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University of Arizona Nuclear Reactor Laboratory Decommissioning Environmental Report

Nuclear Regulatory Commission Facility Operating License R-52

Prepared for:
University of Arizona

THE UNIVERSITY OF ARIZONA

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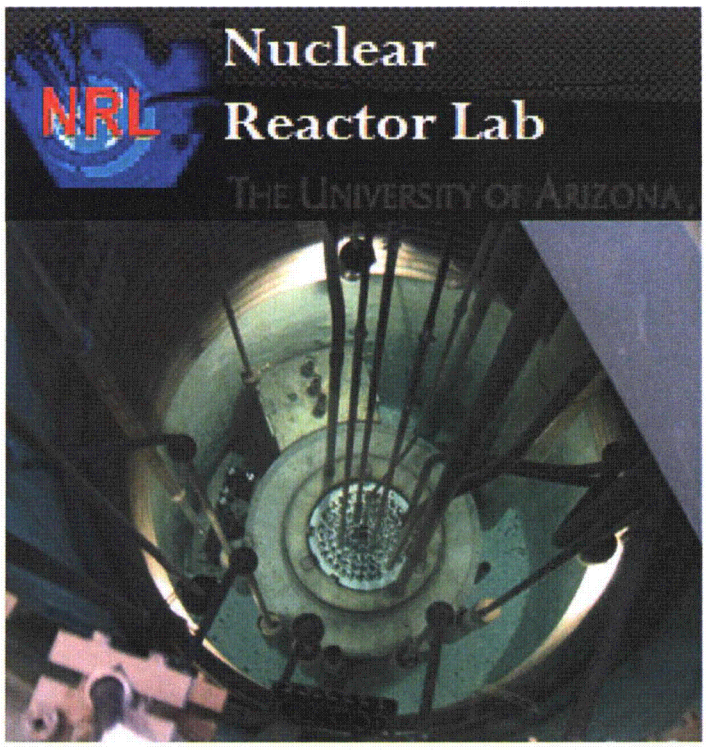

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Acronyms and Abbreviations

ER	Environmental Report
HEPA	High-efficiency particulate air
LLRW	Low-level radioactive waste
mrem	millirem
NEPA	National Environmental Policy Act
NMSS	NRC Office of Nuclear Material and Safety and Safeguards
NRC	U.S. Nuclear Regulatory Commission
NRL	Nuclear Reactor Laboratory
UA	University of Arizona
UARR	University of Arizona Research Reactor

1.0 INTRODUCTION

This Environmental Report (ER) describes the environmental effects related to the decommissioning of the University of Arizona Research Reactor (UARR). This ER was prepared in accordance with the guidance provided in Chapter 6.0 of the U.S. Nuclear Regulatory Commission (NRC) Office of Nuclear Material and Safety and Safeguards (NMSS) NUREG-1748, Environmental Review Guidance for Licensing Actions Associated with NMSS Programs (NRC 2003b). This ER is designed to be used by the NRC in conducting its environmental assessment in accordance with the National Environmental Policy Act (NEPA) of 1969. NEPA requires Federal agencies, as part of their decision-making process, to consider the environmental impacts of actions under their jurisdiction. The NRC's NEPA requirements are provided in 10 CFR 51.

1.1. Purpose and Need for Action

The Nuclear Reactor Laboratory (NRL) operates a nuclear reactor and two gamma-irradiation facilities in support of research and education and provides irradiation services for university and other regional users. The reactor is one of 26 non-power reactors currently operating at universities in the U.S. Current users of the reactor and the gamma-irradiation facilities come from the Lunar and Planetary Laboratory, Arizona Research Laboratories Divisions, Atmospheric Sciences, Electrical and Computer Engineering, Chemical and Environmental Engineering, Aerospace and Mechanical Engineering, and General Dynamics Corporation, Scottsdale, AZ. Uses of the reactor and the gamma-irradiation facilities include neutron activation analysis of meteoritic and other geological samples, radiation induced chemical processing, testing of radiation effects in electronics, and radiation dosimetry research for homeland security and other applications. The nuclear reactor is currently licensed for operation until the year 2010, and the University plans to decommission the reactor after that date.

1.2. The Proposed Action

The University plans to remove the UARR from service, dismantle the reactor and its ancillary support systems, remove all radioactive materials from the UARR facility, and reduce the radioactivity to levels that will permit release of the licensed area for unrestricted use and allow termination of NRC License R-52.

1.3. Applicable Regulatory Requirements, Permits, and Required Consultations

Decommissioning of the UARR requires adherence to numerous federal, state, regional, and local regulations. Guidance for determining many of the applicable federal, state, regional, and local requirements are identified below. The information provided below is intended as a broad overview of applicable regulations and is not intended to be all-inclusive. The licensee or owner, UA in this case, is ultimately responsible for compliance with applicable federal, state, and local regulations. The DC is responsible for the costs associated with acquiring applicable permits and for the costs of implementing the necessary compliance programs during decommissioning activities.

1.3.1 Federal Requirements

Decommissioning activities that are subject to federal regulations, permits, licenses, notification, approvals, or acknowledgments include:

- Handling, packaging, and shipment of radioactive waste
- Worker radiation protection
- License termination and final site release
- Worker, contractor, and the general public's health and safety
- Liquid effluent releases
- Hazardous waste generation and disposition
- Handling and removal of asbestos
- Handling and removal of lead paint

Nuclear Regulatory Commission

The majority of radiological activities fall under Title 10 of the Code of Federal Regulations (CFR) and are administered by the NRC. Applicable portions of Title 10 regulations are included within the following Parts:

- Part 20 – "Standards For Protection Against Radiation"
- Part 50 – "Domestic Licensing Of Production And Utilization Facilities" including decommissioning activities
- Part 51 – "Environmental Protection Regulations For Domestic Licensing And Related Functions"
- Part 61 – "Licensing Requirements For Land Disposal Of Radioactive Waste"
- Part 71 – "Packaging and Transportation of Radioactive Material"

Many of the decommissioning requirements that involve activities for site control, characterization, and final status surveys are found within the following Parts of Title 10 of the Code of Federal Regulations (CFR) and are administered by the NRC. The Parts include:

- Part 20.1401 – "General provisions and scope"
- Part 20.1402 - "Radiological criteria for unrestricted use"
- Part 20.1403 – "Criteria for license termination under restricted conditions"
- Part 20.1404 – "Alternate criteria for license termination"
- Part 20.1405 – "Public notification and public participation"
- Part 20.1406 – "Minimization of contamination"
- Subpart F—"Surveys and Monitoring" Part 20.1501 – "General"
- Part 30.36 – "Expiration and termination of licenses and decommissioning of sites and separate buildings or outdoor areas"
- Part 40.42 – "Expiration and termination of licenses and decommissioning of sites and separate buildings or outdoor areas"
- Part 70.38 – "Expiration and termination of licenses and decommissioning of sites and separate buildings or outdoor areas"
- Part 72.54 – "Expiration and termination of licenses and decommissioning of sites and separate buildings or outdoor areas"

Department Of Transportation

The majority of radioactive material transportation activities falls under Title 49 of the CFR and are administered by the Department Of Transportation. Applicable portions of Title 49 regulations are included within the following Parts:

- Subtitle B—"Other Regulations Relating to Transportation" Parts 100 To 185 – as applicable

Environmental Protection Agency

The Environmental Protection Agency (EPA) regulations outlined in Title 40 of the CFR apply as follows:

- Part 61 – "National Emissions Standards For Hazardous Air Pollutants"
- Part 61 Subpart M – "National Emission Standards For Asbestos" pertaining to asbestos handling and removal
- Part 122 –"EPA Administered Permit Programs: The National Pollutant Discharge Elimination System" (NPDES) and Parts 123 to 125 in support of the NPDES
- Parts 129 to 132 –Clean Water Act
- Part 190 – "Environmental Radiation Protection Standards For Nuclear Power Operations"

- Parts 260 to 272 –hazardous waste disposal and solid waste disposal as included in the Resource Conservation and Recovery Act (RCRA)

1.3.2 State of Arizona

The State of Arizona regulations outlined in Arizona State Code Title 49 apply as follows:

- **Arizona State Code - Title 49 - The Environment**
  - Chapter 1 GENERAL PROVISIONS
    - Article 1 Department of Environmental Quality
  - Chapter 2 WATER QUALITY CONTROL
    - Article 1 General Provisions
    - Article 2 Water Quality Standards
    - Article 5 Remedial Actions
    - Article 11 Local Stormwater Quality Programs
    - Article 12 Local Water Pretreatment
  - Chapter 3 AIR QUALITY
    - Article 1 General Provisions
    - Article 2 State Air Pollution Control
    - Article 3 County Air Pollution Control
    - Article 5 Annual Emissions Inspection of Motor Vehicles
  - Chapter 4 SOLID WASTE MANAGEMENT
    - Article 1 General Provisions
    - Article 4 Regulation of Solid Waste
    - Article 5 Enforcement Violations and Penalties
  - Chapter 5 HAZARDOUS WASTE DISPOSAL
    - Article 1 Hazardous Waste Disposal at State Sites
    - Article 2 Hazardous Waste Management
    - Article 3 Sites for Waste Facilities; Notification

- Article 4 Pollution Prevention
- Article 5 Pollution Prevention for State Agencies

- Chapter 6 UNDERGROUND STORAGE TANK REGULATION
  - Article 1 General Provisions
  - Article 2 Underground Storage Tank Tax
  - Article 3 Assurance Account
  - Article 4 Grant Account
  - Article 5 Certification
  - Article 6 Underground Storage Tank Informal Appeals and Underground Storage Tank Policy Commission
- Chapter 7 LIGHT POLLUTION
  - Article 1 General Provisions

2.0 FACILITY DESCRIPTION

The UARR is in the NRL, which is located on the first floor of the north wing of the Engineering Building. See Figure 2.1 for the location of the Engineering Building. The Engineering Building is made of brick and reinforced-concrete construction, including most floors and ceilings. Four adjacent rooms in the Engineering Building are permanently established as the NRL and are designated a controlled access area. These are: 1) Room 122, the Control Room; 2) Room 124, the Reactor Room; 3) Room 216, and 4) Room 124A, Equipment Storage and Experiment Setup Room. Room 216 is the room directly above the reactor room, which was originally designed to receive a beam of neutrons from the reactor. A 9 inch diameter hole penetrates the floor of this room directly above the center of the reactor core, and a 30 inch by 36 inch hatch to the roof above is directly over the hole. Little use was made of this beam capability, so during the refurbishment of the reactor in 1972, no provision was made in the new bridge for a hole to accommodate the beam tube. At this time the hole in the floor is capped and locked, and the room is used for storage of reactor supplies and departmental records.

The reactor is located near the bottom of a circular pit approximately 14 feet below ground level. The pit contains a steel tank resting on a 1-foot-thick concrete slab. Eight inches of poured concrete surrounds the outside of the tank, except for a window 4 foot wide by 1 foot 10 inches high, which was left in the concrete to allow for the insertion of a thermal column at a later date, and a 3-inch-diameter circular opening, which was intended to accept a van de Graff generator beam tube. The inside of the steel tank is covered on the sides by a layer of Gunite approximately 2 inches thick and on the bottom by a layer 4 inch thick. The entire inner surface of the Gunite is coated with Amercoat (epoxy-base paint).

The UARR is a TRIGA pool-type reactor designed and constructed by General Atomic Division of General Dynamics Corporation (now GA Technologies of San Diego, California). The reactor was constructed at the University of Arizona in 1958 and went into operation in December of that year. The licensed power was 10 kW thermal with operation at 30 kW possible for short times. The original core loading consisted of 61 aluminum-clad fuel elements. Subsequently, two additional aluminum-clad were obtained and the facility was licensed to allow operations at 100kW. The reactor was extensively updated in 1972.

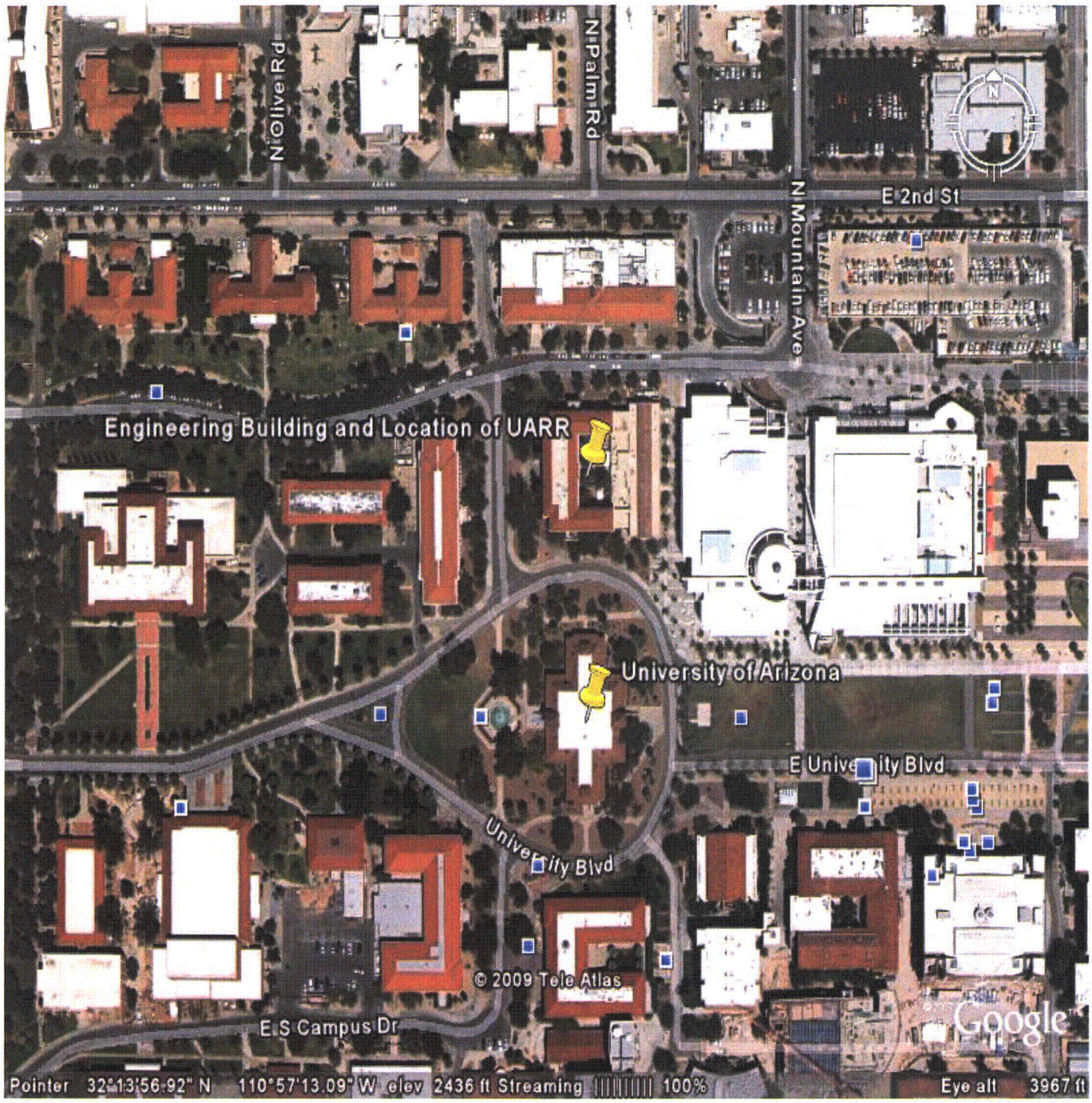
In May of 1972, a new TRIGA control console, control rod drives, and bridge were installed. Based on a revised Safety Analysis, a license amendment was approved in June 1972 allowing for receipt and possession of additional fuel for a complete change over from aluminum-clad to stainless-steel-clad fuel. In December of that year, 87 partially used stainless-steel-clad TRIGA fuel elements were obtained,

permitting operation in the pulsed mode. The original TRIGA console, bridge, control rods, control rod drives and all the aluminum-clad- fuel elements were given to the University of Utah for use in their TRIGA Reactor Facility.

In February of 1973, initial criticality with the stainless-steel-clad fuel was obtained with 71 fuel elements containing approximately 2.4 kilograms of U-235 and graphite reflector elements in non-fuel positions in the F-ring. In June of 1973, a neutron radiography tube was installed in the reactor pool. In December of 1975, a motor-driven reactivity oscillator was first placed in the reactor core, after which a fuel element instrumented with thermocouples was installed in the core in January 1976. In August of 1978, an aluminum-clad graphite thermalizer block was installed in the reactor pool.

In October of 1978, a license amendment increased the maximum reactivity insertion in the pulse mode from $2.10 to $2.50. In January of 1981, a new top grid plate was installed to allow vertical flux mapping and void coefficient measurements in the core.

Figure 2.1 Location of Engineering Building on the UA Campus



3.0 ALTERNATIVES

The proposed action is the decommissioning of the UARR. It was determined that there are two alternatives associated with this action. The following are the alternatives:

- No Action
- Decommissioning of the Reactor and Facility Reuse

Each alternative is discussed in more detail below:

3.1 No Action

This action would require that the university maintain current radiological controls, site security, the license, a reactor administrator, and the utilities. The no-action alternative would require that UA apply for and obtain an extension to the current NRC operating license. The no-action alternative is in non-compliance with the 10CFR30.36 (timeliness rule). The purpose of the timeliness rule is to reduce potential risk to the public and the environment.

3.2 Decommissioning of the Reactor and Facility Reuse

The University plans to remove all radioactive materials from the UARR facility, dismantle the reactor and its peripheral support systems, release the licensed area for unrestricted use and seek termination of License R-52.

Many of the reactor components and systems that are either activated or contaminated and will need to be segregated from non-radiological components and surfaces so that they disposed of as low level radioactive waste (LLRW). Building materials such as the reactor tank and dry storage pits will need to be evaluated for radiological activity and removed and disposed of according to their radiological status, as necessary.

The following are decommissioning tasks, which are necessary for site release. The sequence in which these tasks occur may vary:

- Further characterization
- Remove loose equipment
- Remove hazardous materials (lead, cadmium) and asbestos
- Remove the control rod drives, rotary rack drive, and bridge
- Remove fuel storage rack, holsters, and cooling coils
- Remove the reactor structure, reflector, and irradiation components

- Remove and disposition pool water
- Segregate and package materials according radioactivity levels and classification
- Remove auxiliary systems (rabbit system, water purification, ventilation)
- Remove Gunite, activated portions of the tank liner, concrete, and affected soils
- Decontaminate or remove the dry storage pits
- Decontaminate building surface
- Ship waste for disposal
- Perform the Final Status Survey (FSS)
- Submit required reports that demonstrates to the NRC that the facility meets the release requirements
- Request license R-52 termination
- Restore the facility for future use by the University.

The UARR is expected to shut down operations in May 2010. The on-site decommissioning tasks are expected to start after fuel removal within the following year and are anticipated to last about 4-6 months.

The FSS will be developed by the Decommissioning Contractor using the criteria provided in NUREG-1575, "Multi-Agency Radiation Survey and Site Investigation Manual" (MARSSIM) (NRC 2000). Since it is anticipated that no subsurface foundations or soils are impacted by the operation of UARR, the FSS will only cover the exposed concrete and soil surfaces remaining within the UARR facility after reactor and activated components have been demolished and removed.

3.3 Alternatives Considered but Eliminated

The alternative for continued operation of the UARR past 2010 was considered but not evaluated. This report is based on the assumption that the University will decide that the license is to be terminated and that operation past 2010 is not feasible.

3.4 Cumulative Effects

The cumulative effects of the implementation of the proposed action will result in short term cumulative impacts as discussed in Section 5.0 of this ER.

3.5 Comparison of the Predicted Environmental Effects

The following table provides the predicted environmental effects and impacts of the alternatives that were evaluated for this ER. More detailed information on the expected impacts can be found in Section 5.0 of this ER.

Affected Environment	No Action	Proposed Action
Land Use	No Impacts	Possible Impact
Transportation	No Impacts	Possible Impact
Geology and Soils	No Impacts	No Impacts
Water Resources	No Impacts	No Impacts
Ecological Resources	No Impacts	No Impacts
Meteorology, Climatology, and Air Quality	No Impacts	Possible Impact
Noise	No Impacts	Possible Impact
Cultural and Historic Resources	No Impacts	No Impacts
Visual/Scenic Resources	No Impacts	No Impacts
Socioeconomic	No Impacts	No Impacts
Environmental Justice	No Impacts	No Impacts
Public and Occupational Health	No Impacts	Possible Impact
Waste Management	No Impacts	Possible Impact

4.0 DESCRIPTION OF THE AFFECTED ENVIRONMENT

The following sections describe specific areas of the Environment that may be affected as a result of the Decommissioning activities.

4.1 Land Use

The UARR is in the NRL, which is located on the first floor of the north wing of the Engineering Building. The Engineering Building is made of brick and reinforced-concrete construction, including most floors and ceilings. The reactor is located near the bottom of a circular pit approximately 14 feet below ground level. The pit contains a steel tank resting on a 1-foot-thick concrete slab. Approximately 8 inches of poured concrete surrounds the outside of the tank. The inside of the steel tank is covered on the sides by a layer of Gunite approximately 2 inches thick and on the bottom by a layer 4 inches thick. The entire inner surface of the Gunite is coated with Amercoat (epoxy-base paint).

4.2 Transportation

The UARR is located in a relatively low traffic area in the center of Tucson, AZ. A recent corridor study for the development of a modern streetcar for this area recommends that the streetcar line be located a few hundred yards to the south (Diehl, 2007). The local streets will be used to carry radioactive waste and construction debris during the decommissioning of the UARR.

4.3 Geology and Soils

Tucson is in the Basin and Range Province. The physiography of the area is typical of the province with alternating broad valleys and mountains. Tucson is located in the center of the Santa Cruz River Valley. This valley appears to be a grabben or down-dropped block between valley bounding normal faults. The valley is filled with about 2,000 feet of upper Tertiary and Quaternary sedimentary deposits composed of alternating sands, silts, clays, and gravels, which are underlaid by Tertiary volcanic rocks. The surface deposits are gravels of composition similar to the bedrocks of the nearby mountains. Tucson is in an area of relatively low seismicity. No major earthquakes have been reported in the area. A search of the U.S. Geological Survey's earthquake data file indicates that the nearest reported earthquake was a magnitude 4.5, which occurred on March 9, 1972, and had an epicenter more than 44 miles from Tucson. Tucson is reported to have experienced Modified Mercalli intensities of up to IV from distant earthquakes. S. M. Dubois and others (NUREG/CR-2577) place the site in their Seismic Zone 3, which they define as a zone of sparse seismicity. A geologic map and cross sections can be found in the Safety Analysis Report – Section II – Site Characteristics.

4.4 Water Resources

Tucson is located near the center of a valley almost completely surrounded by mountains. The valley gradually rises toward its center, and the University is located near this high point. The licensee provided data, in the submittal dated July 17, 1989, that show that the base of the reactor is above the 100-year flood level of near or distant stream beds. The physical contours of the site and the drainage path near the building will not permit accumulation of water around the building. There are no credible paths for reactor pool water to get into the campus water system or sanitary sewer system. The water table at the university is typically 200 feet below the surface.

4.5 Ecological Resources

The NRL is in a well developed area with native plants and wildlife on the outside of the Engineering building.

4.6 Meteorology, Climatology, and Air Quality

The climate of Tucson is classified as a west coast desert climate. Tucson's coldest month is January when the average low is 36.4°F and the hottest month is July when temperatures reach an average high of 99.1 F. Tucson is approximately 325 miles from the Pacific coast, and therefore hurricane and tropical depression energy directed toward the city is depleted by the time the disturbance reaches the city. Typical wind direction is from the southeast in the morning, shifting to a general west-northwest direction in the afternoon. Wind speed is usually between 5 to 10 miles per hour. The average annual rainfall in Tucson is 11.2 inches Tornados in Tucson are rare; sightings occur once in 2 years and one may touch down once every 10 years. On the basis of the meteorological data presented in the licensee's Safety Analysis Report, the NRC staff concluded that the meteorological conditions at the reactor site do not pose a significant risk of damage to the reactor nor render the site otherwise unacceptable for the facility. (ref. 3)

4.7 Noise

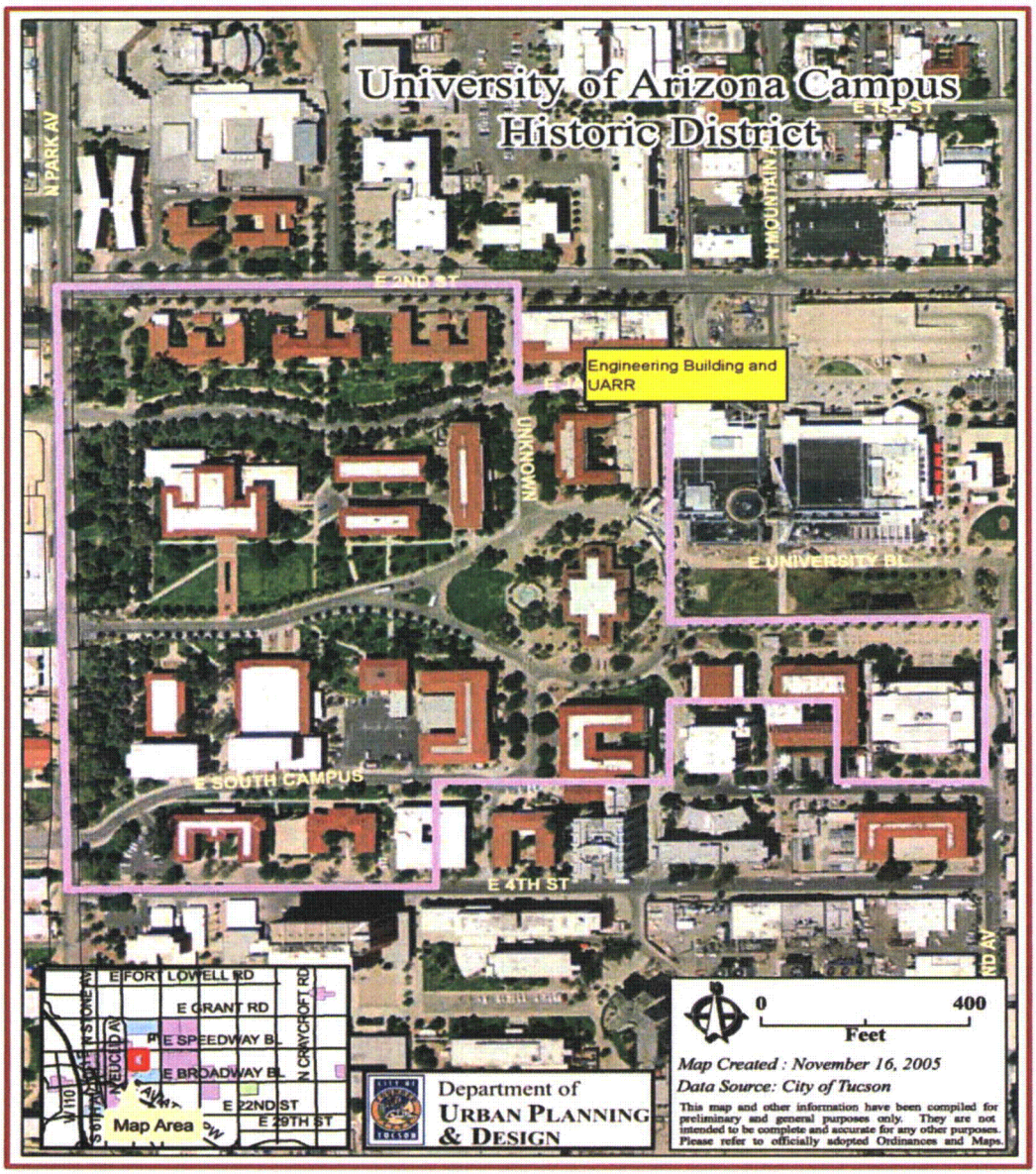
The UARR is in an academic setting and noise is typically at a low level. The noise is primarily from maintenance of the grounds and facilities near the Engineering Building.

4.8 Cultural and Historical Resources

The oldest portions of the University of Arizona campus were listed on the National Register in 1986 (Giebner et al. 1985). This historic district (see Figure 4.5) is comprised mainly of the original 40 acres on which the University was founded in 1887. Additional areas to the south and north of this area are included in the district, as well as a volcanic stone wall encircling the campus and several areas

containing historic landscaping. The Period of Significance for the University of Arizona Historic District is the university's historic growth period, 1885-1938, and the district is characterized by Queen Anne Revival, Classical Revival, and Spanish Romanesque Revival architecture. Brick and locally mined volcanic stone are the prevalent building materials. Historic plantings include mainly cactus and desert-adapted trees, many of which were among the first of their kind to be planted in Tucson. The Engineering building is located within this historic district.

Figure 4.1 Engineering Building Location within the Historic District



4.9 Visual/Scenic Resources

The UARR is located within the Engineering Building in the center of the UA campus. The visual scenic resources in the area of the UARR consist of building interiors, which include laboratory and office facilities as well as the control room and reactor areas.

4.10 Socioeconomic

The population of Tucson's metropolitan area in 1988 was 648,492 and was projected to grow to 943,000 by the year 2000. The nearest residence is Yuma Hall, a student dormitory, located 300 feet west of the NRL. The nearest private residences that are not under University control are approximately 1300 feet west of the reactor laboratory. The nearest private residences in the direction of the prevailing winds (southwest to northwest) are also approximately 1300 feet from the laboratory. There is no heavy industry in the vicinity of the University campus. The nearest airport, Tucson International Airport, is 6.5 miles south of the campus. Interstate 10, a major highway, passes within 1.75 miles from the west of the reactor laboratory. The Southern Pacific Railway and Amtrak pass within 1.1 miles south of the reactor laboratory. The Davis Monthan Air Force Base is the only major military facility in the vicinity of Tucson and is located 5 miles southeast of the campus. In view of the safe operating history of the previous 30 years and the location of nearby industrial, transportation, and military facilities, the NRC staff concluded that these facilities pose no significant risk to the safe operation of the UARR. (ref. 3) There have been no changes that should alter these conclusions.

4.11 Public and Occupational Health

Public and Occupation Health activities associated with the current operations of the UARR include the following:

Reactor

Sources of radiation directly related to reactor operations include the reactor core, the ion-exchange columns, the cooling water cleanup system, and radioactive gases (primarily argon-41). The fission products are contained within the stainless steel cladding of the TRIGA fuel elements. Radiation exposures from the reactor core are reduced to acceptable levels by water and concrete shielding. The ion-exchange resins are changed routinely before high levels of radioactive materials have accumulated, thus limiting personnel exposure. Personnel exposure to the radiation from chemically inert argon-41 is limited by dilution and prompt removal of this gas from the reactor area and its discharge to the atmosphere, where it is further diluted in the unrestricted area.

Extraneous Sources

Sources of radiation that may be considered as incidental to normal reactor operation but associated with reactor use include radioactive isotopes produced for research, activated components or experiments, and activated samples or specimens. Four fixed radiation monitors are located in the NRL. A continuous air monitor (CAM) and two remote air monitors (RAMs) are located in the Reactor Room, and a Geiger-Mueller (G-M) monitor is located in the exhaust stack. The CAM is located in the northwest corner of the reactor room and automatically shuts down the window vent and starts the high efficiency particulate air (HEPA) (stack) vent. It has an audible alarm and also a flashing light. The readout is in the reactor room, but it may also be observed through the Control Room window. The two RAMs are located at the south and west windows of the reactor room with audible alarm and readout in the control room. The G-M stack monitor is located downstream from the HEPA filter in the stack exhaust system with readout and audible alarm in the Control Room. In addition to the four fixed radiation monitors, portable survey meters are available for routine use in the laboratories and for checking the radioactivity of samples removed from the core of the reactor. Thin-window G-M tube detectors are used in the laboratory to monitor equipment and people for traces of radioactive contamination.

Routine Monitoring

Personnel exposure to radiation from intentionally produced radioactive material as well as from the required manipulation of activated experimental components is controlled by extensively developed and reviewed operating procedures that incorporate the normal protective measures of time, distance, and shielding.

4.12 Waste Management

A Waste Management Plan will be implemented for the disposal of the waste generated during the UARR facility D&D project. The Waste Management Plan will be submitted to the Reactor Laboratory Director for review prior to the start of work. The Waste Management Plan will include detailed guidance for the characterization, sampling, classification, segregation, handling, packaging, manifesting, transporting and disposal of all waste categories.

Uncontaminated wastes will consist primarily of support equipment and building demolition debris. Waste equipment will come from offices, storage areas, work areas, and the Control Room. These wastes will include desks, chairs, storage shelves and cabinet, and electronic control equipment. These items will be released using radiological surveys and the surface contamination release criteria. These waste streams are suitable for disposal at a local solid waste disposal facility or reuse by the University.

Non-radioactive hazardous waste will be managed through the University's existing hazardous waste disposal system.

Clean construction and demolition waste will be released according to release criteria specified in the Decommissioning Plan. Construction waste will be disposed of at the disposal facility being utilized by the University at the time the material is generated.

Waste generated during the reactor D&D project will be characterized and segregated on site according to separate categories for removal and disposal. These categories may include: uncontaminated waste acceptable for land disposal or reuse, uncontaminated demolition wastes suitable for land disposal or recycle, and Class A LLRW. Additionally, mixed wastes and non-radiological hazardous waste will be segregated from LLRW.

5.0 ENVIRONMENTAL IMPACTS

The following sections describe the potential environmental impacts that may result from the Decommissioning activities of the UARR.

5.1 Land Use Impacts

Land use impacts are expected to be minimal. There will be no construction performed outside of the engineering building and all removed components will be replaced with materials similar to those that currently exist within the main Engineering Building. Following the removal of all radioactive material, the building will become made available for future University academic use. A recommendation will be made to backfill and cap the reactor pool cavity, following license termination.

5.2 Transportation Impacts

Various forms and quantities of radioactive waste will be shipped from the UARR facility during the D&D project. The dose consequence from transportation accidents could be higher than the contamination accident scenarios described in Section 5.6 and Section 5.12.2 because high-activity reactor components could be involved. As such, there is a potential for a moderate dose consequence of between 1 and 25 mrem for the public following a transportation accident. However, adherence to NRC and DOT radioactive material packaging and transportation requirements is considered a sufficient control measure for mitigating transportation-related incidents.

5.3 Geology and Soils Impacts

It is expected that there will be no Geology and Soils impacts as a result of the Decommissioning of the UARR.

5.4 Water Resource Impacts

It is expected that there will be no impact to Water Resources as a result of Decommissioning of the UARR. All water generated as a result of the decommissioning of the UARR will be contained and dispositioned in accordance with all University, federal, state, and local regulations. No water will get introduced to the subsurface environment or into the natural environment outside of the Engineering Building. No water will be discharged to the storm water system, unless it has been sampled to verify it is within regulatory limits.

5.5 Ecological Resource Impacts

No Ecological Resource impacts are expected, as all work will be performed within the NRL. Potential lay down areas for equipment will only be placed in developed areas. Decommissioning the reactor would have no impact on amphibians, reptiles, birds, fish, mammals, or threatened species.

5.6 Air Quality Impacts

An uncontrolled release of airborne radioactivity could occur during cutting and demolition activities involving contaminated or activated materials. Such activities may take place inside temporary containment structures equipped with HEPA filter ventilation systems. The failure of the containment structure could result in the release of airborne radioactive materials into the UARR facility. If the negative pressure is still maintained in the UARR at the time of such an incident, the facility air filter system would prevent release to the environment. If the air flow system in the UARR facility is not operating at the time of such an incident, airborne radioactive material could be released directly to the environment. Alarming continuous air monitors (CAM) will be used in the work areas to warn against the release of airborne radioactivity.

Temporary containment systems with HEPA filter systems will likely vent to the UARR building or tie into existing building ventilation. A failure in the HEPA filter system could result in the uncontrolled release of airborne radioactive materials. CAM will be used to monitor effluent air. If allowable effluent criteria are exceeded, the CAM will alarm and operations inside the containment structure will immediately stop.

While the actual concentrations of airborne radioactive materials are unknown at this time, the dose consequence of an uncontrolled release is expected to be low (< 1 mrem off-site impact and < 25 mrem to on-site workers). As such, safety management operations (standard engineering and administrative controls) are sufficient for protecting against such accidents.

5.7 Noise Impacts

Noise impacts during the decommissioning of the UARR are expected to be those associated with normal construction activities inside of an enclosed building.

5.8 Historic and Cultural Resources Impacts

No Historical and Cultural impacts are expected. The only work being performed to decommission the UARR is inside the Engineering Building. The planned decommissioning activities will not affect the outside or historical architecture of the building

5.9 Visual/Scenic Resource Impacts

Visual/Scenic Resource impacts associated with decommissioning are primarily visual and relate to the structures and visual attributes of the decommissioning site. The impact of decommissioning on site aesthetics (e.g., truck traffic, noise) is limited both in terms of land disturbance and duration (i.e., any impacts are temporary and will cease when decommissioning activities are completed).

5.10 Socioeconomic Impacts

No Socioeconomic impacts are expected from the decommissioning of the UARR.

5.11 Environmental Justice

High and adverse health, economic, or environmental effects to local low-income and minority populations characterize environmental justice. There is no reason to believe that low-income or minority populations would be affected by UARR decommissioning.

5.12 Public and Occupational Health Impacts

5.12.1 Nonradiological Impacts

The Nonradiological impacts will be associated with the removal of any asbestos in the decommissioning area. A negative pressure enclosure will be used for the removal of asbestos to prevent the material from causing any impacts.

5.12.2 Radiological Impacts

There is a potential for radiological accidents during the UARR facility D&D project resulting from the uncontrolled release of radioactive materials to the work area or the environment. These releases are most likely associated with the management of contaminated liquids in the reactor tank. Uncontrolled releases of airborne contamination could also occur during the demolition of the reactor tank and segmentation of activated and/or contaminated reactor components such as the reactor core components. An uncontrolled release of radioactive material could also occur during a transportation accident.

The accidental dropping of an activated reactor component was also considered as a potential accident. However, because the more highly activated components are located under water, the surface contamination on these parts would not be sufficiently high to release significant quantities of radioactive materials during such an incident. Such an incident would mostly likely result in additional unplanned external exposures. The airborne release fraction from dropped metal is relatively low.

A fire is another possible source of an uncontrolled release of radioactive materials. However, the majority of the combustibles that will be present on site will be clean materials. Potentially contaminated combustibles will include dry active waste such as personal protective clothing and rags and towels used for site cleanup and decontamination. The radioactivity contained in these materials would not be high enough to result in a significant release of during such an incident. There will be no fissile materials located on site that could result in a criticality incident because all nuclear fuel will have been removed prior to the commencement of Decommissioning activities.

5.13 Waste Management Impacts

The UARR facility D&D project will generate solid LLRW, mixed waste (i.e., contaminated lead and cadmium), hazardous waste (i.e., ACM and oils and fluids drained from equipment), and potentially liquid LLRW (i.e., tank water and decontamination liquids). These wastes will be handled, stored, and disposed of according to applicable state and federal regulations. The DC will coordinate with the waste disposal site(s) regarding the site's waste acceptance criteria and pre-shipment processing requirements.

Waste processing may include volume reduction through compaction or segmentation, neutralization, stabilization, or solidification. Due to the limited size of the facility and work area, concrete rubblization beyond that required for demolition is not expected to occur on site. Complying with written procedures, standard work practices, and operating with the limits of the NRC license will ensure safe waste processing operations. The decisions as to the type and degree of waste processing will primarily be based on economics that weigh the costs of additional handling and processing compared to transferring the material off-site for treatment and/or disposal.

After the characterization surveys and sampling are complete, wastes will be wrapped, bagged, and/or containerized and staged in the appropriate designated area. Items and containers will be properly labeled as Radioactive Material and the label will indicate the external dose rate from the material. Radioactive wastes will be stored in properly secured radioactive materials storage areas. Logs will be maintained for materials placed in disposal and shipping containers.

5.13.1 Radioactive Waste Disposal

Prior to disposal, all waste streams will be properly characterized according to the requirements of the disposal facility. This characterization will include qualification of primary radionuclides of concern as well as hard-to-detect radionuclides. Additionally, those radionuclides that have specific limits for Class A waste will be directly quantified or estimated based on ratios to concentrations of other radionuclides.

All waste will be shipped to an acceptable waste disposal site in accordance with applicable NRC and DOT regulations regarding waste packaging, labeling, and placarding. Each LLRW shipment will be accompanied by a shipping manifest as specified in Section I of Appendix F to 10 CFR 20, "Requirements for Low-Level Waste Transfer for Disposal at Land Facilities and Manifests." The waste will be manifested consistent with its classification. Only licensed transporters will be used to transport wastes from the UARR facility.

Mixed wastes may be shipped to a licensed processing facility or directly to a licensed land disposal facility depending on the nature of the waste and the treatment options available.

The consequence levels discussed in this section are described in more detail in the U.S. Department of Energy (DOE) Standard DOE-STD-1120-2005, "Integration of Environment, Safety, and Health into Facility Disposition Activities" (DOE 2005)

6.0 MITIGATION MEASURES

The following areas may be impacted by the decommissioning of the UARR:

- Transportation
- Meteorology, Climatology, and Air Quality
- Noise
- Public and Occupational Health
- Waste Management

Mitigation measures that will be used to reduce potential impacts in these areas will include:

Affected Environment	Mitigation Measures
Transportation	Proper loading and shipping of containers and/or materials going off site
Meteorology, Climatology, and Air Quality	Build negative air pressure tents around work areas so that potential air contaminants are contained within work areas. Using water sprays to minimize the amount of dust that is generated
Noise	Limit the time of increased noises to daylight hours, with a schedule that takes account of the University's academic calendar
Public and Occupational Health	Constant radiological monitoring during decommissioning activities will ensure that the public and the occupational workers are safe
Waste Management	Proper decontamination and segregation of waste will ensure that wastes are disposed of properly.

7.0 ENVIRONMENTAL MONITORING AND MEASUREMENT PROGRAMS

This section describes the environmental monitoring and measurement programs that will be used during the decommissioning of the UARR.

7.1 Radiological Monitoring

Frequent radiological monitoring will be performed during the UARR decommissioning activities. CAMs will be used to monitor the air during selected decommissioning activities. Survey stations will be set-up to monitor personnel and equipment. All waste materials will be surveyed prior to leaving the facility for disposal.

7.2 Physiochemical Monitoring

Monitoring for chemical / hazardous constituents such as asbestos will be performed as needed during the UARR decommissioning activities.

7.3 Ecological Monitoring

No Ecological monitoring is required during the decommissioning of the UARR.

8.0 COST BENEFIT ANALYSIS

Detailed cost estimates for the completion of the UARR Decommissioning activities are included in the Decommissioning Plan. The following are some of the benefits associated with completion of the decommissioning of the UARR:

- Increased public health and safety;
- Decreased operating and maintenance costs;
- Improvement in the Engineering Building Environment from an air quality and waste inventory perspective
- Increased space for other activities within the Engineering Building
- Free release the facility for reuse and termination of the license.

9.0 SUMMARY OF ENVIRONMENTAL CONSEQUENCES

The following is a summary of the environmental consequences related to the implementation of the proposed action:

Affected Environment	Environmental Consequences
Land Use	Short Term Impacts – Construction and remodeling of the Engineering Building
Transportation	Short Term Impact – Hazardous, Solid, and Radioactive Waste Transportation
Geology and Soils	No Impacts
Water Resources	No Impacts
Ecological Resources	No Impacts
Meteorology, Climatology, and Air Quality	Short Term Impacts – Possible Air quality issues associated with construction activities
Noise	Short Term Impact – Noise from construction operations
Cultural and Historic Resources	No Impacts
Visual/Scenic Resources	No Impacts
Socioeconomic	No Impacts
Public and Occupational Health	Short Term Impact – Possible radiological exposure and dust above background
Waste Management	Short Term Impact – Disposal of Solid, Hazardous, and Radioactive Waste

There will be no adverse or long term environmental impacts as a result of implementation of the proposed action.

10.0 REFERENCES

The following references were used to develop this Environmental Report;

1. University of Arizona NRC License renewal Environmental Impact Appraisal
2. Safety Analysis Report University of Arizona TRIGA Mark 1 Research Reactor – June 1995
3. Safety Evaluation Report related to the renewal of the operating license for the TRIGA training and research reactor at the University of Arizona Docket No. 50-113 – May 1990
4. EMERGENCY PLAN FOR THE UNIVERSITY OF ARIZONA NUCLEAR REACTOR LABORATORY Facility License R-52 Docket 50-113 Revision 9 May 2003
5. Cultural Resources Assessment for the Modern Streetcar Project, Tucson, Pima County, Arizona; Allison Cohen Diehl; September 25, 2007
6. NUREG-1748, Environmental Review Guidance for Licensing Actions Associated with NMSS Programs (NRC 2003b).
7. City of Tucson Arizona Urban Planning and Development Web Site for Historical Districts.