EA-565; Environmental Assessment AND (FONSI) Center For Energy Studies Arkansas Technical University Russellville, Arkansas

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

CENTER FOR ENERGY STUDIES ARKANSAS TECHNICAL UNIVERSITY ENVIRONMENTAL ASSESSMENT DOE/EA - 0565 JULY 1992

Prepared for

Office of Energy Research

by

Chicago Operations Office

Project and Facilities Management Division

U.S. Department of Energy

1.0 NEED FOR THE PROPOSAL

Senate Report 101-83 accompanying the Energy and Water Appropriations Act, 1990, indicated that $850,000 had been included in DOE's fiscal year 1990 appropriation for support of a proposed Center for Energy Studies (the Center) at Arkansas Technical University (ATU). The total amount of funds available for this activity was reduced by the application of Gramm-Rudman-Hollings sequester and a general reduction. Total funds available after those reductions were imposed is 838,100.

This environmental assessment has been prepared in compliance with the National Environmental Policy Act of 1969, 42 U.S.C. 4321 et seq. (NEPA) to support the Department of Energy's (DOE) decision to provide a grant of $838,100 to be used by ATU for construction of two buildings for the Center. Total project cost is estimated at $1.2 million.

ATU is located in Russellville, Arkansas, in a geographical region whose economy is strongly influenced by the production of energy. The ATU-proposed facility would be devoted to energy education and applied energy research. The proposed Center for Energy Studies would allow ATU to consolidate existing and planned functions in energy education and research. At present, no research reactors are operating in Arkansas. The ATU program would provide education in nuclear science engineering, including a special degree program in physical science for power plant operators for Arkansas Nuclear One, the only nuclear power generating plant in the state. ATU also conducts a long-term pressure vessel neutron dosimetry study for Arkansas Nuclear One.

The proposed location for the Center for Energy Studies is east of the Corley Building, which houses the Department of Engineering (as determined by a site location analysis) [Figure 4]. This location is also near the Arkansas Mining and Minerals Resources Research Institute, and McEver Hall, which houses chemistry, biological science, and physical science; thus, the Center would be near those expected to use the research reactor. Other state universities, the Medical School in Little Rock, and the National Center for Toxicological Research near Jefferson, Arkansas, also would have access to the reactor for research involving neutron activation analysis.

2.0 PROPOSED ACTION AND ALTERNATIVES

2.1 Proposed Action

The proposed action would partially fund the design and conventional construction of two separate buildings with a passage between them [Figures 1 and 2]. The administrative/classroom building would contain approximately 418 square meters (4,500 square feet), and the reactor building would contain approximately 232 square meters (2,500 square feet). The administration/classroom building would provide office space for the director and faculty. Two classrooms, a reception/display area, a conference room and a nuclear engineering laboratory would also be included in this building. The reactor building would contain a reactor control room, two radiation counting laboratories, a small shop and utility rooms, and a 25 ft deep below-grade pool approximately 10 feet in diameter surrounded by 3 ft of reinforced concrete.

Necessary utilities (communications, electricity, domestic water, and sanitary sewer) would be connected from existing services on the campus. Hot water, chilled water, and compressed air would be produced at the Center. An electric- or gas-forced air heating system would be installed. All utilities at the Center would be maintained by ATU.

After construction of the buildings, ATU proposes to install a Mark I TRIGA research reactor previously used at Michigan State University (MSU) in the reactor building portion of the Center [Figure 3]. The reactor, manufactured by GA Technologies, Inc. and updated with a new control system and refurbished control rod drives, would be operated under the same conditions under which it was operated at MSU from 1967 until it was decommissioned and dismantled in 1989 after the retirement of the principal researcher. The proposed steady power level of 250 kW (kilowatt thermal) and pulse power of 300 MW (megawatt thermal) were used safely at MSU.

Operation of the reactor would be licensed by the U.S. Nuclear Regulatory Commission (NRC). The NRC licensing process requires compliance with NEPA in support of the issuance of an operating license. The NRC intends to prepare an environmental assessment (EA) independent of this DOE EA as part of its licensing process.

2.2 No-Action

Under the "no-action alternative", the funding through DOE would not occur. This would leave ATU with less than half of the funding required for construction of the two buildings. At this time, ATU does not have a means of mitigating the loss of the DOE grant for the project. It is likely that ATU would reduce the scope of the project commensurate with the remaining available funds, and build just the reactor building on the proposed site. If the reactor was not utilized at ATU, it would be available for use by another University. The area proposed for construction of the Center for Energy Studies is in a prime area of the campus and would be put to other use involving construction in the near term.

Figure (Page 3)

Figure 1. Proposed Center for Energy Study Arkansas Tech University

Figure (Page 4)

Figure 2. Floor Plan for the Center for Energy Studies

Figure (Page 5)

Figure 3. TRIGA Mark I cutaway.

Figure (Page 6)

Figure 4. Areas of Potential Flooding Near Prairie Creek
(Corps of Engineers, Plate 29. Feb. 1969)

3.0 ENVIRONMENTAL IMPACTS OF THE PROPOSED ACTION AND NO-ACTION ALTERNATIVE

This EA assesses the environmental impacts of construction of the two buildings. For completeness, it also briefly describes the radiological aspects of research reactor operation. The analysis is drawn from the Safety Analysis Report (SAR) prepared by ATU to support the reactor licensing application to the NRC. This EA also includes the information currently available on the effects of reactor decommissioning. At the end of its useful life, reactor decommissioning options will have been identified, and additional NEPA reviews may be appropriate. The proposed action does not involve any unresolved conflicts concerning alternative uses of available resources within the meaning of section 102(2)(E) of NEPA.

3.1 Construction Impacts

The proposed site for the Center for Energy Studies is a vacant, grass-covered area of the ATU campus. It is currently used for baseball practice fields, and was previously part of a landing strip for training WWII pilots on light aircraft. No environmentally sensitive areas exist in the vicinity that could be affected by construction activities. No threatened or endangered species or their critical habitats are known to be present on site or in the immediate vicinity of the site [Attachment 1]. There are no wetland areas and no federal or state-designated natural areas. No prime agricultural lands or special sources of water exist that would be affected by the proposal. There is no known property of historic, archaeological, or architectural significance at or near the proposed construction site [Attachment 2]. Should cultural remains be discovered during construction, the Arkansas Historic Preservation Program would be notified immediately and an evaluation of the significance would be conducted. The one acre site is well-drained and lies at an elevation of approximately 348 ft. This is well above the flood level for the campus area, i.e. the Corps. of Engineers' Intermediate Regional Flood (100-year floodplain) and Standard Project Flood (500-year floodplain), which are at the 334 ft. and 338 ft. elevations, respectively. [Figure 4].

Site work would consist of conventional excavation and construction. Excess dirt and rock (approximately 20-25 yd3) would be utilized elsewhere on campus as parking lot fill. Building construction waste (approximately 25 yd3 of paper and wood) would be disposed of in the Russellville Sanitary Landfill in accordance with applicable state and federal regulations. The proposed action would not require the construction or expansion of waste disposal, recovery, or treatment facilities.

Construction activities for the Center would not differ substantially from those required during standard construction projects, and should have no impact on areas beyond the Center site. Structural engineering of the building would be specified by standard university procedures established in accordance with the Uniform Building Code and the State Building Code. All elements would be designed to Zone 1 seismic conditions. The provisions of the Life Safety Code and National Fire Protection Code would be included in building features. The sub-strata of the proposed building is capable of accommodating substantial loads (1,690 kg/m2). The building foundation would be composed of poured concrete piers with a concrete slab on compacted fill. The building superstructure would be reinforced concrete. Exterior structural walls would be masonry construction.

3.2 Operations Impacts

3.2.1 Radiological Effects

Among other guidance, the ATU staff would follow ANSI/ANS 15.11 "Radiological Control at Research Reactor Facilities". The facility structure would be designed to provide protection for the fuel elements, special nuclear materials, and the reactor. Design of access points and interior walls would be specified for security control, fire control, and ventilation control. Penetrations (other than doors into the reactor room and control room) would be limited in size and sealed to limit air leakage. Radiation exposure would be monitored in accordance with requirements of licenses by the Arkansas Department of Health, the NRC, and other applicable laws and standard safety practices. Supervision and surveillance during reactor operations would be performed to assure that appropriate radiation protection procedures are followed and that planned radiation precautions are observed. Operators would be trained and checked in the proper use of radiation protection equipment, proper functioning of which would be routinely checked. Management would be promptly notified if radiation exposure dose limits were approached or if unanticipated problems were to develop during the course of the work.

3.2.1.1 Occupational Exposures

Radiological contributions would be from argon-41 (Ar41) and nitrogen-16 (N16). Ar41 is produced by the activation of argon-40 present in the air in experimental facilities or in the air dissolved in water. Release of Ar41 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. N16 is produced by the activation of oxygen-16 in the reactor core region. It takes the water approximately 109 seconds (ATU SAR pp. 6-14) to rise from the core region to the top of the pool. Due to the very short half life (7.11 sec) the concentration of N16 is significantly reduced before it leaves the pool. Release of N16 is related primarily to the reactor power level and coolant flow through the reactor. Controls on both gases would be applied to limit occupational exposures. Both NRC regulations (10 CFR 20.101), and DOE Order 5480.11 Radiation Protection for Occupational Workers, limit the radiation dose to individuals in restricted areas to 1.25 rems (1250 mrems) to the Whole Body in a calendar quarter (5 rem/yr).

Previous Reactor Operations. Complete gamma dose measurements were taken around the TRIGA reactor during 250 kW steady-state and 300 kW pulse-power operation at MSU. Typical measurements are listed below. No neutron leakages were detected from the operating TRIGA reactor except for a thermal neutron dose of 0.03 mrem/hr (15 n/cm2-sec) measured above the rotary specimen rack drive shaft tube during 100 kW operation. As indicated in Table 1, the measured radiation dose rates are low enough to allow operating personnel to perform experiments at the top of the reactor tank during full power operation. The dose rates would apply when the reactor cooling system is in operation. These doses are given in milliroentgens (mr). Since the roentgen equivalent man (rem) is defined (10 CFR 20) as the dose of any ionizing radiation that will produce the same biological effect as that produced by 1 roentgen of x-ray or gamma radiation, and in this case only gamma radiation was measurable, mr is equivalent to mrem.

Table 1: Gamma Dose Rates Around MSU TRIGA Reactor During 250 kW Steady-state Operation

Location of Instrument	Dose Rate (mrem/hr)
Surface of Reactor Tank Water	1.0
1 ft. Above Surface of Pool (floor level)	0.8
At Handrail Adjacent to Reactor Tank	0.1

At Ceiling (Approx. 4 m above reactor pool) 0.2 - 0.3

Estimated Argon-41 Dose Rate. Calculations documented in the Safety Analysis Report (SAR, 1989) prepared by ATU to support the application for an NRC license for the reactor facility show activity concentrations of Ar41 of 2 x 10E-7 uCi/ml (Ci/m3) from the pool water and 9 x 10E-5 Ci/m3 from experimental facilities at full power (250 kW) (SAR pp. 6-9). These are equilibrium concentrations of the activity released into the reactor room volume of 394 m3. The building exhaust rate was assumed to be 0.401 m3/s. For the release rate from the experimental facilities (central thimble, rotary specimen rack and pneumatic transfer system) an exhaust rate of 4.75 x 10E-3 m3 (about 10 cfm) was assumed. Experiments usually replace about 80% of the air in these facilities, reducing the activity concentration coming from the experimental facilities to 1.8 x 10E-5 Ci/m3 [9 x 10E-5]. The total concentration of Ar41 from the above two sources was therefore estimated at 1.82 x 10E-5 Ci/m3.

Using this activity concentration, the dose to an occupational worker in the reactor room from Ar41 was estimated to be 0.43 mrad/hr. [For gamma radiation, 1 mrad is the equivalent to 1 mrem.] The dose from continuous single shift operation at full power for 1 year (1920 hr/yr) would therefore be 826 mrem, or less than 20% of the NRC limit.

Estimated Nitrogen-16 Dose Rate. The saturation concentration of N16 in the reactor room was estimated to be 1.68 x 10E-8 Ci/m3 (reference ATU SAR pp. 6-14). The diffuser which discharges Water above the core region in the pool greatly increases the transit time and this further reduces the concentration of N16. Therefore, using an average gamma energy of 6 MeV, the dose rate from N16 in the reactor room was calculated to be 1.08 x 10E-6 rad/hr (rem/hr). The annual occupational dose for continuous single shift operation at full power would therefore be 2.1 mrad.

Combined Estimated Dose Rate. Based upon the calculation, above, the combined annual occupational dose from Ar41 and N16 would be about 828.1 mrem, well within the NRC limits of 1250 mrem per calendar quarter, or 5000 mrem per year. Moreover, ATU projects actual reactor operation time to be less than 20% of the 1920 hours which is used to calculate this dose, in which case the actual combined occupational dose would be significantly lower, or about 166 mrem per year. This number would be further reduced by lower power levels (neutron fluxes), smaller air volumes, shorter operation times, larger dilution factors, and by any operational limitations NRC may impose in the license for reactor operations.

3.2.1.2 Radioactive Air Emissions

As previously indicated, anticipated radioactive gas effluents produced by the reactor include Ar41 (half-life 109 minutes) and N16 (half-life 7 seconds). Production and release of these gases would be controlled in accordance with EPA and NRC regulations. The short half-life of each product would further diminish the radiological impact of any release to the environment.

As was the case at MSU, the reactor building would comprise the restricted area. The MSU SAR prepared in 1984 indicated that doses in unrestricted areas as a result of actual releases of Ar41, when averaged over a year, have never exceeded or even approached the limits specified in 10 CFR 20.105 (500 mrem/yr). The MSU reactor facility measured the release of airborne radioactivity at approximately 400 microcurie/yr. Furthermore, the less-than-50 mrem/yr dose beyond the limits of the reactor facility experienced for reactor operations at MSU gives reasonable confidence in estimates of the potential dose to the public as a result of any Ar41 release.

Using a realistic estimate of the air exchange in the experimental facilities (which make the major contribution to Ar41 emissions), and information from other reactors, the Ar41 concentration in the outside air was calculated to be 2.3 x 10 Ci/m3. This estimate is approximately 35% higher than the the value for Ar41 in EPA's Table 2 Concentration Levels for Environmental Compliance [40 CFR 61, Appendix E]; however, since the actual full-power operation time of the reactor would be less than 20% of the 1920 hours used in the calculation, the actual average emission concentration would be well below that which EPA estimates would cause any member of the public to receive an effective dose equivalent of 10 mrem/yr. Also, when compared to actual measured Ar41 release rates from operation of TRIGA reactors, these estimates are still conservatively high by at least a factor of 2. The NRC license would impose further limits on operations if necessary to assure compliance with NRC and EPA regulations. ATU would monitor radioactive air emissions from the facility and change procedures and/or restrict operations if necessary.

Potential coolant water contamination, due to activation of impurities and small quantities of deuterium and tritium, would be removed by circulation through the resin bed to remove impurities. Makeup water would be added as necessary. The only potential for release to the environment is through evaporation of pool water; however, these releases are projected to be less than one-half the allowable concentrations for the hydrogen isotopes (2 x 10E-7 uCi/ml) and the gaseous activation products of oxygen and nitrogen are short-lived and therefore would not constitute significant environmental effects.

3.2.1.3 Radioactive Waste

Total volume of all solid radioactive waste is projected to be a 1 to 2 m3/yr. Solid radioactive waste could include: gloves, paper, containers, samples, the air filters used in the exhaust ventilation system, and ion exchange resin which would accumulate activation products from the reactor coolant system. Biological targets would not be used, and no biological waste would be generated as part of the radioactive waste stream. The air filters would be changed annually and disposed of as potentially radioactive solid waste. The annual volume of resin required to control pool water quality is anticipated to be less than 0.1 cubic meters, with dose rates

at the surface of the resin volumes typically in the 10-20 mrem/hr range with intermediate and long half-life activation products present. This low level radioactive waste would be disposed of at an authorized, licensed, low-level waste disposal facility as required under state and federal (NRC) regulations. The frequency of waste shipments to a disposal facility would depend on minimum volume requirements of shippers, and are expected to be coordinated with shipments from Arkansas Nuclear One in order to minimize cost. Currently Arkansas Nuclear One utilizes a commercial waste disposal service which transports low level waste to Hanford, Washington pending establishment of the regional low level waste compact site, probably in Nebraska.

The only high-level radioactive waste that would be generated during operation of the reactor would be the reactor fuel. Fuel elements (approximately 100 39-gram enriched U238 TRIGA fuel pins) would be obtained under the DOE University Reactor Fuel Assistance Program after NRC review and approval. Through this program, begun in the 1950's and operated substantially unchanged since the early 1970's, DOE loans reactor fuel rods at no cost to approximately 33 universities nationwide. Extra fuel rods could be stored in fuel racks in the pool or in 8" diameter storage wells in the reactor building pool enclosure. However, since the expected fuel lifetime exceeds the 40-year operating life of the research reactor, no storage of spent fuel rods is anticipated (although, if needed, they could also be stored in the in-pool fuel racks prior to final shipment from ATU). As the fuel elements remain DOE property throughout the life of the research reactor, the final disposition of the high-level waste at the time of reactor decommissioning would be the responsibility of DOE as specified in the Research Reactor Assistance agreement. Based upon projections from the operation schedules of similar types of reactor facilities, accumulations of less than 750 MW-days of burnup are anticipated over 4O years. [See Section 3.3, Decommissioning Impacts.]

3.2.1.4 Radioactive Liquid Effluent

Liquid waste releases typical of similar facilities (including operation of the Mark I TRIGA at MSU) are less than 0.01 curies per year and should be substantially less for this facility. Before any releases of potentially contaminated waters to the sanitary sewer system, representative samples would be collected and analyzed by standard techniques. Only wastewater meeting the limits of 10 CFR 20.303 would be discharged directly to the sewer. Non-conforming wastewater would be retained until radioactive products decay to acceptable limits, or filtered, solidified, and disposed of as low level waste.

3.2.1.5 Radiological Effects of Accidents

Accidents associated with university research reactors are very unlikely and low frequency events. The following accident scenarios were evaluated in the ATU SAR prepared for the NRC licensing application. Each has a probability of occurrence less than one in one million, and does not have the potential for catastrophic consequences.

Reactivity Insertion Accidents. During a pulsing operation, reactivity is inserted rapidly into the reactor and is a designed feature of the fuel per-

formance [West, 1967]. The U-ZrH (H/Zr = 1.6) fuel used in the TRIGA reactor has a strong, prompt negative temperature coefficient. This temperature coefficient terminates any nuclear excursion. The maximum reactivity that may be inserted by the pulsing operation is limited through the use of mechanical stops to limit control rod withdrawal. This prevents an accident during research experiments. Movement of the safety transient rod above 1 kW is prevented by circuit design.

There could be no loss of clad integrity, damage to the fuel, or radiological consequence as a result of the maximum reactivity insertion. [ATU SAR, 1989] While cladding failure could occur due to substantial volume changes associated with phase transformations, the peak temperature of the TRIGA fuel element at the conclusion of a pulse (662 degrees C) is well below the temperature at which the Zr-H becomes unstable (1250 degrees C), [Simnad, 1980] eliminating the potential for rupture of fuel cladding. The clad theoretically could also fail as a result of high internal gas pressures produced by the hydrogen released from the fuel, the fission product gases, and the expansion of air at the time of peak fuel temperature. However, at a temperature of 662 degrees C, the ultimate tensile strength of the 0.02 in. thick, type 304 stainless steel cladding is above 41500 psi, and the yield strength is 28500 psi, which far exceeds the total internal pressure for the H-Zr fuel (1894 psi).

Loss of Reactor Coolant. Loss of reactor coolant water (i.e. by the tank being accidentally pumped dry) is prevented by installation of siphon breakers (1/2 inch diameter holes located 1 ft below the inlet and outlet water lines), and by the use of a recirculating pump which does not have sufficient suction head to drain the tank. Also, groundwater level is five feet above the bottom of the tank, preventing the water from being completely drained out of the tank in the case of a tank failure.

In the TRIGA reactor, water is the major moderator of neutrons, and the loss of water will terminate the chain reaction. If the coolant is lost during reactor operation, fission product decay heat would be removed by natural convective air flow through the core. If the coolant was lost immediately at shutdown (zero cooling time), the maximum fuel temperature would reach 329 degrees C, which would not result in any damage to the fuel. At this temperature, the stress on the clad would be 1186 psi, which as previously discussed is well within the clad yield strength, and would not result in any damage to the cladding, which would contain the fission products, preventing a release to the environment. The fuel temperature could reach 900 degrees C without substantial yielding of the clad, which would require operation at 1540 kW, well above the 250 kW proposed operation level.

The radiological hazard associated with the loss of shielding water scenario has been calculated for a direct radiation location 6.4 m above the unshielded reactor core, near the top of the reactor tank, and for a scattered radiation location, at floor level. The calculations for the second location assume that the radiation is reflected by a thick concrete ceiling 7 m above the top of the reactor tank (normal roof structures would give considerably less backscattering). Table 2 shows the occupational dose rates for two cases: loss of shielding water after reactor operation for 10 hours, and loss of shielding water after reactor operation for 1000 hours.

Table 2: Radiation Dose Rates for Loss of Shielding Water

	RADIATION (rad/hr)			
	Direct		Scattered	
DECAY TIME	10 hr	1000 hr	10 hr	1000 hr
1 minute	660.0	820.0	.21	.25
1 hour	150.0	300.0	.048	.094
1 day	16.0	110.0	.0045	.035
1 week	1.7	47.0	.00052	.014
1 month	0.3	17.0	.00003	.0054

Based upon these calculations, the greatest potential dose of 820 rem/hour at the top of the tank would result in exceedance of the NRC limit of 5 rem/year to an occupational work in 22 seconds of exposure. However, as a practical matter, anyone observing the loss of shielding water from the top of the tank would know to return to the floor and leave the building immediately, thereby greatly limiting exposure.

Fission Product Release from Clad Rupture. The SAR also evaluated the potential for release of fission products to the environment due to clad rupture [Figure 5] during fuel handling. As the "maximum hypothetical accident" the SAR assumed that a fuel element from the region of highest power density failed in air after a long exposure at full power. The fission products released would be those that collected in the fuel-clad gap during normal operation [Foushee, 1971]. The inventory of radioactive noble gases and halogens in the fuel element were calculated assuming complete burnup after operations at 250 mW for 5 years. [Lamarsh, 1977; Meek, 1974). The analysis assumed release of 100% of the noble gases and halogens in the gap, zero ventilation in the room, and occupant exposure in the room for 10 minutes while evacuation takes place.

The total whole body 10 minute exposure for a reactor room occupant was calculated to be 0.61 mr, well within the 1250 mrem/quarter occupational dose limit of 10 CFR Part 20. Thyroid exposure of 5.16 rem was calculated based upon isotope inhalation for 10 minutes (compared to the NRC standard of 30 rem/yr, which is based on Appendix B concentrations).

Exposure to the public from a fuel clad accident was calculated assuming a stack release rate based upon negative pressure in the reactor room, release through the exhaust vent at roof level (10.0 m above grade), wind dilution, and functioning stack radiation monitors and diversion of the ventilation air flow through an absolute filter. Under such conditions, the exposure to an individual in the unrestricted area was calculated as 0.07 mr whole body over 1 hr (compared to the NRC standard of 50 mrems/yr). This amounts to a one hour thyroid dose of 9.9 mrems (compared to the NRC standard of 1500 mrem/yr). Using anticipated operation times reduces exposures by 80% (less than 2 mrem).

Figure (Page 14)

Figure 5 Instrumented Fuel Assembly (not to scale)

3.2.2 Non-radiological Effects

Non-radiological waste products from operation are limited to heat, and domestic/sanitary waste. Heat disposal from the reactor pool would be provided by heat exchange with a central chilled water supply. Estimated chilled water requirements for dissipation of the peak facility heat load is 275 kW for the reactor and 66 kW for the building. A new chilled water facility with a capacity of about 350 kW would provide the ultimate heat rejection source.

3.2.2.1 Hazardous Waste

Generation of non-radioactive hazardous waste is not expected during construction and operation of the Center. No scintillation fluid containing RCRA-listed hazardous waste would be used.

3.2.2.2 Domestic/Sanitary Waste

Generation of solid non-hazardous wastes and liquid waste at the Center would be primarily due to ongoing activities relocated from elsewhere on campus, and would represent an insignificant fraction (1/2 yd3, or less than 2%) of total University-generated amounts. Existing solid waste handling and sewer systems and County landfill capacity are adequate to handle the increase.

3.2.2.3 Chemical Storage/Use

No chemical storage or use is anticipated.

3.3 Decommissioning Impacts

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 Co60, Zn65, and C14, although several other isotopes and such rare earth radionuclides as Eu152 are expected to be present in reactor materials and shield concrete.

Based on data from the MSU reactor decommissioning, ATU estimates that less than 1000 ft3 of radioactive waste would require disposal at the time of decommissioning. This waste would primarily consist of reactor structural components located inside the pool. By enlarging the pool diameter, ATU expects to eliminate the need to remove concrete from around the pool. MSU had a small pool and was required to remove a relatively small (<1000 ft3) amount of concrete for disposal as low level radioactive waste.

ATU would be responsible for the decommissioning and dismantling of the reactor. A decommissioning fund has been established, per State Board of Higher Education requirements, to set aside $47,000/year for the next ten years. It is expected that all low-level radioactive waste produced through the decommissioning efforts will be able to be removed from ATU in one shipment. This shipment would be made to an authorized, licensed low-level radioactive waste disposal site by a licensed carrier in accordance with the rules and regulations of the State of Arkansas and the Nuclear Regulatory Commission. ATU expects that the regional low level radioactive waste compact disposal site proposed for Nebraska (approximately 600 mi.) would be accepting waste by that time. One truckload (40 ft. long van) would be adequate for the shipment of all low level radioactive waste associated with decommissioning.

Figure (Page 16)

Figure 6. Campus Map of Arkansas Tech University

The only high-level radioactive waste associated with decommissioning of the reactor would be the reactor fuel elements, which remain the property of the DOE. Final disposition of the fuel elements during decommissioning would therefore be a DOE responsibility under the University Reactor Fuel Assistance Program. Additional NEPA reviews, if required, would be undertaken at that time to address decommissioning options and impacts.

3.4 Cumulative Impacts

3.4.1 Construction Phase

ATU has recently received [Stripper Well] funds from the Arkansas State Energy Office enabling construction of a Cool Storage Facility, which would provide cooling water for the Center. The proposed site for the Facility is 20 to 30 ft south of the proposed site for the Administration/Classroom building of the Center for Energy Studies. The building would be 3,000-5000 ft2 of one-story warehouse-type space on a concrete slab, with the same outside finish (brick) as the Center. Construction activities could coincide with construction of the administrative/classroom and reactor buildings of the Center, but would have minimal effect on the environment, and cumulative effects of the two construction projects on air quality, ambient noise levels, and other environmental features would be temporary.

3.4.2 Operations Phase

Other labs on the ATU campus do not produce radioactive wastes. Small quantities of chemical waste generated by other departments on campus are disposed of in accordance with Federal and state regulations. The Cool Storage Facility will use water or some other off-the-shelf phase-change material, to cool the administrative/classroom building of the Center. The facility will demonstrate the energy and cost efficiency of using ice made at night, when electricity rates are lower, to provide cooling during the day. No regulated chemicals will be used in the facility, which will consume no more electricity than the equivalent air conditioning equipment.

ATU established an environmental survey program at the beginning of the second quarter of 1990. The program consists of eight thermoluminescent dosimeters (TLDs) for measuring radiation dose, positioned around the vicinity of the proposed research reactor [Figure 6]. The results of the program to date are to be used to establish a baseline radiation level prior to construction of the TRIGA reactor. This background is due to naturally occurring radionuclides and Arkansas Nuclear One units I and II, located approximately 5 miles from the ATU campus in Russellville (combined generating capacity 1,694 MW of electricity). ATU utilizes an outside contractor to do the counting of the environmental dosimeters. The results of the quarterly readings have indicated doses below the minimum measurable quantity for each quarter. The contractor TLDs have a minimum level of 10 mrem for x-rays and gamma rays.

Since the dosage contributed by the ATU TRIGA reactor would be minimal, the cumulative effect to the area also would be minimal.

3.5 Long-Term Effects of Facility Construction and Operation

Experience has shown that TRIGA systems can be designed, constructed and safely operated in the steady-state and pulsing modes of operation. The history of safety and the conservative design of TRIGA systems has allowed them to be sited in urban areas using buildings without pressure containment. Analyses in the SAR indicate that the TRIGA Mark I Reactor System proposed for installation and operation at ATU would pose no health or safety problem during normal operations or during abnormal conditions.

3.6 Environmental Effects of the No-action Alternative

If the reactor building is not constructed, the environmental impacts associated with construction and operation of the reactor (as described in Chapter 3) would not occur, and existing environmental conditions would remain the same or change in response to future activities proposed by ATU.

4.0 RELATIONSHIP OF THE PROPOSED ACTION TO ANY APPLICABLE FEDERAL, STATE, REGIONAL OR LOCAL LAND USE PLANS AND POLICIES LIKELY TO BE AFFECTED.

The proposed construction is an educational building, and as such, is not restricted by the city. The building inspector for the City of Russellville determined that there are no zoning restrictions that apply at the proposed construction site.

5.0 ENVIRONMENTAL PERMIT REQUIREMENTS

Arkansas Tech University submitted an application for a construction permit/ operating license for a TRIGA research reactor to the U.S. Nuclear Regulatory Commission on November 13, 1989. The Safety Analysis Report for the application was the source of radiological impact analyses for this document.

The National Emission Standard for Radionuclide Emissions applicable to facilities licensed by the NRC [40 CFR Part 61, Subpart I] is not currently in effect, and therefore no NESHAPS permit is required for this facility. If the permit requirement is reinstated after November 15, 1992, the appropriate application would be prepared and submitted.

6.0 LISTING OF AGENCIES AND PERSONS CONSULTED.

The consultation requirements of Section 7 of the Endangered Species Act, and Section 106 of the National Historic Preservation Act have been satisfied [Attachments 1 and 2]. The requirements of E.O. 11988 "Floodplain Management" and E.O. 11990 "Protection of Wetlands", of the Migratory Bird Treaty Act, and the Fish and Wildlife Coordination Act are not applicable to this project.

In addition, the NRC was consulted by telephone regarding that agency's NEPA process in connection with future granting of an operating license under 10 CFR 20.

7.0 REFERENCES.

Slade, D.H. (ed.), "Meteorology and Atomic Energy," USAEC Reactor Develop. and Tech. Div. Report TID-24190, DFSTI, Springfield, Virginia, 1968

"Safety Analysis Report," Arkansas Tech University TRIGA Reactor Facility, September, 1989.

West, G.B., W.L. Whittemore, J.R. Shoptaugh Jr., J.B. Dee, and C.O. Coffer, "Kinetic Behavior of TRIGA Reactors", General Atomic Report GA-7882, 1967.

Simnad, M.D., "The U-ZRHx Alloy: Its Properties and Use in TRIGA Fuels", General Atomic Report E-117-833, 1980.

Foushee, F.C., and R.L. Peters, "Summary of TRIGA Fuel Fission Product Release Experiments", Gulf Energy and Environmental Systems Report Gulf-EES A10801, 1971, p. 3.

Lamarsh J.F., "Introduction to Nuclear Engineering," Addison Wesley, 1977.
Meek and Ryder, "Compilation of fission product yields," NEDO 12154, 1974.

U.S. DEPARTMENT OF ENERGY FINDING OF NO SIGNIFICANT IMPACT
CENTER FOR ENERGY STUDIES AT ARKANSAS TECHNICAL UNIVERSITY
RUSSELLVILLE, ARKANSAS

AGENCY: U.S. Department of Energy

ACTION: Finding of No Significant Impact

SUMMARY: The Department of Energy (DOE) has prepared an environmental assessment (EA), DOE/EA-0565, to support the DOE decision to provide a grant of $838,100 to be used for support of the proposed Center for Energy Studies at Arkansas Technical University (ATU) in Russellville, Arkansas. Based upon the analysis in the EA, DOE has determined that the proposed action is not a major Federal action significantly affecting the quality of the human environment within the meaning of the National Environmental Policy Act of 1969 (NEPA). Therefore, the preparation of an Environmental Impact Statement is not required and DOE is issuing this Finding of No Significant Impact (FONSI).

PROPOSED ACTION:

Senate report 101-83 accompanying the Energy and Water Appropriations Act, 1990, indicated that $850,000 (later reduced to $838,100) had been included in DOE's fiscal year 1990 appropriation for support of the Center for Energy Studies on the campus of Arkansas Technical University (ATU). The Center would consolidate existing and planned functions in energy education and applied energy research, including nuclear science engineering and a special degree program in physical science for power plant operators for Arkansas Nuclear One. The grant

would partially fund the design and conventional construction of a 4,500 ft2 administrative/classroom building and a 2,500 ft2 reactor facility to house a TRIGA Mark I research reactor previously used at Michigan State University. The reactor facility would contain a reactor control room, two radiation counting laboratories, shop and utility rooms, and a 25' x 10' diameter below-grade pool surrounded by three feet of concrete reinforcement. Site work would consist of conventional excavation and standard reinforced concrete and masonry construction activities, which are anticipated to have no impact on areas beyond the Center site. Structural engineering of the building would be specified by standard University procedures established in accordance with the Uniform Building Code and the State Building Code. All elements would be designed to Zone 1 seismic conditions, the Life Safety Code, and the National Fire Protection Code.

The TRIGA Mark I research reactor ATU intends to install will operate under the auspices of the Arkansas Department of Health and the Nuclear Regulatory Commission (NRC) after conclusion of the NRC's licensing and NEPA processes. Safe operation of the reactor for the proposed steady power levels of 250 kW (kilowatt thermal) and pulse powers of 300 MW (megawatt thermal) was established by Michigan State University, where it was operated from

1967 until 1989, when it was decommissioned and dismantled after the retirement of the principal researcher. GA Technologies, Inc., which originally manufactured the reactor, recently installed an upgraded control system and refurbished control rod drives.

Fuel elements (approximately 100 39-gram enriched U238 TRIGA fuel pins) would be obtained from DOE under the University Research Reactor Assistance Program after NRC review and approval. Disposal of fuel elements by DOE would be undertaken as a part of decommissioning.

and is anticipated to involve accumulations of less that 750 MW-days of burn-up over 40 years, based upon projections from the operation schedules of similar research reactors.

ALTERNATIVES:

Two alternatives were considered: (1) the proposed action, to provide the Congressionally-appropriated grant; and (2) no action. Under the no-action alternative, the funding would not occur. This would leave ATU with less than half of the funding required for construction of the two buildings. At this time, ATU does not have a means of mitigating the loss of the DOE grant for the project. It is likely that ATU would reduce the scope of the project commensurate with the remaining available funds, and build just the reactor building on the proposed site. If the reactor was not utilized at ATU, it would be available for use by another university. The proposed site for the Center for Energy Studies is a prime location at ATU and would be put to other use in the near term.

ENVIRONMENTAL IMPACTS:

The potential environmental consequences of the proposed action were analyzed for all phases of activity, including (1) construction of the Center; (2) operation of the Center, including the TRIGA Mark I research reactor; and (3) decommissioning of the reactor building.

Construction:

The proposed construction site is a vacant, grass-covered area of the ATU campus. No environmentally sensitive areas exist in the vicinity that could be affected by construction activities. There are no wetland areas and no Federal or state-designated natural areas. The location is well drained and lies above the floodplain. Consultation with the State Historic

Preservation Office and the Fish and Wildlife Service indicates that the proposed project would have no effect on historic properties or threatened and endangered species.

Operations:

No chemical storage, use, or generation of non-radioactive hazardous waste is proposed for the operation of the Center laboratories, or shop and utility rooms. The proposed action does not require the construction or expansion of waste disposal, recovery, or treatment facilities. ATU expects to operate the reactor for approximately 20% of a work-year (1920 hours), or about 384 hours per year. Routine operation of the TRIGA Mark I research reactor would result in minute radiation exposures to operations personnel and visitors to the reactor building. Calculations of such exposures are documented in the Safety Analysis Report prepared by ATU to support the application for an NRC license for the reactor facility. Due to its very short half life (7.11

seconds), nitrogen-16 would contribute less than 0.25% to the estimated occupational dose. The radionuclide of concern to workers in the restricted area (reactor room) is argon-41. The average dose from argon-41 is estimated to be 0.43 mrem/hour. This estimate is consistent with gamma dose measurements taken around the TRIGA Mark I reactor during 250 kW steady-state operations at MSU, which ranged from 0.2 to 1.0 mrem/hour. The estimated combined occupational annual dose from argon-41 and nitrogen-16 (166 mrem, assuming operation at full power for 384 hours per year) is well within the NRC licensing standard of 5000 mrem/year for individuals in the restricted area.

Conservatively high calculations estimate that the concentration of the radionuclide of concern (argon-41) in the outside air from reactor operation would be less than 1.2 x 10E-9 Ci/m3, well within the proposed EPA hazardous air emission limit for NRC-licensed facilities (1.7 x 10E-9 Ci/m3, 40

CFR Part 61, Appendix E). This conservatively calculated argon-41 concentration is based on reactor operation at 50% of the work year; the actual expected level of operation would be less than 20% of the work-year.

Liquid waste releases typical of similar facilities are less that 0.01 curies per year and should be substantially less for this facility. Representative samples of liquid wastes would be collected and analyzed by standard techniques before any release of potentially contaminated waters to the sanitary sewer system. When the concentration of radioactive materials in the liquid waste is less that the guideline values in 10 CFR 20.303, the liquid can be discharged directly to the sewer.

The total volume of solid radioactive waste (gloves, paper, containers, samples) is projected to be 1 to 2 cubic meters per year. This volume also includes approximately 0.1 m3 of contaminated ion-exchange resin used to remove activation products (primarily intermediate and long half-life) from the reactor coolant system. Dose rates at the surface of the resin typically would be 10-20 mrem/hr.

The most severe credible accident is postulated to be the release of fission products to the environment due to clad rupture during fuel handling. This is calculated to result in a potential maximum total whole body dose of 0.61 mrem to a reactor room occupant from a 10 minute exposure during evacuation. This is well within the NRC requirements (10 CFR Part 20) of 1250 mrem/quarter occupational dose limit. Thyroid exposure of 5.16 rem was calculated based upon isotope inhalation for 10 minutes (compared with the NRC standard of 30 rem/yr). The maximum exposure to an individual in the unrestricted area from a stack release of fission products from such a fuel clad accident would result in a calculated whole body dose of 0.07 mrem/hr (compared

with the NRC standard of 50 mrem/yr), and a thyroid dose of 9.9 mrem/hr (compared with the NRC standard of 1500 mrem/yr).

Decommissioning:

Studies such a Nuclear Regulatory Commission study on decommissioning (NUREG CR-1756) contain detailed information for the radionuclide inventories expected in reactor materials and concrete shielding after operation of a typical research reactor facility. Major isotopes of concern identified are Cobalt-60, Zinc-65, and Carbon-14. ATU would be responsible for the decommissioning and dismantling of the reactor, and has established a decommissioning fund in keeping with State Board of Higher Education requirements. The amount of the fund is based on the estimated volume of waste, primarily of reactor structural components located inside the pool. By enlarging the pool diameter, ATU expects to eliminate the need to remove concrete from around the pool. ATU expects to ship the low level radioactive waste to a disposal site in Nebraska (approximately 600 miles). Based on data from the MSU reactor decommissioning, ATU estimates that less that 1000 ft3 of radioactive waste, or one truckload (40 ft. long van) would require disposal at the time of decommissioning.

DETERMINATION:

Based on the analysis in the EA, the DOE has determined that the proposed DOE decision to provide partial funding of the Center for Energy Studies at Arkansas Technical University does not constitute a major Federal action significantly affecting the quality of the human environment within the meaning of the National Environmental Policy Act of 1969. Therefore, an Environmental Impact Statement on the proposed action is not required.

PUBLIC AVAILABILITY: Copies of this EA (DOE/EA-0565) are available from:

Mr. Bohdan J. Bodnaruk
Programs and Facilities Management Division
U.S. Department of Energy
Chicago Field Office
9800 South Cass Avenue
Argonne, Illinois 60439
(708)252-2823

For further information regarding the DOE NEPA process, contact:

Carol Borgstrom, Director
Office of NEPA Oversight
U.S. Department of Energy
1000 Independence Avenue, SW
Washington, D.C. 20585
(202)586-4600 or (800)472-2756

Issued in Washington, D.C., this 6th day of August, 1992.

Paul L. Ziemer, Ph.D.
Assistant Secretary
Environment, Safety and Health