Home of the 1996 Olympic Village
Georgia Institute of Technology

Capital Project Management Office
Office of Facilities
Georgia Institute of Technology
915 Atlantic Drive, NW
Atlanta, Georgia 30332-0410
Phone (404) 894-4610
Fax (404) 894-8188

May 28, 1999

Docket No. 50-160

United States Nuclear Regulatory Commission
11555 Rockville Pike
Rockville, MD 20852-2738

Attention: Mr. Marvin M. Mendonca, Senior Project Manager
Non-Power Reactors and Decommissioning Project Directorate
Division of Reactor Program Management
Office of Nuclear Reactor Regulation

Subject: Environmental Report for the Georgia Tech Research Reactor

Dear Mr. Mendonca:

Transmitted herewith is the Environmental Report for the Decommissioning of the Georgia Tech Research Reactor. This report is submitted per USNRC Regulation 51.53 (d).

For your information I have also enclosed the Environmental Report submitted in April 1994 in conjunction with license renewal.

If you have any questions please call me at (404) 894-4610.

Sincerely,

William A. Miller

William A. Miller
Project Manager

Enclosures as stated

Cc: Dr. Narl Davidson, Associate Dean of Engineering
Dr. Nolan Hertel
Members of the TSRC

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ENVIRONMENTAL REPORT FOR THE DECOMMISSIONING OF THE GEORGIA TECH RESEARCH REACTOR

INTRODUCTION

This revised environmental report is prepared in accordance with 10 CFR 51.53 (d) as part of the requirements for the decommissioning of the Georgia Tech Research Reactor (GTRR). The GTRR is a heavy-water cooled and moderated reactor having used uranium fuel and operated at power levels up to 5 MW. The reactor operations began in 1964 and produced a total of 40,204 MW-hrs of energy. The fuel was removed from the complex on February 15, 1996. Furthermore, the heavy water was removed during the summer of 1998.

Georgia Tech plans to decommission the GTRR during 1999 and 2000. The decommissioning area, as delineated in the Decommissioning Plan (DP), will be released for unrestricted use by the Neely Nuclear Reseach Center (NNRC). The University has elected to exclude particular equipment and facilities that fall under the State of Georgia byproduct material license #147-1.

ACTIVITIES AND TASKS REQUIRED FOR DECON

The DP outlines twenty-four activities and tasks to be accomplished in the sequence shown below:

Task 1	Mobilization & Preparation
Task 2	Removal of Vertical Beam Ports
Task 3	Removal of Shim Safety Rods and Drives
Task 4	Removal of Horizontal Beam Gates
Task 5	Removal of Spent Fuel Storage Holes
Task 6	Removal of Piping and Instrumentation
Task 7	Removal of Lead Cover Plate
Task 8	Removal of Upper Top Shield
Task 9	Removal of Lower Shield Plug
Task 10	Removal of Fuel Spray Manifold
Task 11	Removal of Reactor Vessel
Task 12	Removal of Graphite Retaining Sleeve
Task 13	Removal of Graphite Reflector
Task 14	Removal of Horizontal Beam Ports
Task 15	Boral Removal
Task 16	Removal of Inner Steel Tank
Task 17	Removal of Lead Thermal Shield
Task 18	Removal of Outer Steel Tank
Task 19	Removal of Thermal Column Shutter and Shielding
Task 20	Removal of Biomedical Radiation Facility Shutter and Shielding
Task 21	Removal of Fission Chambers
Task 22	Removal of Biological Shield
Task 23	Facility Decontamination
Task 24	Final Radiological Survey

Descriptions and analyses of the above tasks are covered in the GTRR DP.

DESCRIPTION OF ENVIRONMENT AFFECTED

The containment building and rooms adjacent to it in the NNRC will be the affected environment. The window, doors, and walls in this area are defined as the confinement boundary for the GTRR reactor. A forced ventilation system is present within the containment building. The NNRC is located on the Georgia Tech campus in downtown Atlanta, Georgia. Maps that show the location of the NNRC can be found in the GTRR DP.

ENVIRONMENTAL IMPLICATIONS OF DECOMMISSIONING

A comprehensive Safety Analysis Report (SAR) was completed in April 1994 for license renewal. This report addressed environmental implications of routine and accident conditions related to the reactor operations. Since the fuel and heavy water have been removed from the facility prior to the start of decommissioning activities, the potential for environmental impacts will be greatly reduced.

In fact, due to the small amount of radioactive materials present, no adverse radiological impact is expected. During the decommissioning, the containment building and adjacent rooms will be classified as construction/demolition zones for a period of several months and therefore will be unusable by Georgia Tech. The estimated collective occupational doses for decommissioning activities are shown in the DP broken down by decommissioning activity. The total estimated collective dose is 7.74 person-rem.

Radiation exposure to the general public is expected to be minimal. This will be accomplished by keeping the public at a safe distance and by minimizing effluent releases during decommissioning. A safe distance will be maintained by not allowing the public within the containment building of the reactor during decommissioning activities. The NNRC is surrounded by a security fence and access to the building is controlled. The containment building within the NNRC has an additional level of access control and only those qualified and approved will be provided access to the containment area.

All liquid waste that is generated during the decommissioning activities will be collected and disposed of in accordance with state and federal guidelines. All demolition activities will be carried out within the NNRC's fenced area. Additional containment measures will be taken as necessary to minimize the spread of contamination. Work involving the demolition of contaminated material which could cause airborne radioactivity levels to exceed the established limits will be performed within a contamination control envelope (CCE). The CCE will be maintained at a negative pressure relative to the environment outside the CCE during the time that physical demolition or handling of the contaminated material is occurring within the CCE. The exhaust from the CCE will be through a HEPA ventilation unit to ensure retention of potential contamination.

Decommissioning activities will result in the generation of low-level radioactive waste. This waste can be categorized as:

- Activated metal components from the reactor internals
- Activated and contaminated concrete and other structural material
- Miscellaneous radioactive waste; e.g., gloves, disposal PPE, etc.

The estimated disposal volume of radioactive waste is 9600 ft^3 as determined in the GTTR DP. The estimated weight of mixed waste to be generated is 134,000 lbs. Non-radioactive demolition waste will be disposed of locally.

Residual radioactivity remaining after decommissioning will be at the level of background radiation. Potential exposure to the public after license termination is anticipated to be well below levels in NUREG guide 1.86.

ALTERNATIVES

The non-power reactor decommissioning requirements in 10 CFR 50.82 (b)(1)(ii) and (b)(1)(iii) state that decommissioning activities should be completed without significant delay unless prevented by factors beyond the licensee's control. This essentially limits the choice for non-power reactors to the DECON alternative.

The DECON alternative has been selected for decommissioning the GTRR. DECON is the preferred alternative for the following reasons:

- The GTRR is a research reactor, rated at 5MW power level.
- There does not expect to be any major issues associated with disposal of the quantities of radioactive waste generated from decommissioning activities.
- Commercial radioactive disposal facilities are accessible to the project.
- NNRC personnel familiar with the reactor are available.
- Georgia Tech intends to utilize the space for other programs after the area is approved for unrestricted release by the NRC.

ENVIRONMENTAL REPORT

GEORGIA TECH RESEARCH REACTOR

NEELY NUCLEAR RESEARCH CENTER

GEORGIA INSTITUTE OF TECHNOLOGY
ATLANTA, GA 30332-0425

April 1994

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I. INTRODUCTION

This environmental report is prepared in accordance with 10 CFR 51 as part of the nuclear reactor license renewal at Georgia Institute of Technology. The Georgia Tech Research Reactor (GTRR) is a heavy-water cooled and moderated reactor using uranium fuel. The reactor is operated at power levels up to 5 MW. The reactor is used extensively for training of nuclear engineers and health physicists; for research projects by scientists specializing in nuclear science; and as a research tool by scientists in other disciplines.

The reactor is located in the Neely Nuclear Research Center, a free standing facility, located on the Georgia Institute of Technology campus, Atlanta, Georgia. A full description of the reactor is contained in the GTRR 1994 Safety Analysis Report.

II. PROPOSED ACTIONS

We propose to continue operating the Georgia Tech Research Reactor (GTRR) as we have done over the previous license period. The GTRR has a 30 year history of safe and reliable operations. The reactor was initially licensed in 1964 to operate at power levels up to 1 MW. Based upon the first decade of operation and some design modifications, the reactor license was amended in 1974 to operate at power levels up to 5 MW.

III. IMPACT OF THE PROPOSED ACTIONS ON THE ENVIRONMENT

The GTRR is operated solely for educational and research purposes which benefit the community, the country and the environment. Specific benefits include:

3.1 Nuclear Education

3.1.1 Nuclear Engineering

Nuclear engineering is a discipline which is concerned with the safe release, control, and utilization of all types of energy from nuclear sources. Energy is needed to meet the world's technological needs and to maintain a suitable standard of living. Nuclear reactors are used to produce radioisotopes for diagnosis and therapy of disease, to produce research radiochemicals, and to provide energy sources for medical devices, e.g., pacemakers or for probes to outer space.

The engineering of safe nuclear power sources is vital to the future growth of the world. One of the reasons we have one of the finest nuclear engineering programs in the country is because we have an on-site nuclear reactor. The Georgia Tech Nuclear Engineering program builds upon the foundations of mathematics, physics, thermal hydraulics, material science, radiation protection, radiation transport, interaction of radiation with matter and applied computer science. On top of this foundation, the GTRR serves as a training site for the nuclear engineering students. At the GTRR the students gain practical experience in reactor operations, reactor safety, environmental concerns, health physics and interactive decision making.

3.1.2 Health Physics

Health physics is a professional discipline based upon the scientific knowledge of, and the practical means for, radiation protection. The objective of a health physicist is to protect people and the environment from unnecessary exposure to radiation. Thus, the basic tenets of radiation must be understood, radiation knowledge explored, practical problems evaluated, radiation effects established and risk measurements relative to effect derived and implemented.

The academic health physics program at Georgia Tech is the largest health physics program in the country the Georgia Tech Research Reactor is an essential component to this program. The reactor provides the student with a hands on, real world laboratory. It is at the reactor where the environmental health physicist of the future learns how to monitor nuclear reactors for safety, how to communicate with regulatory agencies, how to implement emergency plans and how to monitor for environmental radiation. We have one of the finest health physics programs in the country because we have a nuclear reactor for students to use and gain practical experience.

3.1.3 Community

The Georgia Tech Research Reactor is used by high school science classes for plant irradiation experiments. The reactor is used by the Boy Scouts of American for those scouts interested in obtaining the nuclear merit badge. Students and faculty at the reactor often participate in middle school or high school "career days" representing the area of nuclear science.

3.2 Support of Scientific Programs

In addition to the educational programs, the GTRR is one of the finest research tools in the country. The reactor was designed to produce a thermal neutron flux of more than 10E14 n/cm^2/sec at 5 MW.

3.2.1 Nuclear Research Programs

The reactor contains a bio-medical irradiation facility. This facility, with its specially shielded room is useful for animal and human irradiations. The reactor, with its associated bio-medical irradiation facility has recently been identified as the best potential nuclear reactor in the United States with which boron neutron capture therapy can be implemented.

Georgia Tech scientists, working with Emory University neurosurgeons, have the capability of treating brain tumors in a unique way that combines the attributes of chemotherapy with radiation therapy. The bombardment of boron atoms located in tumors with neutrons provides a high intensity radiation dose to the tumor while minimizing radiation effects on other parts of the body. Key to evaluating this developing technology is the continued operation of the GTRR.

Nuclear Science faculty research programs include the design and development of neutron irradiation filters, the design, development and dosimetry of new pharmacological imaging agents and neutron dosimetry.

3.2.2 Indirect Nuclear Research Programs

Many scientists, both at Georgia Tech and across the nation, use the unique capabilities of the GTRR reactor in support of their own particular research specialty. Herein, the GTRR is used as a tool by other scientists in order to improve either the sensitivity or specificity of their research. GTRR capabilities for isotope production, neutron diffraction, activation analysis and provision of neutrons are unique scientific assets essential to maintaining Georgia Tech as a leader in developing technologies.

Specific studies currently using the facility include a chemist evaluating radiation decomposition of chemicals, a materials scientist interested in characterizing neutron absorbing materials, and numerous geologists who characterized their soil samples using neutron activation analysis.

3.3 Education for Future Energy Needs

The availability of energy strongly affects standards of living and quality of life. The increase in energy consumption is driven by the world population growth and by the desire of people everywhere to have higher standards of living. In nations where there are adequate supplies of electrical energy, health care improves, more children receive education, work is more productive, pollution control is better, life spans are longer, and more people have hopes for a better life for their children in stark contrast to energy poor countries.

Nuclear energy is a vital part of the nation's energy future. Nuclear energy produces thermal energy without the release of carbon dioxide. Current scientific information indicates a strong correlation between carbon dioxide concentration in the atmosphere and mean earth temperature. An increase of mean earth temperature could cause significant worldwide environmental changes.

Acid rain produced from the emissions of fossil fuel plants continue to damage fragile areas of our environment. The major environmental effect caused by the Three Mile Island nuclear accident is not the radioactivity released from the reactor but the sulfur emissions from fossil fuel power plants which were built to replace the lost energy available from the reactor.

IV. ADVERSE ENVIRONMENTAL RISKS WHICH CANNOT BE AVOIDED.

Some low-level environmental risks cannot be eliminated. They include the use of nuclear fuel, the production of minimal gaseous effluent, the generation of some liquid and solid radioactive wastes, some waste heat, and some radiation exposure of personnel to radiation. None of these are considered significant with respect to environmental impact although each is individually assessed. They are:

4.1 Nuclear Fuel Cycle

The GTRR is designed for 19 fuel rod assemblies spaced 6 inches apart in a triangular array. Each assembly contains 16 fuel plates. The total uranium-235 content is 3.5 Kg. In practice, the reactor is functional with 17 fuel rod assemblies with the other 2 assemblies maintained as spares. The annual burn-up rate depends on the extent of reactor usage. For the past five years the burn-up quantities were:

Year	1993	1992	1991	1990	1989
Workload (MWh)	75	283	236	1021	128
Fuel Burn-Up (gms)	3.8	14.7	12.3	53.1	6.7

Because of the low burn-up rate there is no special need for fuel replacement.

4.2 Radioactive Waste

Radioactive waste is generated from the research operations of the facility. This waste is either in liquid or solid form. The solids include absorbent paper, plastic gloves, spent samples, some contaminated laboratory apparatus, spent standards, clean-up resins from the demineralyzer systems, etc. Liquid wastes consist of spent standards, diluents and rinsings of contaminated objects during the decontamination process.

All of the radioactive waste from the Georgia Institute of Technology campus is processed by the health physics staff at the Neely Nuclear Research Center. Short lived isotopes (< 30d) are stored in a secure facility. Radioactive materials with a longer half life are consolidated, compacted or treated to reduce volume and shipped to established radioactive waste disposal sites. During the last five years the volume of radioactive waste produced was:

Year	1993	1992	1991	1990	1989
Dry Waste (ft^3)	115	7.5	105	454	559

It is estimated that about 10 % of the aforementioned waste, in terms of both volume and activity, was generated by the GTRR; the rest was generated under the byproduct license from the State of Georgia.

4.3 Release of Radioactive Gases

The levels of gaseous radiation released from the GTRR reactor have been conservatively calculated for 1) Radiation Doses Resulting from the Release of Fission Products into the Atmosphere, in our original Safeguards Report (GTRR January, 1960, Appendix B) and 2) Radioactive Effluents as they apply to the controlled released of radioactive gases (GTRR Technical Specification 3.5). These calculations indicate that at a maximum continuous argon-41 release rate of 585 uCi/sec, the annual radiation doses to an unrestricted areas will not exceed 500 millirem.

In practice, Ar-41 gas is the only gaseous radioactive effluent emitted from the reactor. The argon-41 release rate is continuously monitored by a detector located within the effluent emission stack. While technical specifications limit our release to 585 uCi/second, the highest release rate measured during the past five years was 475 μCi/sec. For the past five years:

Year	1993	1992	1991	1990	1989
Total Release (Ci)	19.5	39.5	59.2	264	27.8
Maximum Instant Release Rate(μCi/sec)	275	475	285	380	171
Hours of Operation	132	158	292	464	224

Each year the environmental health physics class has a laboratory where they monitor the release of radioactive gases from GTRR. The only contaminate ever identified has been Ar-41. In all cases, the measured levels are below the conservative calculations developed for the original Safeguards Report of the Technical Specifications.

The US Environmental Protection Agency provides a computer code that assesses gaseous radioactive effluents using the latest environmental modeling techniques. This code, called COMPLY, has been used to assess gaseous radioactive effluent emission at the GTRR based upon the nearest "receptor". The nearest receptor for Georgia Tech is a fraternity house located on campus at a distance of 500 feet from the emission stack. We used the COMPLY code to calculate radiation levels at the reactor perimeter and again at the fraternity (assuming that the fraternity was downwind of the reactor during operations). In each scenario the calculations indicate only 1 mrem/y would be potentially received by an individual living at the receptor site or living at the perimeter of the nuclear reactor. This calculated dose rate is smaller than variations in natural background radiation for various sites because of differences in altitude or soil types. Furthermore, Ar-41 with a short half-life of 1.8 hours is such that build up of gaseous effluent or long term environmental burden will be minimal.

The health physics staff of the GTRR routinely monitor for other potential effluent gases or particulate matter. For the past five years, tritium, radioiodines and particulate effluent releases, if any, were below the lower limits of detection.

4.5 Heat Generation

The heat generated in the reactor is first passed to the primary loop of heavy water and then transferred to an isolated secondary loop of regular water. The warm water is then transferred to a cooling tower. The heat exhausted by the cooling tower amounts to one - three thousand kwhr per year. This is a very small quantity.

4.6 Radiation Exposure of Personnel

Radiation exposures to reactor users and the operating staff are very small. Radiation exposures during the past two years are:

Annual Exposure	No. Radiation Workers 1992	1993
< 10 millirem	7	11
10 to 49 millirem	7	8
50 to 99 millirem	2	0
100 to 199 millirem	1	0
> 200 millirem	0	0

The person-rem dose for all GTRR personnel for 1992 was 0.54 rem with the highest reading being 150 millirem. The person-rem dose for all GTRR personnel for 1993 was 0.16 rem with the highest reading being 40 millirem. In comparison the person-rem dose for all 1992 Georgia Tech occupationally employed radiation workers was 2.07 person-rem with the highest reading being 250 mrem.

Georgia Tech has an active "AS LOW AS REASONABLY ACHIEVABLE" (ALARA) policy in place. In essence, The Program attempts to achieve, through engineering controls and thorough planning, detailed procedures to minimize radiation exposures to as low as possible. Furthermore, any exposures exceeding 20% of the regulatory limit are evaluated and, where practical, remedial action is taken.

4.7 Environmental Radiation Exposure

Environmental Radiation Exposures around the reactor are monitored both by GTRR health physics staff and by the Georgia Department of Natural Resources.

The State of Georgia monitors environmental radiation emissions using thermoluminescent dosimeters (TLD's) in fourteen locations. The TLD's are located in approximately three rings around the GTRR. The inner ring is located at 40-60 meters, the middle ring at 100-250 meters and outer ring at 500-1000 meters from the control area. Analysis of annual radiation exposures over the past four years indicates no significant difference of mean exposures from the inner through the outer rings, no significant difference chronologically between years for individual dosimeters and no significant difference between the environmental dosimeters and the calculated background levels at the EPA defined nearest receptor, i.e., the fraternity. The only significant radiation exposures above background were recorded by those dosimeters located close to the University radioactive Waste Storage Barn and dosimeters located close to a granite wall.

Using a micro roentgen ionization detector, monthly nuclear reactor environmental measurements are made at the reactor perimeter by health physics staff. During peak periods of reactor operations, radiation exposures of about 10 μroentgen per hour are measurable.

4.8 Heavy Water

The Heavy water system consists of about 2350 gallons distributed as follows: 1100 gallons in the reactor vessel, 350 gallons in the Emergency Cooling system and the remaining 900 gallons in the heat exchanges and piping. The water is used for neutron reflection and for cooling of the reactor. The heavy water system is a sealed system.

With time, some deuterium atoms in the heavy water is activated into tritium. The GTRR reactor is designed so that any leakage or liquid wastes are collected in a 5000 gallon suspect waste water tank. In addition, there are two 1500 gallon low level retention tanks which can be utilized. Any leakage of tritiated water is collected internally, analyzed and/or treated before release of any residuals to the environment.

V. ADDITIONAL ENVIRONMENTAL BENEFITS

5.1 Provision of short half life radioisotopes

The availability of a nuclear reactor on campus provides researchers the opportunity to use short half life radioisotopes unavailable to users that don't have access to an on campus reactor. For example, sodium-22 is a typical sodium isotope scientists use if they have to purchase the isotope from a commercial source. Sodium-22 has a half life of 2.26 years. As an alternative and because of the capabilities of an on-site nuclear reactor, sodium-24 may be used. Sodium-24 has a 15 hour half life. Thus potential problems with packaging, shipping or receiving sodium-22 from a commercial source are diminished. Furthermore, sodium-24 can be held for radioactive decay for one week when all the radioactivity has dissipated. In contrast, all materials contaminated with sodium-22 would require radioactive waste disposal in a permitted site.

5.2 Public awareness of environmental energy alternatives

The GTRR faculty and staff provides an open forum for the education about alternative energy sources. An informed public can make informed decisions. Because of the GTRR, Georgia Tech employs faculty and staff with an expertise in nuclear science. This expertise is used to advise on radiological safety and alternative energy sources and issues germane to the Atlanta community. Such issues include regulations, radiation safety and environmental control for other universities, colleges and schools, industry and resolution of legal issues regarding ionizing radiation.

VI. ALTERNATIVES TO THE CONTINUED OPERATION OF THE REACTOR

There is no comparable alternative facility. If the reactor is not relicensed, the quality of education for nuclear engineers and health physicists will be diminished. Research projects will come to a halt. The forward progress of nuclear science technology will be decreased.

VII. RELATIONSHIP BETWEEN LOCAL SHORT-TERM USES AND LONG-TERM BENEFITS

The short term use of the GTRR centers around the education of nuclear engineers, health physicists, research scientists and the general education of the students and community about nuclear energy and radioisotopes.

The long term contribution that the GTRR provides, comes from the many contributions to society made by graduate engineers, graduate health physicists and scientists to country. Numerous novel ideas have been developed over the past thirty years by students and scientists at GTRR. Some of these ideas have turned into commercial products and successful businesses. The GTRR serves as radiation science incubator of ideas and products. These products and services have an intrinsic societal value.

The continued operation of the GTRR is not an irreversible commitment. Changes in programs, extent of operations, and potential decommissioning are all equally possible at any time in the future.

VIII. ANALYSIS

The GTRR is an important education facility. It is an integral part of the overall Georgia Institute of Technology plan for education, research and service commitment to Atlanta, the state of Georgia, and the world. It is an essential tool to all scientists. It has no significant adverse environmental impact. Radiation exposures to non-GTRR personnel are not significant when related to the variation in natural radiation in the same area.

The GTRR is already in operation. New capitalization funds are not necessary. It is the most prudent use of taxpayers money to continue operation of the nuclear reactor. At this point in time, Georgia's capital investment costs have been paid off. All technology, science, education and services rendered now are at minimal cost. Thus the resultant benefit/cost ratio is very high.

The GTRR provides numerous technological spin-off's of products and services to the community. Graduates of the Georgia Tech program are making significant contributions to the resolution of societal energy development problems and contribute products and services for the community.

The GTRR is the best potential reactor for the evaluation of a new type of irradiation therapy known as neutron capture therapy. This technology has the potential for treatment of certain types of brain tumors that here-to-fore resisted all other forms of therapy.

IX. LONG TERM EFFECTS ON THE ENVIRONMENT

At the end of its useful life, the GTRR site will be returned to general university use. The small additional increase in fuel burn-up will not be a significant factor. When finished, the fuel rods will be sent to a DOE facility where the unspent uranium will be recovered and the radioactive byproducts recovered for commercial use or packaged and shipped for disposal through commercial radioactive waste disposal brokers.

The long term effects on the environment from renewing the operating license for the GTRR are insignificant.