accidents

Accidents ranging from failure of experiments to the largest core damage and fission product release considered possible result in doses of only a small fraction of 10 CFR Part 100 guidelines and are considered negligible with respect to the environment. Credible accident analysis for TRIGA and TRIGA fueled reactors are presented in NUREG CR - 2387 (PNL-4028).

D. Unavoidable Effects of Facility Construction and Operation

The unavoidable effects of construction and operation involves the materials used in construction that cannot be recovered and the fissionable material used in the reactor. No adverse impact on the environment is expected from either of the unavoidable effects.

E. Alternatives to Construction and Operation of the Facility

There are no suitable or more economical alternatives which can accomplish both the educational and the research objectives of this facility. These objectives include the training of engineering students in the operation of nuclear reactors, the operation as a source of neutrons for neutron activation analysis or neutron radiography and other

activities related to education and radioisotope applications.

F. Long-Term Effects of Facility Construction and Operation

The long-term effects of a research facility such as the Nuclear Engineering Teaching Laboratory are considered to be beneficial as a result of the contribution to scientific knowledge and training. This is especially true in view of the existing facility and the minimal impact on the environment associated with a facility such as the Nuclear Engineering Teaching Laboratory.

G. Costs and Benefits of Facility and Alternatives

The cost for a facility such as the Nuclear Engineering Teaching Laboratory is projected at $4.5 million with a minimum environmental impact from the operation of the facility. The benefits include, but are not limited to: the applications of neutron activation analyses, production of neutron beams for research and or application, production of short-lived radioisotopes, education of students and public, and training of operating personnel. Some of these activities could be conducted using particle accelerators or radioactive sources, but these alternatives are also costly and less effective and in some cases not applicapable. There is no reasonable alternative to a nuclear research reactor of the type presently used at the UT Nuclear Engineering Teaching Laboratory for conducting the broad spectrum of activities previously mentioned.