APPLICATION FOR AMENDMENT NO. 5

to

MEMPHIS STATE UNIVERSITY FACILITY OPERATING LICENSE
NO. R-127, DOCKET 50-538

Submitted: _____
Thomas G. Carpenter
President
Memphis State University

STATE OF TENNESSEE
COUNTY OF SHELBY

Thomas G. Carpenter, being duly sworn, states that he is President of Memphis State University; that he executed this document for the purpose set forth; that the statements made herein are true to the best of his knowledge , information, and belief; and he is authorized to execute this document on behalf of said university.

Sworn and attested this day before me March 14, 1985

_____
Notary Public

My commission expires 12/19/87

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I. GENERAL INFORMATION

A. Introduction. The Model AGN-201, serial 108 Nuclear Research and Training Reactor has been operated by the Memphis State University Center for Nuclear Studies since December 10, 1976. Effective December 31, 1984, the Center was terminated and all prior training commitments were scheduled for completion by selected members of the operating staff no later than March 31, 1985. Accordingly, and pursuant to the Code of Federal Regulations, Title 10, Chapter 1, Part 50.90, Memphis State University (MSU) hereby applies for amendment to its Class 104(c) Facility Operating License R-127, Docket 50-538, to:

1. Change the reactor facility to a SAFSTOR (reference 1) status permitting the licensee to possess but not operate the AGN-201, serial 108 Nuclear Reactor and,

2. Possess, in an approved storage facility, up to 700 grams of contained U-235 normally used in connection with operation of the facilty and,

3. To possess, but not to separate, such byproduct and special materials as may have been produced by operation of the reactor.

Approval of this application will provide assurance that the MSU Reactor Facility can be safely maintained for an indefinite period during which further planning and preparation can be accomplished to either decommission and dismantle the facility or to secure adequate resources for future restoration to an operational status. Maintenance and security of the facility in compliance with license requirements specified for SAFSTOR or mothballed status are within the capabilities of existing permanently staffed full-time positions at the university.

B. The Applicant. General information required by 10 CFR 50.33 concerning the applicant, except as shown below, is contained in the Application for Construction Permit and License to Operate the Model AGN-201, Serial 108 Nuclear Reactor at Memphis State University dated April 11, 1975, as amended (see Docket 50-538).

1. The names, addresses and citizenship of its directors and of its principal officers pursuant to 10 CFR 50.33(d)(3)(ii) has been updated and included herein as Appendix A.

2. Earliest date for completion of SAFSTOR: March 31, 1985.

3. Latest date for completion of SAFSTOR: June 30, 1985.

II. CURRENT STATUS OF THE FACILITY

The MSU Research and Training Reactor, Model AGN-201, is located in an annex to the ground floor of Building 113 which is situated in the northwest corner of the MSU South Campus. The reactor is constructed as a sealed system containing a solid, homogeneous core, four control rod assemblies, solid graphite reflector, and lead and water shielding in a reactor tank which is 6½ feet diameter by 9½ feet high. The reactor is operated at ambient temperatures and requires no auxiliary or liquid cooling systems. The fuel is distributed within nine core discs and four control rod capsules and is composed of UO_2 in polyethylene (approximately 3.3 kg Uranium enriched 19.8% in the isotope U-235). A 10 milligram Radium-Beryllium neutron source and drive assembly is installed in one of the experiment ports of the reactor assembly.

Reactor operations are conducted from a console situated in a separate Reactor Control Room. Electrical cables for neutron monitoring instruments and rod control systems interconnect the console and reactor assembly via a floor-level cable trough passing through the Control Room and Reactor Room. A designated fuel storage area is located in the basement of Room 147 at the northeast corner of Building 113. The existing facility arrangement is shown in Appendix B. Detailed descriptions of the reactor assembly, console, and fuel storage area are documented in references 2-6.

The MSU reactor was operated for approximately fifteen years (1957-1972) by Argonne National Laboratory and eight years (1976-1985) by Memphis State University. The reactor had been in storage for about four years prior to restoration at the present site. MSU has conducted more than 2,400 startups and accumulated approximately 960 hours of operations at critical since December, 1976. The core has never operated at steady-state power levels exceeding 0.1 Watt (thermal). The inherent design features of this reactor and the low power at which it is operated preclude the buildup of significant amounts of fission products and the fission product inventory is considered to be negligible (reference 2).

III. PROPOSED FACILITY MODIFICATIONS

A. Reactor Fuel and Neutron Source. All fissionable materials shall be removed from the reactor, core tank, and safety and control rod fuel capsules using the existing, approved MSU AGN-201 Maintenance and Storage Manual. This manual contains a specific Reactor Defuel Procedure and Defuel Checklist. The presence of a Senior Operator licensed pursuant to 10 CFR 55 and the MSU Radiation Safety Officer, or his designated representative, is required during all fuel handling evolutions. The Reactor Defuel Procedure was executed and found to be safe and effective during a routine (5 year) fuel inspection conducted by facility operators in December, 1981.

The fuel discs will be placed into the same containers using the same packing scheme consisting of 6J drums, five gallon pails, and vermiculite that was found to be acceptable (reference 2) to transport and store the fuel during facility construction in 1976. Not more than 200 grams of U-235 shall be in any one container. The shipping/storage containers shall then be sealed and placed into secure storage in Room 010 of our facility (Appendix B). The containers, packing scheme, and fuel storage facility are described in detail in Part 3 of Amendment 3 (December, 1975) to reference 3. A complete listing and identification of special nuclear material (SNM) for the MSU Reactor is contained in Appendix C to this document.

The ten milligram Radium-Beryllium, sealed neutron source will be removed from the reactor, placed into a shielded container, and stored in a sealed D.O.T.-7A type shipping container normally located in the Reactor Room unless an alternate location is specified by the Radiation Safety Office. The container and room will be properly identified pursuant to 10 CFR 20.203 and 20.204.

B. Reactor Components, Shielding, and Controls. Except for purposes of inspection and maintenance when minor disassembly may be required, the defuelled reactor assembly shall remain assembled as follows: the Thermal Column Tank, Access Port Liner Tubes, Glory Hole Liner Tube, and Rod Drive Area Cover Plate shall be installed and gasketed to maintain the vessel secondary fluid-tight integrity. The graphite reflector cylinder, lead shielding, and Access Port Filler Plugs shall remain installed. Neutron detectors with interconnecting instrument cables shall remain installed. The aluminum core tank and safety and control rod assemblies shall not be installed. The doors to the reactor skirt area shall remain locked at all times that authorized personnel are not present.

The defuelled aluminum core tank and safety and control rod fuel capsules will be stored with covers and gaskets in place. The core tank, fuel capsules, and all rod drive assemblies will be stored, apart from the reactor assembly, in the Reactor Room.

Prior to the SAFSTOR condition, the reactor vessel interior including the core tank and fuel capsules shall be thoroughly surveyed for residual radioactivity and loose surface contamination under the supervision of the MSU Radiation Safety Officer.

Surface contamination in excess of acceptable concentrations (references 1,7) shall be clearly identified and documented for future reference. If warranted, appropriate placards and/or tags shall be affixed to the vessel or specific components listing the radioactivity concentrations and nuclides that are present.

The Shield Tank and Thermal Column Tank water shall be sampled for radioactivity and drained using existing, approved procedures from the MSU AGN-201 Maintenance and Storage Manual. The Shield Tank and Thermal Column Tank will be blown dry with air and shall remain dry in SAFSTOR status.

Except for purposes of inspection and maintenance when minor disassembly may be required, the console shall remain intact with access doors locked. The Rod Control Circuits shall remain deenergized. All of the reactor control cabling is routed through a single, multi-conductor cable with a molded 60-pin plug at each end. The control cable plug at the reactor assembly and the control cable plug at the console will be disconnected and wrapped in protective plastic. The power cable connecting 115 VAC to the console Reactor Control Power circuits shall be disconnected and removed. Interconnecting cables for the neutron flux monitors may remain connected.

The Reactor Room and Control Room shall remain locked at all times that authorized personnel are not present.

C. Administrative Controls.

1. Organization. The position of Director, Center for Nuclear Studies, was discontinued after December 31, 1984. Staff positions subordinate to the Director which include the Supervisor of Nuclear Operations, Reactor Administrator, Reactor Supervisor, and Reactor Operators will be discontinued after removal of fuel from the reactor. Reactor defuel is scheduled to be accomplished by March 31, 1985. The Reactor Safety Committee (RSC) will be disbanded only after the license amendment for SAFSTOR has been approved and issued.

   a. The Vice President for Advancement and Continuing Education shall remain as the Administrative Officer directly responsible to the President of Memphis State University for maintenance, safety, security, and administration of the reactor facility and fuel storage area. He shall, in this capacity, represent the President in matters pertaining to the facility license and, within limitations set forth in the license, have final approval authority and responsibility for decisions, procedures, and events that would affect the facility, the reactor, reactor components, and reactor fuel. He shall be responsible for official communications in connection with the reactor facility including all required reports and retention of records. To assist the Vice President, university service organizations are available and shall provide the person-

nel described in paragraph III.C.1.b to assure long term protective storage of the facility and radioactive materials. The Vice President may appoint personnel, as necessary, to positions reporting directly to him for purposes of executing routine requirements of the facility license so long as the appropriate personnel qualifications standards are met.

The Vice President for Advancement and Continuing Education shall be advised by the Radiation Safety Subcommittee in all matters concerning risks to personnel health and safety from ionizing radiation and shall be advised by the Director of MSU Security and Safety Services in all matters concerning physical security of the facility and fuel storage area.

b. The MSU Radiation Safety Officer (RSO) fills a full-time position established within the Department of Security and Safety Services and maintains the MSU Radiation Safety Office. The RSO, or his designated representative, shall perform such surveillance activities of the reactor facility and fuel storage area as specified in the SAFSTOR amendment. The RSO shall advise the Vice President for Advancement and Continuing Education, in writing, of the results of these activities including any appropriate recommendations.

Maintenance activities necessary to maintain the facility utilities and support systems shall normally be performed by the Department of Physical Plant and Planning upon request from the Office of Advancement and Continuing Education and in accordance with the existing university policies and procedures.

Physical security shall be maintained by MSU Security Officers in accordance with the approved security plan for the reactor and fuel storage facility.

2. Procedures. The approval of existing written procedures pertaining to startup and operation of the reactor including experiments that would involve the reactor or reactor fuel shall be revoked. Controlled copies of such procedures shall be removed from circulation and shall not be used.

There shall be written procedures, approved by the Vice President for Advancement and Continuing Education and as otherwise specified in the SAFSTOR amendment, for the surveillance and testing of support and protection systems necessary to maintain the mothball status of the facility; personel radiation protection consistent with 10 CFR 20; and implementation of the approved Security Plan and Emergency Plan.

IV. PROPOSED AMENDMENT NO. 5 TO OPERATING LICENSE R-127

It is proposed that the existing Operating License be amended to change paragraphs 2.B.(1), 2.B.(3), 2.B.(4), 2.C.(1), 2.C.(2), 2.D, and the Technical Specifications as follows:

A. Scope of Authorization and Conditions of the License.

1. Change paragraph 2.B.(1) to read: "... to possess but not operate the facility at the designated location in Memphis, Tennessee, in accordance with the procedures and limitations set forth in this license."

2. Change paragraph 2.B.(3) to read: "... to receive, possess, and store up to 700 grams of contained Uranium-235 enriched equal to or less than 20% in connection with the facility, and ...".

3. Change paragraph 2.B.(4) to read: "... such byproduct and special materials as may have been produced by operation of the reactor."

4. Change paragraph 2.C.(1), Maximum Power Level, to read: "The licensee is not authorized to operate the reactor."

5. Change paragraph 2.C.(2), Technical Specifications, to read: "The Technical Specifications contained in Appendix A, as revised through Amendment No. 5, are hereby incorporated in the license. The licensee shall possess and maintain the facility in accordance with the Technical Specifications."

6. Change paragraph 2.D. to read: "The licensee shall maintain in effect and fully implement all provisions of the Commission's approved physical security plan, including amendments and changes made pursuant to the authority of 10 CFR 50.54(p). The approved security plan consists of documents withheld from public disclosure pursuant to 10 CFR 2.790 and entitled 'Physical Security Plan for the AGN-201 Nuclear Reactor Facility

and Special Nuclear Material Storage Area at Memphis State University, March 1985.

B. Technical Specifications.

1. Amend Section 1.0, Definitions, by adding the following:

"1.15 Reactor Secured - The reactor shall be considered secured when:

(1) It contains insufficient fissile material or moderator present in the reactor, adjacent experiments or control rods, to attain criticality under optimum available conditions of moderation and reflection, or

(2) No work is in progress involving core fuel, control rods or control rod drives unless they are physically decoupled from the reactor, and

(3) The console key switch is in the off position and the key is removed from the lock."

"1.16 SAFSTOR or Mothball - The reactor facility is considered to be in a SAFSTOR or mothballed condition when the facility is in a state of protective storage. The facility may be left intact except that all fissionable materials, radioactive wastes, and radioactive fluids shall be removed from the reactor room. The reactor fuel shall be in storage containers and located in a remote fuel storage area in accordance with an approved fuel storage plan. Appropriate surveillance, radiation monitoring, and security procedures are established under a possession-only license to ensure that the health and safety of the public is not endangered."

2. Change Section 2.0, Safety Limits and Limiting Safety System Settings, as follows:

   a. Delete existing parts 2.1 and 2.2 in their entirety.

   b. Add, " Not Applicable. The reactor shall remain secured and the facility shall be in mothball status."

3. Change Section 3.0, Limiting Conditions for Operation, as follows:

   a. Delete existing parts 3.1, 3.2, 3.3 and 3.4 in their entirety.

   b. Add, "Not Applicable. the reactor shall remain secured and the facility shall be in mothball status."

4. Delete existing Section 4.0 and replace with the following:

"4.0 Surveillance Requirements

Actions specified in this section are applicable to the SAFSTOR or mothballed condition of the facility and shall be performed within the specified surveillance period.

4.1 Facility Support and Protection Systems

Applicability

This specification applies to the facility support and protection systems such as physical barriers, fire protection systems, and radiation monitoring activities.

Objective

To assure that the public health and safety are not endangered as a result of physical degradation of the facility during the term of SAFSTOR.

Specification

a. Physical barriers to unauthorized entrance into the reactor facility and fuel storage area, e.g., building, rooms, doors, and access openings, shall be visually inspected at least once each calendar quarter (intervals not to exceed four months).

b. Fuel storage containers, container locking rings, and seals shall be visually inspected at least once each calendar quarter (intervals not to exceed four months).

c. A radiation survey of the reactor facility and fuel storage area shall be performed at least once each calendar quarter (intervals not to exceed four months).

d. The reactor building fire alarm system, including the reactor room smoke detector, shall be tested annually (intervals not to exceed fifteen months).

Bases

The physical barriers, e.g. building, rooms doors, and access openings are inspected to assure that these barriers have not deteriorated and that locks and locking apparatus are intact.

Storage containers, container locking rings, and seals are inspected to assure integrity of the containers. This inspection in conjunction with radiation surveys of the reactor facility and fuel storage area verifies that radioactive material has not been removed from the containers or is not escaping or being transported through the containment barriers. In addition, the radiation surveys provide assurance that radiation doses to facility personnel and to the public are maintained at a level below 10 CFR 20 limits.

Tests of the reactor building fire alarm system and reactor room smoke detector verify that these systems are operable."

5. Amend Section 5.0, Design Features, by adding the following new part:

"5.4 SAFSTOR or Mothball Status

During a mothballed state of protective storage:

a. The reactor is defuelled and assembled with the Thermal Column Tank, Access Port Liner Tubes, Glory Hole Liner Tube, and Rod Drive Area Cover Plate installed and gasketed to maintain the design fluid-tight integrity. The graphite reflector cylinder, lead shielding, and access port filler plugs are in place. The Shield Tank and Thermal Column Tank are empty of fluids and dry.

b. The defuelled aluminum core tank and safety and control rod fuel capsules are removed from the reactor assembly and are sealed to maintain design fluid-tight integrity. The rod drive assemblies are electrically disconnected and removed from the reactor. Rod control cabling between the reactor and control console is disconnected.

c. All fissionable material used in connection with operation of the reactor is stored in 6J drums, containing less than 200 grams of U-235 each, and is located in a designated, controlled fuel storage area in accordance with paragraph 5.2 of these technical specifications."

6. Delete existing Section 6.0, Administrative Controls, in its entirety and replace with the following:

"6.0 Administrative Controls

6.1 Organization, Responsibilities and Authority. Responsibility for protective storage of the reactor facility shall be with the organization shown in Figure 1 of this section. Individuals at the various management levels shall be responsible for safeguarding the public and facility personnel from undue radiation exposures and for adherence to all requirements of the facility license. Assignment of specific responsibilities shall be as described in the following paragraphs.

6.1.1 President. The President of Memphis State University is the Chief Administrative Officer ultimately responsible to the Tennessee State Board of Regents for the university and its activities. The President is responsible for the reactor facility license.

6.1.2 Vice President for Advancement and Continuing Education. The Vice President for Advancement and Continuing Education is the Administrative Officer directly responsible to the President for maintenance, security and access control, administration, and safety of the reactor facility and fuel storage area. The Vice President may, in this capacity, represent the President in matters pertaining to the facility license and, within limitations set forth by the license, have final approval authority and responsibility for decisions, policies, procedures, and events that would affect the facility, the reactor, reactor components, and reactor fuel. The Vice President for Advancement and Continuing Education shall be responsible for official communications concerning the reactor facility and fuel storage area including all required reports and retention of facility records.

The Vice President for Advancement and Continuing Education shall be advised by the Radiation Safety Subcommittee in all facility matters involving risks to personnel health and safety from ionizing radiation and shall be advised by the Director, MSU Safety and Security Services, in all matters involving physical security of the facility and reactor fuel. The Vice President may appoint personnel having the appropriate qualifications, as necessary, to positions reporting directly to him for purposes of executing requirements of the facility license and assuring safe storage of the facility.

6.1.3 Radiation Safety Subcommittee. The Radiation Safety Subcommittee (RSSC) is a subcommittee of the University Standing Committee on Safety (University Safety Committee) whose members are appointed by the President. The RSSC is formed to administer the Radiation Safety Program for the university. In this capacity, the RSSC shall be responsible and have approval authority for all procedures, policies, and activities which involve risks to the health and safety of personnel from ionizing radiation. The RSSC shall advise the Vice President for Advancement and Continuing Education in radiation control and safety matters related to the reactor facility and fuel storage area and shall be informed by the Office of the Vice President of the status and locations of radioactive materials and of any activities involving personnel exposure to ionizing radiation within these facilities.

The Radiation Safety Subcommittee shall hold meetings and shall be responsible for independent reviews and audits of surveillance and maintenance activities including radiation surveys. Based upon these reviews and audits, the RSSC shall make appropriate recommen-

dations to the Vice President for Advancement and Continuing Education to assure that the state of the facility does not endanger the health and safety of the public.

6.1.4 Radiation Safety Officer. The Radiation Safety Officer (RSO) is a member of the Radiation Safety Subcommittee and is empowered to enforce regulations and regulatory procedures established by the university, federal agencies, and state agencies for the control of radioactive materials and protection of personnel from ionizing radiation. The RSO shall be responsible for the performance of radiation surveys and shall maintain survey records in connection with the reactor facility and fuel storage area. In addition to routine surveillance activities delineated in these Technical Specifications, the RSO shall maintain materials inventory records and records of personnel exposures to ionizing radiation. The RSO shall inform the Vice President for Advancement and Continuing Education, in writing, of surveillance and inspection results within 14 days of completing such activities.

The Radiation Safety Officer shall be responsible for and shall supervise activities involving the movement of radioactive materials within the facility and/or the packaging and shipment of radioactive materials off-campus. The RSO shall be directly responsible for the proper identification and posting of restricted areas within the reactor facility and fuel storage area.

6.1.5 Director, Security and Safety Services. The Director of Security and Safety Services is the management official directly responsible for the physical security of university property and the enforcement of university security and safety regulations on the MSU South

Campus. In this capacity, the Director of Security and Safety Services shall provide the services and trained security officers necessary to implement the facility security plan approved as part of this license to assure protective storage of the reactor and fuel. He shall advise the Vice President for Advancement and Continuing Education in matters involving physical security and access control of the reactor facility and fuel storage area and shall be informed of personnel authorized for access by the Office of the Vice President.

6.2 Radiation Safety Subcommittee Meetings, Reviews, Audits, and Records

6.2.1 Qualifications. The Radiation Safety Subcommittee is established as a subcommittee of the University Safety Committee. Members of the University Safety Committee are appointed by the President. The Subcommittee is appointed by the Chairperson of the University Safety Committee and includes a chairperson, the University Safety Director, the Radiation Safety Officer and several members selected on the basis of their expertise in radiation safety and related matters. The Subcommittee is empowered to meet and keep minutes independently of the University Safety Committee and with the authority to administer the university's radiation safety program.

6.2.2 Meetings and Quorum. The Radiation Safety Subcommittee shall meet as necessary but at least once each calendar quarter (intervals not to exceed four months). A quorum for review and approval functions shall consist of the chairperson, or designated alternate, and two other members.

6.2.3 Reviews. The Radiation Safety Subcommittee shall review:

a. All procedures and major revisions thereto pertaining to the reactor facility and fuel storage area and which have radiological safety significance, or include changes to facility equipment or systems, or affect authorized personnel access to the facility.

b. Proposed changes to the facility license, technical specifications, or charter.

c. Violations of the license, technical specifications, or charter.

d. Reportable occurrences listed in 6.4.

e. Abnormalities in, or deviations from, the normal and expected status of facility equipment and protective barriers.

6.2.4 Audits. The Radiation Safety Subcommittee shall conduct audits that include selective (but comprehensive) examination of facility and fuel storage area records, logs, and other documents. Discussions with cognizant personnel and observation of activities should also be conducted as appropriate. In no case shall the individual immediately responsible for an area perform the audit in that area. The following items shall be audited:

a. Facility operation, surveillance, and maintenance for conformance to the Technical Specifications and applicable license conditions, at least once per calendar year (intervals between audits not to exceed fifteen months).

b. The results of actions taken to correct deficiencies that may occur in reactor facility and fuel storage area equipment, systems, structures, and radioactive materials storage containers, at least once per calendar year (intervals between audits not to exceed fifteen months).

c. The reactor facility and fuel storage area security plan and implementing procedures, at least once every other calendar year (intervals between audits not to exceed 30 months).

d. The reactor facility and fuel storage area emergency plan and implementing procedures, at least once every other calendar year (intervals between audits not to exceed 30 months).

6.2.5 Records and Reports. The Chairperson of the Radiation Safety Subcommittee shall ensure that records of the committee's activities are prepared, distributed, and retained as follows:

a. Minutes of each Radiation Safety Subcommittee meeting shall be prepared and retained on file in the University Radiation Safety Office. A copy of these minutes shall be forwarded to the Vice President for Advancement and Continuing Education within 30 days following each meeting.

b. A written report or minutes of the findings and recommendations of each review group shall be prepared and submitted to the Vice President for Advancement and Continuing Education and all Radiation Safety Subcommittee Members in a timely manner after the review has been completed. A copy of each report shall be retained on file in the University Radiation Safety Office.

c. Deficiencies uncovered that affect radiation safety or protective storage of the reactor or reactor fuel shall be immediately reported to the Vice President for Advancement and Continuing Education. A written report of the findings of each audit shall be submitted to the Vice President and all Radiation Safety Subcommittee Members within three months after the audit has been completed. A copy of all audit reports shall be retained on file in the University Radiation Safety Office.

d. The Chairperson of the Radiation Safety Subcommittee shall submit an annual report to the President prior to March 31, of each calendar year. The report shall contain an assessment of the facility's suitability for continued protective storage of radioactive materials, including the reactor fuel, and any appropriate recommendations. Copies of this report shall be submitted to the Vice President for Advancement and Continuing Education and retained on file in the University Radiation Safety Office.

6.3 Procedures and Procedure Approvals.

6.3.1 Procedures. There shall be written procedures for the following.

a. Surveillance and testing of equipment and systems required for protective storage of the reactor and reactor fuel.

b. Personnel radiation protection consistant with 10 CFR 20.

c. Access control to the reactor facility and fuel storage area.

d. Implementation of the security plan and emergency plan.

e. Notification of the proper authorities in the event of unauthorized entries of personnel into the facility and significant changes in the radiation or contamination levels within the facility.

6.3.2 Procedure Approvals. The Vice President for Advancement and Continuing Education shall have final approval authority for all procedures in connection with the reactor facility and fuel storage area. The Radiation Safety Subcommittee shall review and have approval authority for those procedures which may include risks to the health and safety to personnel from ionizing radiation in addition to those reviews specified in 6.2.3. The Director of Security and Safety Services shall review and have approval authority for procedures written to implement the security plan and emergency plan.

6.4 Reporting Requirements

6.4.1 Annual Report. An annual report describing the status of the facility, the results of environmental and facility radiation surveys, an evaluation of the performance of security and surveillance measures, personnel exposures to radiation, and any abnormal occurrences during the previous calendar year shall be submitted to the Director of Nuclear Reactor Regulation prior to March 31, of each calendar year.

6.4.2 Reportable Occurrences. Reportable occurrences shall be reported as expeditiously as possible by telephone and confirmed by telegraph, mailgram or facsimile transmission to the Director of the appropriate NRC Regional Office, or his representative, no later than

the first work day following the event. A written followup report describing the reportable occurrance including causes, probable consequences, corrective actions, and measures to prevent recurrence shall be submitted within 14 days. Information provided shall contain narrative material for a complete explanation of the circumstances surrounding the event. The following events shall be reported:

a. Discovery of significant, unexplained increase in radiation or contamination levels within or around the reactor facility or fuel storage area.

b. Abnormal degradation discovered in protective barriers for the reactor facility or fuel storage area which would compromise the physical security established for protective storage of the reactor and reactor fuel.

6.4.3 Special Reports. Special reports which may be required by the Nuclear Regulatory Commission shall be submitted to the Director of the appropriate NRC Regional Office within the time period specified for each report.

6.5 Record Retention.

6.5.1 SAFSTOR Records. Records or logs relative to the following items shall be kept and retained until the license is terminated, unless otherwise specified by the NRC:

a. Environmental surveys.
b. Facility Radiation surveys.
c. Inspections of physical barriers.
d. Abnormal occurrences.
e. Records of meetings of the Radiation Safety Subcommittee.

6.5.2 Prior Facility Operation.

6.5.2.1 Records or logs relative to the following items shall be retained for a period of at least five years:

a. Operating logs or data which shall identify:

1. Completion of pre-startup checkout, start-up, power changes, and shutdown of the reactor.

2. Installation or removal of fuel elements, control rods, or experiments that could affect core reactivity.

3. Installation or removal of jumpers, special tags or notices, or other temporary changes to reactor safety circuitry.

4. Rod worth measurements and other reactivity measurements.

b. Principal maintenance operations.

c. Reportable occurrences.

d. Surveillance activities required by technical specifications.

e. Facility radiation and contamination surveys.

f. Experiments performed with the reactor.

g. Changes to operating procedures.

6.5.2.2 Records or logs relative to the following items shall be retained for the life of the facility, unless otherwise specified by the NRC:

a. Gaseous and liquid radioactive effluents released to the environs.

b. Appropriate off-site environmental monitoring surveys.

c. Fuel inventories and fuel transfers.

d. Radiation exposures for all personnel.

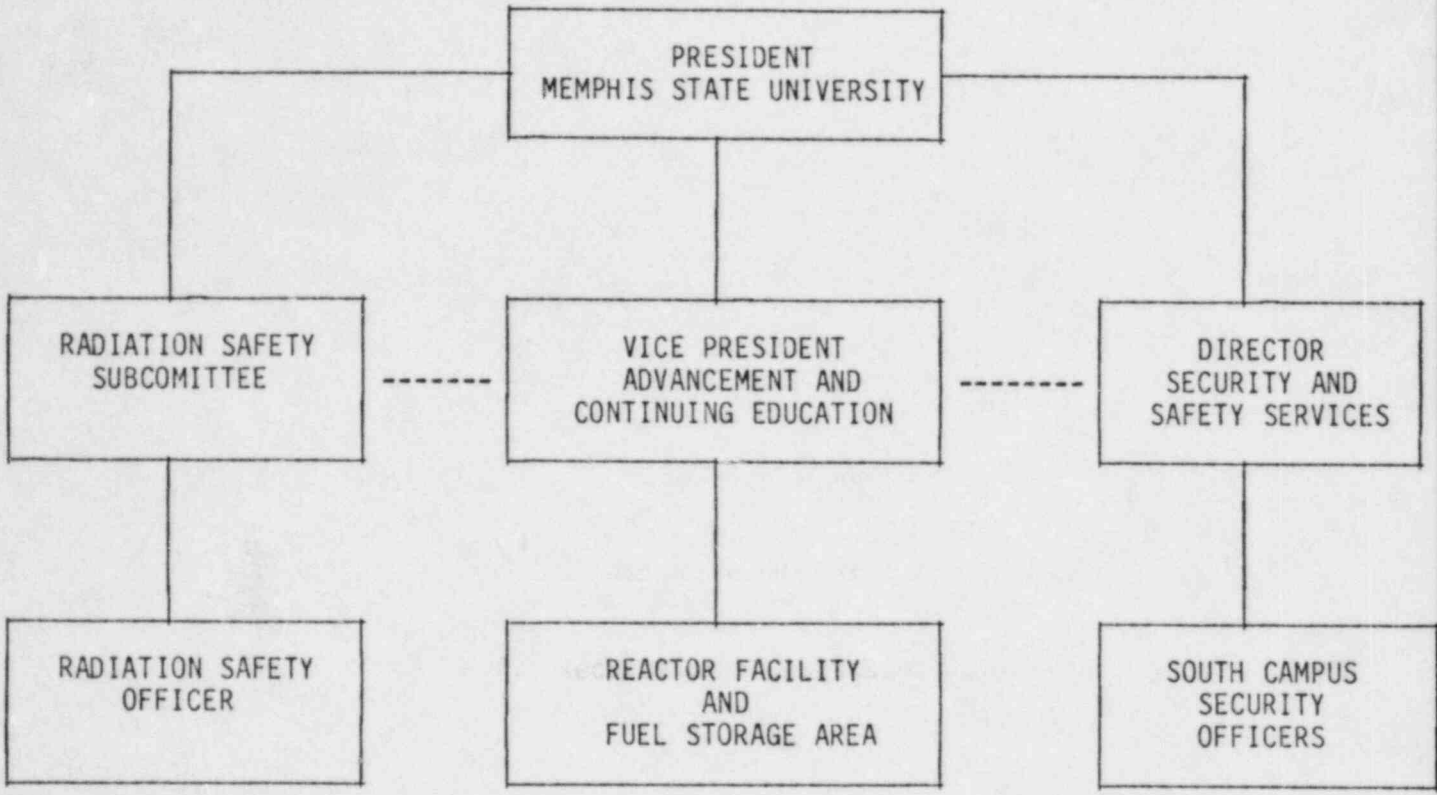
e. Updated as-built drawings of the facility.

f. Records of transient or operational cycles for those components designed for a limited number of transients or cycles.

g. Records of training and qualifications for members of the facility staff.

h. Records of reviews performed for changes made to procedures or equipment or reviews of tests and experiments pursuant to 10 CFR 50.59.

i. Records of meetings of the Reactor Safety Committee.



_____ Direct Line of Authority

---------- Advisory/Assistance Capacity

FIGURE 1. REACTOR FACILITY SAFSTOR ORGANIZATION"

V. SAFETY EVALUATION

The Memphis State University AGN-201 Nuclear Reactor Facility and designated fuel storage scheme have been previously assessed in Safety Evaluations by the Office of Nuclear Reactor Regulation in support of Operating License R-127, Docket No. 50-538 (reference 2,3). The following evaluation applies to alterations proposed in Part III and IV of this application.

A. Facility Modifications. The removal of fuel from the reactor, fuel handling activities, and preparation of the fuel for storage will be performed under supervision and in the presence of a Senior Operator licensed pursuant to 10 CFR 55 and the MSU Radiation Safety Officer. Defuel procedures have been reviewed and approved by both the Reactor Safety Committee and the Radiation Safety Subcommittee and have been found to be safe and effective during use in a prior defuel evolution. The fuel storage scheme includes adequate measures to prevent criticality, reactivity changes, or releases of radioactivity and has been used in the past without incident. The small quantities and distribution of radioactive materials, including fission product activity, are estimated in Appendix D of this application and are consistent with previously documented low-level radiation exposure rates measured upon contact with the surface of AGN-201 fuel elements.

The SAFSTOR condition of reactor components, shielding, and control systems represented by statements in this application, in addition to the removal of all fissionable materials from the reactor facility, assures that the reactor and control systems cannot be operated. The removal of all liquids from the shield tank and thermal column tank will minimize long-term corrosion of the reactor vessel structures. Radiation surveys will identify surface contamination levels that are greater than acceptable for unrestricted access (references 1,7), any such areas will be properly documented and posted, and restoring the vessel, core tank, and fuel capsules to their design liquid-tight integrity will assure containment of such activity throughout the storage term. The physical barriers housing these components will not be open for unrestricted access and shall remain locked at any time authorized personnel are not present.

Changes to the administrative organization described in this application provide for a direct line of authority from, and direct line of communications to, the Senior Executive Officer at Memphis State University. Delegated responsibilities and commensurate authority are clearly delineated to assure protective custody, proper maintenance, and radiation safety of the reactor and reactor fuel. Surveillance, security, and radiological controls requirements are within the capabilities of normally staffed, full-time positions within MSU and which are at the disposal of the Administrative Officer directly responsible to the President for facility security, safety, and license compliance.

Memphis State University has concluded, based upon the considerations discussed above, that: the proposed facility modifications, in conjunction with the existing radiation safety program and administrative controls, will be accomplished within the limitations prescribed in 10 CFR 20 for facility personnel and without risk to the environment or public health and safety; the status of the reactor facility and fuel after the modifications have been accomplished, in conjunction with the proposed administrative controls and implementing procedures, provides assurance that an adequate state of protective storage will be achieved and maintained in compliance with NRC Regulations and; the transition of the facility from an operational to a mothball status in accordance with statements made in this application will not involve an unreviewed safety question.

B. License Amendment. The amendment proposed in this application would change the scope of authorization and required license to a "Possession Only" status which prohibits operation of the reactor. The proposed revision to the technical specifications defines acceptable terms (reference 1,8) which clearly describe the condition in which the reactor and reactor fuel shall remain while in mothball status. Surveillance requirements are specified to assure that facility support and protection systems remain in an acceptable condition. Periodic radiation surveys are required to be performed to assure that radiation and contamination levels remain within regulatory limits and the amended Design Features are clearly descriptive of the facility condition after the proposed modifications have been accomplished.

The proposed Administrative Controls provide for direct lines of authority from, and communications to, the Senior Executive Officer at Memphis State University for individuals responsible for personnel safety, protective storage of materials, and compliance with the facility license. Provisions are made for approval authority, reviews, and periodic audits of activities and implementing procedures involving radiation safety, facility security, and emergency planning. The proposed amendment provides for the maintenance of records, and establishes reporting requirements to assure proper documentation and transmission of required information to the appropriate authorities.

Memphis State University has concluded, based upon the above considerations, that activities in connection with protective storage of the reactor and reactor fuel will be conducted in compliance with regulatory requirements for a "Possession Only" license and that, in conjunction with an approved security and emergency plan, approval of the proposed amendment will not be inimical to the health and safety of the public.

C. Environmental Considerations. Based upon the proposed modifications and statements contained in this application, Memphis State University considers the environmental impact to remain as stated in reference 2, and that an environmental impact statement for the proposed action would not be required.

VI. REFERENCES

1. American National Standard for Decommissioning of Research Reactors, ANSI/ANS-15.10-1981.

2. Memphis State University Facility Operating License R-127, Docket No. 50-538.

3. Application for Construction Permit and License to Operate the Model AGN-201, serial 108 Nuclear Reactor at Memphis State University, April 11, 1975, as amended (Docket 50-538).

4. "Hazards Summary Report for the AGN-201 Reactor", Aerojet-General Nucleonics, August 1956 (Docket F-15).

5. "AGN Model 201 Reactor, Preliminary Design Study", Aerojet-General Nucleonics, May 1956 (Docket F-15).

6. "AGN-201 Reactor Manual," Aerojet-General Nucleonics, July 1957 (docket F-15).

7. U.S. Atomic Energy Commission Regulatory Guide 1.86, "Termination of Operating Licenses for Nuclear Reactors," June 1974.

8. American National Standard for the Development of Technical Specifications for Research Reactors, ANSI/ANS-15.1-1982.

9. Memphis State University Radiation Control and Safety Manual, Revised December 1, 1980: Memphis State University.

10. U.S. Nuclear Regulatory Commission Regulatory Guide 10.1, "Compilation of Reporting Requirements for Persons Subject to NRC Regulations, Revision 4," October 1981.

11. S. Glasstone and A. Sesonske, Nuclear Reactor Engineering, Third Ed., Von Nostrand Reinhold Company: New York, 1981.

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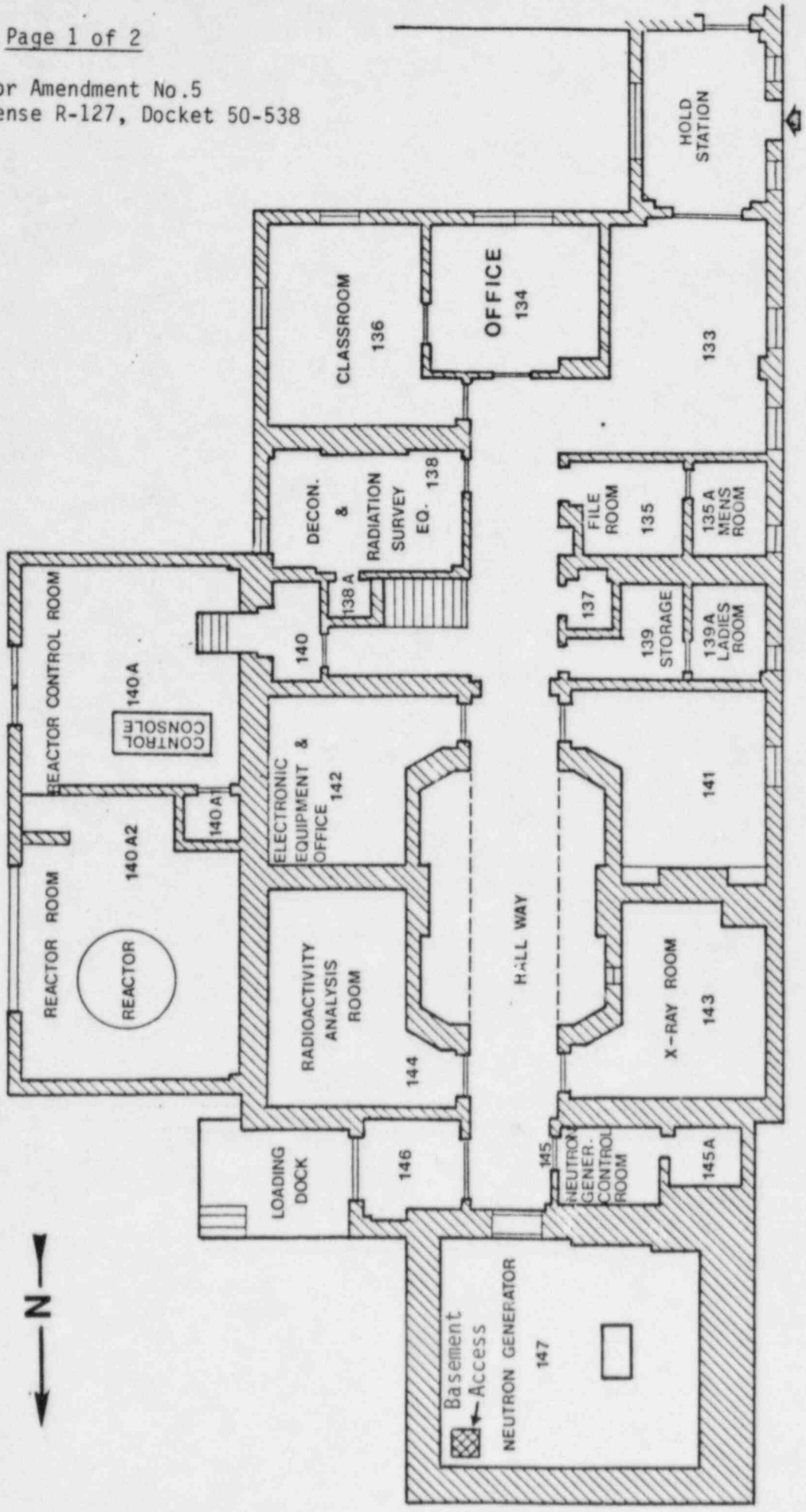
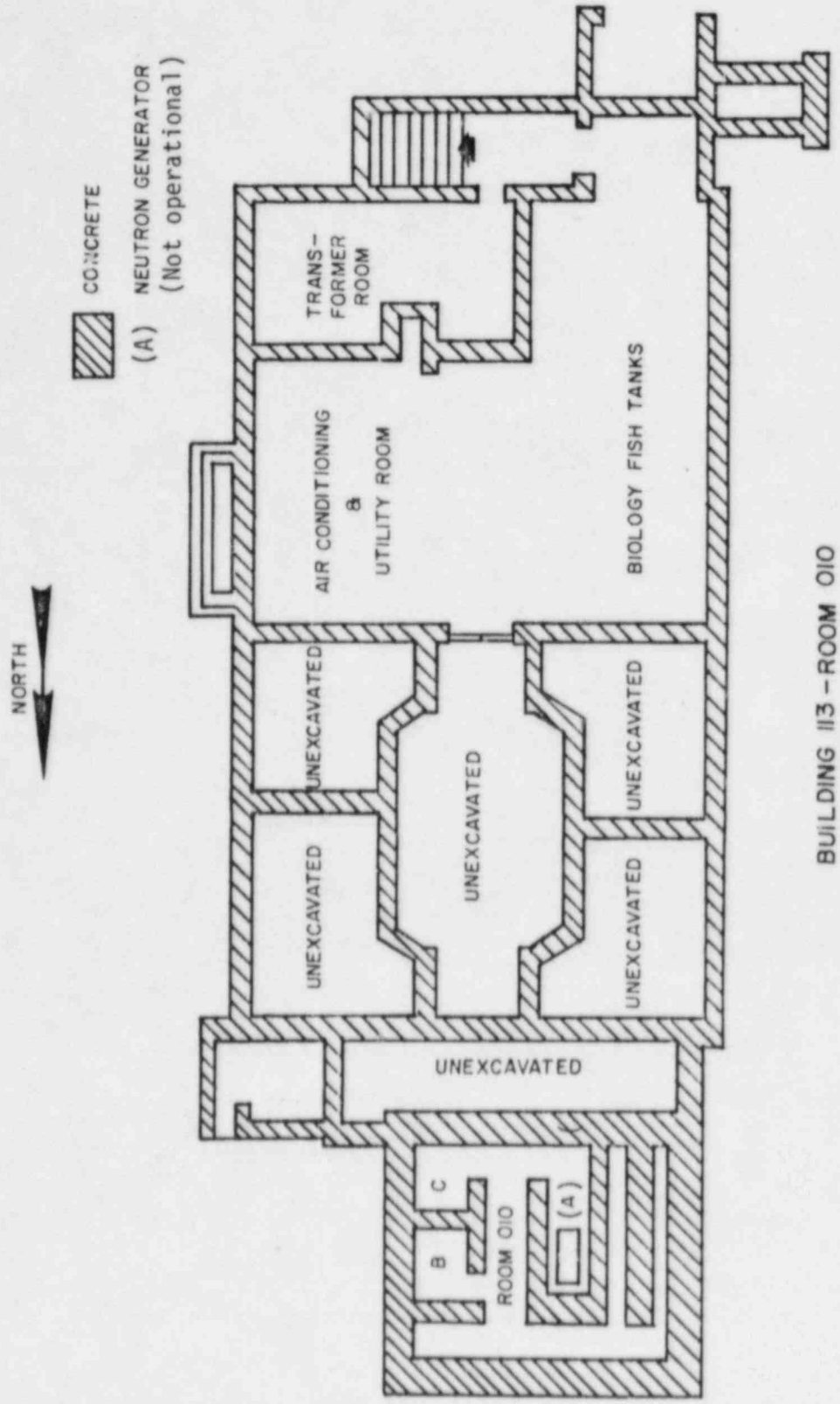
Application for Amendment No.5
Operating License R-127, Docket 50-538

BUILDING 113

FIRST FLOOR





BUILDING 113 - ROOM 010
BASEMENT FLOOR

FUEL INVENTORY (SNM)

ITEM	I.D. NO.	*GROSS WGT. (g)	SNM (g)	U-235 (g)
Core disc - 4 cm	20439	2138.9	495.32	98.28
Core disc - 4 cm	20440	2141.0	495.67	98.35
Core disc - 4 cm	20441	2027.2	468.05	92.87
Core disc - 4 cm	20450	2048.9	475.15	94.28
Core disc - 2 cm	20443	1259.8	291.10	57.76
Core disc - 2 cm	20444	1262.2	292.51	58.04
Core disc - 2 cm	20445	1260.0	291.91	57.92
Core disc - 1 cm	20446	641.5	148.78	29.52
Core disc - 1 cm	20447	629.9	146.26	29.02
Core fuse	20106	5.93	2.02	0.40
CONTROL & SAFETY ROD FUEL CYLINDERS				
4.7 cm dia.	20349	78.89	18.19	3.61
4.7 cm dia.	20350	79.01	18.24	3.62
4.7 cm dia.	20351	78.91	18.24	3.62
4.7 cm dia.	20352	78.91	18.24	3.62
4.7 cm dia.	20354	79.09	18.29	3.63
4.7 cm dia.	20358	79.02	18.29	3.63
4.7 cm dia.	20359	79.01	18.29	3.63
4.7 cm dia.	20360	79.10	18.29	3.63
4.7 cm dia.	20353	78.99	18.24	3.62
4.7 cm dia.	20355	78.92	18.24	3.62
4.7 cm dia.	20356	79.06	18.29	3.63
4.7 cm dia.	20357	78.98	18.29	3.63
2.3 cm dia.	20211	19.80	4.59	0.91
2.3 cm dia.	20212	19.89	4.59	0.91
2.3 cm dia.	20213	19.73	4.54	0.90
2.3 cm dia.	20214	19.78	4.59	0.91
TOTALS		14,442.42	3,344.21	663.56

* Gross Weight: Fuel composition is UO_2 in Polyethylene except for the core fuse which is UO_2 in Polystyrene.

ASSESSMENT AND STORAGE LOCATION OF RADIOACTIVE MATERIALS AND FISSION PRODUCT ACTIVITY

The radioactive materials associated with the AGN-201 Reactor include the reactor fuel and the 10 mg Radium-Beryllium neutron source. The aluminum core tank and control rod fuel capsules may contain trace amounts of short-lived activation products which decay to insignificant levels shortly following removal from the reactor.

1. Reactor Fuel and Core Fuse. Special Nuclear Material (SNM) contained in the fuel discs and core fuse consists of 2680.65 grams of U-238 and 663.56 grams of U-235. A detailed listing of fuel discs is identified in Appendix C.

   a. Natural Activity. The specific natural activity of the fuel may be calculated from the following relation:

$$\text{Sp. Act.} = \frac{N_A \lambda}{A\,(3.7 \times 10^4)} \quad ,$$

where
Sp. Act. = μCi/gram isotope
N_A = Avagadro Constant (atom/mol)
λ = Decay constant (sec^{-1})
A = Atomic wgt. (g/mol)
3.7×10^4 = dps/μCi

For U238: Assume λ = 4.92×10^{-18} sec^{-1} and A = 238.051 g/mol.

$Sp.Act._{238}$ = .336 μCi/gram U238

For U235: Assume λ = 3.12×10^{-17} sec^{-1} and A = 235.044 g/mol.

$Sp.Act_{235}$ = 2.16 μCi/gram U235

TOTAL NATURAL ACTIVITY IN REACTOR FUEL AND FUSE: 2.33 milliCuries

The largest fuel content of any element consists of 397.32g (U238) and 98.35g (U235). Thus, the natural activity of the largest disc is 346 μCuries. The Core Fuse contains 1.62g (U238) and 0.4g (U235) which yields a natural activity of 0.864 μCi.

b. Fission Product Activity. Since December, 1976, less than 1000 hours of operation at critical have been conducted. The highest recorded steady state power level was 80 milliwatts (March, 1977) and the longest period of uninterrupted operation at any power level was less than ten hours. The energy generated in Watt-hours per year is shown as follows using the conservative assumption that the total hours of operation at critical during each month of a given year occurred at the maximum recorded steady-state power level for that month:

	Watt-hours		
1985	<1.0	1980	3.3
1984	2.8	1979	6.8
1983	10.4	1978	3.0
1982	5.8	1977	11.1
1981	10.3	1976	1.1

Total Watt-hours (December 1976 - March 1985): 55.6

The defuel procedure approved for the MSU reactor requires a minimum ten day period following the last shutdown and removal of the neutron source to allow for activity decay prior to commencing fuel handling activities. To estimate the fission product activity remaining in the fuel at the time of removal from the reactor, a semi-empirical approach described in reference 11 is used, where:

$$\text{Total Fission-Product Activity (Ci)} \cong 14\ P_o \left[(\tau - T_o)^{-0.2} - \tau^{-0.2}\right]$$

τ = time, in seconds, from startup to the time of interest
P_o = thermal power level, in Watts, at which the reactor operated.
T_o = time, in seconds, that the reactor operated
$\tau - T_o$ = time, in seconds, after shutdown to the time of interest.

Based upon the intermittant mode of operation over 8¼ years, a "time averaged power level" was calculated for P_o assuming 1000 hours of continuous operation at 80 milli watts (80 Watt-hours) and averaged over a period of 7.23×10^4 hours.

Assuming a negligible quantity of fission product activity existed in the fuel in December, 1976, and using the following values:

$\tau = 2.61 \times 10^8$ seconds
$P_o = .0011$ Watts
$\tau - T_o = 8.64 \times 10^5$ seconds

TOTAL FISSION-PRODUCT ACTIVITY AT TIME $\tau = 6.8 \times 10^{-4}$ Curies

Assuming uniform distribution, the Specific Activity referenced to U235 would be 1.02 μCuries/gram U235 ten days after shutdown.

The largest single fuel element could contain approximately 100 μCuries of fission product activity. The core fuse, the smallest single fuel element and making allowance for a factor of two greater fission rate due to its location in the core, could contain approximately 0.8 μCuries of fission product activity.

c. Summary. At the time of fuel removal, the total fuel activity could be as much as 3 milliCuries composed of U235, U238, and fission products. The fission product activity would comprise less than 30% of the total and decrease to 10% or less of the total during the first three months of storage. The total activity is

distributed and contained within the solid polyethylene moderator comprised by nine core elements, 16 control rod elements, and the core fuse (polystyrene moderator). The largest single fuel element could contain as much as 446 μCuries of combined U235, U238, and fission product activity at the time of removal from the reactor.

The fuel storage scheme requires that not more than 200 grams of contained U235 be in any one storage barrel. Thus, the maximum activity in any one container at the initial time of storage would be approximately 908 μCuries composed of U235, U238, and fission products. After a reasonable period of time, the prevailing natural activity would be approximately 704 μCuries (maximum in any barrel). All SNM will be stored in the designated fuel storage area described in Part III of this application.

2. Radium-Beryllium Neutron Source. The AGN-201 neutron source consists of 10 milligrams (approximately 10 milliCuries) Ra-Be sealed in a stainless steel capsule. The source will be placed into its original lead shield and stored in the 55 gallon DOT (6J) USA 7A Type A shipping container that was used for transport in 1976. The maximum radiation exposure rate at three feet from the outer surface of the 6J container is expected to be less than 1.0 mR/hr. The Ra-Be Source will normally be stored in the Reactor Room of the facility unless an alternate location is specified by the Radiation Safety Office.

3. Aluminum Core Tank and Control Rod Fuel Capsules. The core tank and control rod fuel capsules are constructed of aluminum and contain the fuel elements during reactor operation. Upon disassembly, trace amounts of activity may exist due to contamination of the inner surfaces by the reactor fuel and/or activation by the reactor neutron flux. The core tank and fuel capsules will be sealed using their normal gasketed covers to achieve liquid-tight integrity and stored in the Reactor Room of the facility.