

Center for Nuclear Studies Memphis State University

1984
Annual Report
Nuclear Reactor Operations

License R-127, Docket 50-538
AGN-201 Nuclear Reactor, Serial 108

January, 1985

An Equal Opportunity University



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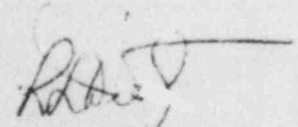
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MEMPHIS STATE UNIVERSITY

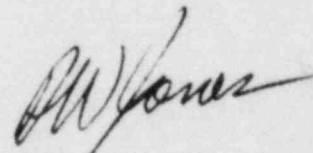
1984 ANNUAL REPORT
of
NUCLEAR REACTOR OPERATIONS

AGN-201 Nuclear Reactor, Serial 108
Facility Operating License R-127, Docket 50-538

January 23, 1985



R. L. Dietz
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ABSTRACT

The 1984 Annual Report of Nuclear Reactor Operations is prepared in compliance with Technical Specification 6.9 of Appendix A to Memphis State University Facility Operating License R-127, Docket No. 50-538. The report includes facility operation from January 1 through December 31, 1984.

Reactor operations during 1984 were primarily for purposes of operator training. New or previously untried experiments were not conducted. A total of 128 startups were performed, 58.16 hours of critical operations were accumulated, and the maximum steady state power level achieved was 50 milliwatts. Four unscheduled shutdowns are described in Section B of the report and an additional 12 training scrams were experienced throughout the operating year. The reactor did not require any safety-related maintenance. Routine, annual reactivity measurements of core parameters were made in December, 1984, and do not significantly differ from data contained in previous reports of AGN-201 performance. An upgraded Emergency Plan has been approved for the reactor facility and a copy of the plan is contained in Appendix A of this report.

Radiation exposure rates measured during reactor operation do not exceed maximum permissible levels specified in 10 CFR 20 and the highest cumulative dose-equivalent received by an individual was .059 Rem for the operating year. A statistical summary pursuant to 10 CFR 20.407 is provided in Section K of this report. A total of six independent audits were performed in various areas of facility operation and are listed in Section L.

Based upon a decision by Memphis State University, the Center for Nuclear Studies is being terminated and changes which will affect the description of the reactor facility are likely during early 1985.

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A. REACTOR OPERATING EXPERIENCE

1. Student Training Programs

Two power plant employees participated in training exercises designed by Memphis State University (MSU) to provide research reactor startup experience for cold license candidates. In addition, six students from MSU's specialized on-campus Nuclear Skills Training Program performed reactor startups and related training exercises as part of the normal curriculum for that program. A total of 34 reactor startups were conducted for purposes of student training.

2. Staff Operator Training

A total of 78 reactor startups were conducted for purposes of preparing new staff operators for license examinations. As of December 31, 1984, the MSU Center for Nuclear Studies Staff held four Senior Licenses and one Operator License for the AGN-201 Reactor.

3. Additional reactor operations were conducted for purposes of routine tests, calibrations, and surveillance activities.

4. Operations Summary

<u>Month</u>	<u>Hours</u> <u>Critical</u>	<u>Max. Power</u> <u>(milliwatts)</u>	<u>Month</u>	<u>Hours</u> <u>Critical</u>	<u>Max. Power</u> <u>(milliwatts)</u>
JAN	0	0	JUL	0	0
FEB	0.57	47	AUG	25.13	50
MAR	7.78	50	SEP	6.22	50
APR	0	0	OCT	2.72	35
MAY	0.47	50	NOV	2.47	32
JUN	1.47	21	DEC	11.33	50

Total Number of Reactor Startups During 1984: 128

Total Hours of Critical Operation During 1984: 58.16

B. UNSCHEDULED REACTOR SHUTDOWNS

1. Four unscheduled (non-training) reactor scrams were experienced during 1984. Operating limitations were not exceeded nor were any conditions achieved that would have required reactor shutdown, operation of safety systems, or other protective measures required by technical specifications. None of the unscheduled shutdowns were considered to be reportable occurrences as defined in the facility license.

CHANNEL 1 HIGH LEVEL TRIP: On December 14, 1984, a licensed operator was increasing reactor power in accordance with an approved surveillance procedure to measure the core excess reactivity. The operator failed to initiate control rod withdrawal in sufficient time to turn reactor power before reaching the high level trip setting of the Channel 1 Neutron Flux Monitor. This channel employs an eight-step range switch and has a trip setpoint at 90-95% of full-scale meter deflection which, on the highest range setting, corresponds to approximately 53 milliwatts.

CHANNEL 3 HIGH LEVEL TRIP: On December 12, 1984, a licensed Senior Operator was increasing reactor power to measure the reactor period in accordance with approved procedures for calibrating control rods. While attempting to switch the Channel 3 Neutron Flux Monitor to a higher scale, the operator erroneously positioned the range selector to a lower setting which resulted in a high level trip at 90-95% of full scale meter deflection. Reactor power at the time of this trip was approximately 2 milliwatts.

CHANNEL 2 LOW LEVEL TRIP: On November 2, 1984, the reactor was operating at a constant power level of 15 milliwatts when a spurious low level trip occurred from the Channel 2 Neutron Flux Monitor. This instrument is a log-picoammeter with a full scale range of six decades and is used to provide input signals to the protective system for measurement of reactor period, a high flux level trip, and a low flux level trip. A calibration check of the instrument and trip circuits immediately following this unscheduled shutdown was performed and no abnormalities could be found. The instrument was returned to service and operations resumed without further incident.

CHANNEL 1 AND CHANNEL 3 LOW LEVEL TRIPS: On August 7, 1984, while conducting a reactor startup and observing the subcritical multiplication during a 1/M approach to critical, low-level trips were experienced simultaneously from the Channel 1 and Channel 3 Neutron Flux Monitors. These trips resulted from maintenance activities that were being conducted by the electric power utility and which involved the transfer of power sources for the MSU South Campus. Although power to the reactor facility was not interrupted, the induced line voltage transients were sufficient to cause a rapid downscale perturbation in both the Channel 1 and Channel 3 instruments and actuate their low level trips. Reactor operation was resumed without further incident.

2. Twelve additional scrams were caused by trainees during the conduct of student training programs. Most of these trips resulted from students improperly positioning instrument range switches while performing approved training exercises.

C. PREVENTIVE AND CORRECTIVE MAINTENANCE

1. Safety Related Corrective Maintenance: None required.
2. Results of Major Surveillance Tests and Inspections:
 - a. Safety and Control Rod Assemblies Fuel Inspection: This bi-annual surveillance procedure was completed on November 21, 1984. The fuel discs in each safety and control rod capsule were found to be in excellent condition with no observable evidence of cracking or deterioration.
 - b. Reactor Shield Tank Visual Inspection: This bi-annual surveillance procedure was completed on November 19, 1984. The shield tank was sampled (gross activity less than minimum detectable, where $MDA=1 \times 10^{-7}$ uCi/ml referenced to Cobalt-60) and drained to permit entry. The tank was cleaned and areas

containing minor patches of rust were scraped and repainted. The shield tank was re-filled with pure water and the water level float assembly was recalibrated.

- c. Control Rod Drive Assembly Inspection and Lubrication: This annual surveillance procedure was completed on November 21, 1984. The drive assemblies were found in satisfactory condition with no evidence of abnormal wear or deterioration.
- d. Measurement of Safety and Control Rod Scram and Insertion Times: This annual surveillance procedure was completed on November 28, 1984, with the following results:

	<u>Insertion (cm/sec)</u>	<u>Scram (millisec)</u>
Safety Rod No. 1	0.473	108
Safety Rod No. 2	0.470	85
Coarse Control Rod	0.474	96
Fine Control Rod	0.491	N/A

- e. Reactivity Measurements: This annual surveillance procedure was completed on December 18, 1984, with the following results:

<u>Parameter</u>	<u>% Reactivity</u>
Control Rod Integral Worth:	
Fine	0.326
Coarse	1.260
Reactivity Insertion Rate:	
Safety Rod No. 1	0.035/sec
Safety Rod No. 2	0.034/sec
Coarse Control	0.035/sec
Fine Control	0.009/sec
Excess Reactivity (Glory Hole empty, 20°C, all rods IN)	.2029
Shutdown Margin (Most Reactive Rod IN)	2.67

D. CHANGES IN FACILITY DESIGN, PERFORMANCE CHARACTERISTICS, OR PROCEDURES RELATED TO REACTOR SAFETY

An upgraded Emergency Plan for the Memphis State University AGN-201 Reactor Facility (Revised August 1, 1984) was accepted by the U.S. Nuclear Regulatory Commission on November 7, 1984. Full implementation of this plan is scheduled to be accomplished by March 1, 1985, following preparation and proper approval of the appropriate implementing procedures. A copy of the Emergency Plan is contained in Appendix A of this report.

E. CHANGES WHICH WOULD AFFECT THE FACILITY DESCRIPTION

On December 7, 1984, Memphis State University ordered that the Center for Nuclear Studies be terminated, effective December 31, 1984, and that all prior training commitments be completed by March 31, 1985. As of the date of this report, there have been no changes to the AGN-201 Reactor Facility which would affect its description. However, the following alternatives for the reactor facility are being evaluated by MSU officials:

1. Reorganization of administrative control with responsibility for operation and maintenance of the facility assigned to the Physics Department under the Vice President for Academic Affairs or,
2. Removal and onsite storage of reactor fuel with an approved change in facility status to "possession but not operate" or,
3. Removal of all radioactive components and dismantling the facility under an approved decommissioning order and request for termination of Operating License No. R-127.

It is expected that one of these three alternatives will be decided upon within the first calendar quarter of 1985.

F. CHANGES TO ADMINISTRATIVE PROCEDURES

1. Revision 8 (3/84) to the AGN-201 Nuclear Reactor Facility Organization and Regulations Manual was issued March 31, 1984, to update the Emergency Plan Notification List and reflect proper phone contacts and numbers.
2. A revision (2/84) to the MSU/CNS Radiation Dosimetry Equipment Calibration Program Procedures was issued on March 1, 1984, to provide editorial changes and extend applicability to new equipment and calibration sources procured subsequent to the original issue.

G. NEW OR UNTRIED EXPERIMENTS

None.

H. RADIOACTIVE EFFLUENTS

1. Liquid: None
2. Airborne: None
3. Solid: None

I. ENVIRONMENTAL RADIOLOGICAL SURVEYS PERFORMED OUTSIDE THE FACILITY

Areas of unrestricted access begin at the outside walls of the reactor room. A general area radiation survey conducted December 17 and 18, 1984, revealed the maximum level of gamma radiation to be 0.2 mR/hr measured upon contact with the outside east wall. The maximum level of neutron radiation measured 0.1 mrem/hr at the same location. The reactor was operating at a steady power level of 50 milliwatts for the duration of the survey.

Wipes/smears taken randomly on surfaces inside and outside the reactor facility did not reveal any loose surface contamination above natural background concentrations.

The reactor was not operated above 50 milliwatts during 1984. Therefore, full power radiation survey results are not available.

J. RADIATION EXPOSURES GREATER THAN 100 MILLIREM (50 MILLIREM FOR PERSONS UNDER 18 YEARS OF AGE)

None.

K. PERSONNEL EXPOSURE AND MONITORING: 10 CFR 20, PART 407 (a) (2) AND PART 407 (b)

1. Personnel monitoring was provided for a total of 55 persons during 1984. The highest cumulative exposure for an individual was .059 rem. The average exposure for the 55 individuals monitored was .0036 rem.

2. Statistical Summary:

<u>Estimated Whole Body Exposure (Rems)</u>	<u>Number of Indiv. in Each Range</u>
No measureable exposure	45
Measureable exposure less than 0.1	10
0.1 to 0.25	0
0.25 to 0.5	0
0.5 to 0.75	0
0.75 to 1.0	0
1 to 2	0
2 to 3	0
3 to 4	0
4 to 5	0
5 to 6	0
6 to 7	0
7 to 8	0
8 to 9	0
9 to 10	0
10 to 11	0
11 to 12	0
12 +	0

L. AUDITS AND INSPECTIONS

Audits and inspections of the AGN-201 Reactor Facility were conducted by the following agencies during 1984. Copies of the written reports documenting the results of each audit/inspection are retained on file at the facility.

1. MSU Reactor Safety Committee (RSC)
 - a. Review of the Facility Radiological Controls Program and records (3-7-84)
 - b. Review of the results of actions to correct deficiencies that affect reactor safety (1-19-84)
 - c. Review of the performance, training, and qualifications of the facility staff (1-13-84)
 - d. An evaluation of the conformance of facility operation to the Technical Specifications (1-12-84)
 - e. Review of the Facility Security Plan (1-11-84)
2. U.S. Nuclear Regulatory Commission (USNRC) - Region II

A routine unannounced Physical Security Inspection 3/20-3/21/84. The results of this inspection are documented in USNRC Region II Inspection Report 50-538/84-01.

EMERGENCY PLAN
MEMPHIS STATE UNIVERSITY AGN-201 REACTOR FACILITY
(As Revised August 1, 1984)

EMERGENCY PLAN

MEMPHIS STATE UNIVERSITY AGN-201 REACTOR FACILITY

Prepared at the Center for Nuclear Studies
Memphis State University: October 15, 1982.
Revised: August 1, 1984.

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Attachments

1. Illustration: Memphis State University South Campus
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LIST OF EFFECTIVE PAGES

<u>Page</u>	<u>Revision</u>
Title Page	August 1, 1984
ii, iii	August 1, 1984
1	October 15, 1982
2	August 1, 1984
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11	August 1, 1984
12 through 14	October 15, 1982
15, 15a, 16, 16a, 17, 17a, 18, 18a	August 1, 1984
19 through 21	August 1, 1984
22	October 15, 1982
23	August 1, 1984
Attachment 1, 2	October 15, 1982
Attachment 3-1, 3-2	August 1, 1984

A. INTRODUCTION

The Memphis State University (MSU) Research Reactor, model AGN-201, is located in an annex to the ground floor of Building 113 at the Center for Nuclear Studies and is situated in the northwest corner of the MSU South Campus (Attachments 1 and 2). Activities are conducted under MSU Facility Operating License R-127, Docket No. 50-538 and the reactor is used in training programs in various fields of nuclear technology. The reactor is constructed as a sealed system containing a solid, homogeneous core; is operated at ambient temperatures to a maximum steady state power level of 0.1 watt (thermal); and requires no auxiliary or liquid cooling systems. The core contains approximately 3.3 kilograms of uranium enriched 19.8% in the isotope U235. By virtue of the small fissile material content and low power level, the fission product inventory is negligible.

The purpose of this Emergency Plan is to: (1) describe provisions that have been made through advanced planning to cope with an emergency situation not normally expected from routine reactor operations and, (b) provide assurances that appropriate measures can and will be taken to mitigate the consequences of such an emergency, should it occur, and thereby further assure protection of the public health and safety.

References 2, 3, and 4 delineate standard guidelines for emergency planning for research reactors. Although credible accidents postulated for the AGN-201 Reactor do not result in radiological consequences matching the least severe class of accidents in these references, the MSU Emergency Plan has been developed consistent with, to the extent practical, the guidelines therein. Differences and variations from the standards of references 2, 3, and 4 realistically reflect the characteristics unique to the MSU Reactor Facility.

B. DEFINITIONS

Emergency - An emergency is a condition which calls for immediate action, beyond the scope of normal operating procedures, to avoid an accident or to mitigate the consequences of one.

Operations Boundary - The area within the physical barriers composed of the annex to the ground floor of Building 113 on the South Campus of Memphis State University and which consists of rooms 140, 140A, 140A1, and 140A2 shown in Attachment 2.

Site Boundary - That boundary, not necessarily having restrictive barriers, surrounding the operations boundary wherein the Reactor Administrator may directly initiate emergency activities. The site boundary includes the ground floor of Building 113 on the MSU South Campus and the areas immediately adjacent to the south, east, and north barriers of the operations boundary (Attachment 1, 2).

C. ORGANIZATION AND RESPONSIBILITIES

C.1 Organization

The Emergency Organization consists of a director and team of technical coordinators who possess a detailed knowledge of the Reactor Facility. This team is augmented by selected off-campus agencies which will provide response actions normally beyond the capabilities of MSU personnel. Figure C.1 is a block diagram illustrating the structure of the Emergency Organization.

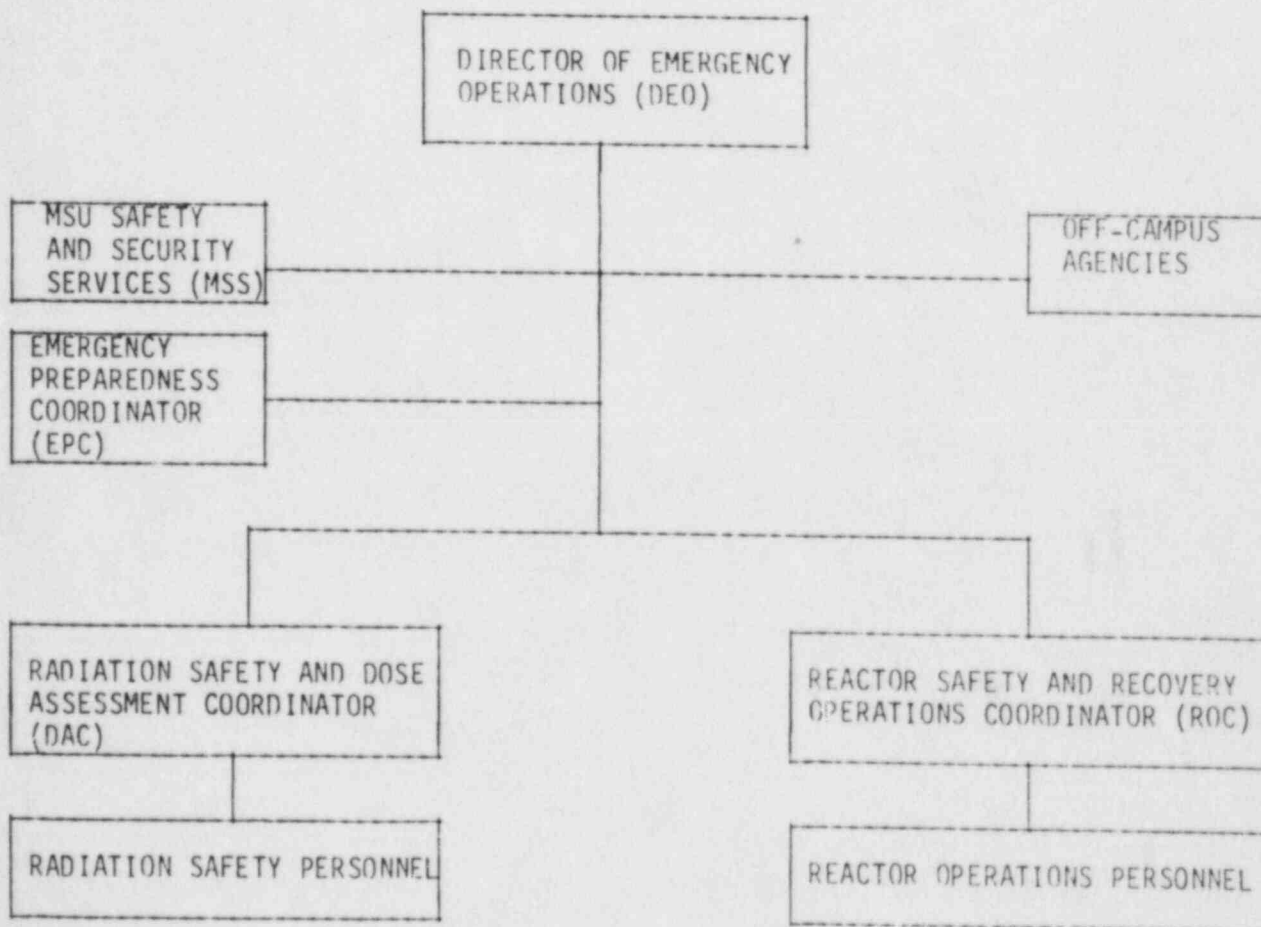
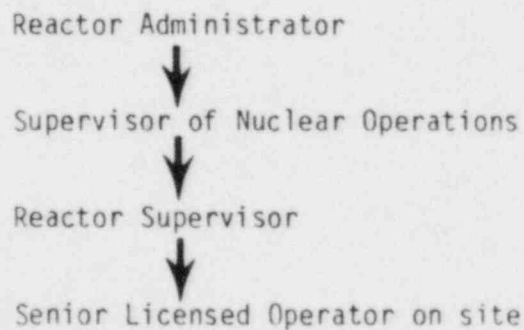


Figure C.1 AGN-201 Reactor Facility Emergency Organization

C.2 Director of Emergency Operations (DEO)

- a. The Director of the Center for Nuclear Studies (CNS) shall be the DEO. In the event that the CNS Director is unavailable or otherwise incapacitated, the DEO shall be assumed according to the following line of succession:



- b. The DEO shall be responsible for:

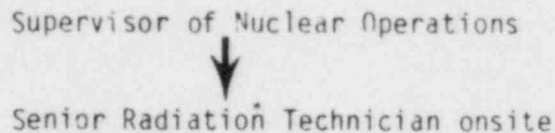
- * (1) Directing all major elements of the Emergency Organization to effectively bring the emergency under control. This responsibility shall include the following key decisions:
- (a) that specific elements of the emergency organization should or should not be activated based upon circumstances of the emergency, existing or imminent;
 - (b) that sufficient control exists such that an emergency, once declared, may be terminated;
 - (c) that recovery actions shall commence;
 - (d) that changes to the planned organization and organizational actions, based upon existing circumstances of the emergency, may be made.

- * (2) Proper notification of and initial liaison with the U. S. Nuclear Regulatory Commission (NRC), Tennessee Emergency Management Agency (TEMA), and the President of Memphis State University and other university officials as may be appropriate to the circumstances, existing or imminent. After contact, liaison with specific elements of NRC and/or TEMA technical groups may be delegated to appropriate technical coordinators of the MSU/CNS Emergency Organization.
- * (3) Informing the emergency organization of any planned organizational actions or changes.
- * (4) Authorizing, upon recommendations from the Radiation Safety and Assessment Coordinator (DAC), volunteer emergency workers to incur radiation exposures in excess of normal occupational limits.
- * (5) Authorizing, upon recommendations from the DAC and Reactor Safety and Recovery Operations Coordinator (ROC), reentry into areas of the facility that required evacuation following an accident.
- (6) Relating information about the emergency situation to the news media and the public. This responsibility may be delegated to a selected Public Affairs Coordinator.

*Responsibilities denoted by an asterisk shall not be delegated.

C.3 Radiation Safety and Dose Assessment Coordinator (DAC)

- a. The MSU Radiation Safety Officer (RSO) shall be the DAC. In the event that the RSO is unavailable or otherwise incapacitated, the DAC shall be assumed according to the following line of succession:



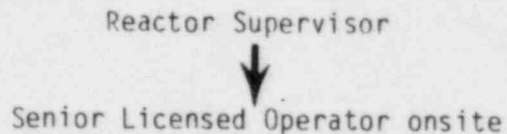
- b. The DAC shall be responsible for:

- * (1) Onsite and offsite radiation dose assessments including the maintenance of records.
- * (2) Making recommendations to the DEO for actions that would mitigate the consequences of - or resolve - radiological hazards resulting from the emergency.
- * (3) The direct supervision of decontamination actions including the decontamination and/or preparation of contaminated injured personnel for transportation to medical facilities.
- (4) Coordinating with the ROC to plan and initiate protective measures to minimize radiation exposures for personnel engaged in corrective and recovery actions.

*Responsibilities denoted by an asterisk shall not be delegated.

C.4 Reactor Safety and Recovery Operations Coordinator (ROC)

- a. The MSU/CNS Reactor Administrator shall be the ROC. In the event that the Reactor Administrator is unavailable or otherwise incapacitated, the ROC shall be assumed according to the following line of succession:



- b. The ROC shall be responsible for:

- * (1) Making recommendations to the DEO for actions that would mitigate the consequences of - or resolve - emergencies directly involving reactor safety. The ROC shall supervise such actions.
- * (2) Assessment of reactor core damage, existing or imminent.
- * (3) Initiating actions to assure reactor shutdown as defined in the MSU Facility Operating License.
- * (4) Making recommendations for actions to improve the posture of any security measures that may have been degraded as a result of an accident.
- * (5) Supervising onsite recovery actions as directed by the DEO.

*Responsibilities denoted by an asterisk shall not be delegated.

C.5 Emergency Preparedness Coordinator (EPC)

- a. The MSU/CNS Supervisor of Nuclear Operations shall be the EPC.
- b. The EPC shall be responsible for:
 - (1) Emergency preparedness planning including the updating of this plan, notification rosters, and implementing procedures.
 - (2) Distribution of the Emergency Plan including approved changes and revisions to appropriate elements of the Emergency Organization.
 - (3) Initiating action to obtain, where necessary, written agreement with offsite support agencies to augment and extend the capabilities of the emergency organization.
 - (4) Ensuring that onsite equipment and facilities are available and maintained in the proper state of readiness to support this plan.

C.6 MSU Safety and Security Services

- a. MSU Safety and Security Services (MSS) is an on-campus organization with a full-time director that maintains a permanent detachment of armed security officers on the MSU South Campus.
- b. The Director of MSS is responsible for:
 - (1) Enforcement of physical security and personnel access regulations.
 - (2) Assistance in communications including those communications requiring the use of two-way radio between the MSU South Campus and Security Headquarters.
 - (3) Liaison with other law enforcement agencies, when required, to ensure effective traffic and crowd control.
 - (4) Coordinating with the DEO to initiate actions that would improve the posture of any security measures that may have been degraded as a result of an accident.

C.7 Off-Campus Agencies

Off-campus agencies will respond, upon call, to augment the on-site organization with the resources and support services identified as follows:

a. Memphis Police Department

- (1) Provide assistance in the event of a bomb threat or civil disturbance directed against the reactor facility.
- (2) Provide assistance in traffic and crowd control.

b. Memphis Fire Department

- (1) Provide fire fighting services.
- (2) Provide ambulance services for injured personnel including injured personnel who may be radioactively contaminated.

c. City of Memphis Hospital; a unit of the Memphis and Shelby County Hospital Authority

- (1) Provide emergency treatment and physician's services for injured victims and including radioactive decontamination, if necessary.

d. Tennessee Emergency Management Agency (TEMA)

- (1) Notification of appropriate elements of Tennessee's emergency response network including state and local government officials, the Tennessee Division of Radiological Health, and the Tennessee Department of Public Safety (Highway Patrol) commensurate with the nature and severity of the

situation and in accordance with pre-established emergency action levels.

- (2) Coordination of the evacuation of offsite personnel when required as a result of an emergency.
- (3) Coordination of technical assistance groups and resources that may be deployed to assure control and stabilization of any emergency which could constitute a threat to the public health and safety.

e. American Nuclear Insurors (ANI)

Provide emergency assistance, where warranted, to qualified members of the public to cope with and to otherwise defray the reasonable immediate expenses brought about by a nuclear incident in accordance with ANI Nuclear Liability Policy NF-251.

Requests for assistance and coordination with the Memphis Police Department will be via MSU Safety and Security Services (MSS) and in accordance with the cooperative agreement existing between these agencies. Written confirmation of agreements with the Memphis Fire Department and the City of Memphis Hospital are appended to this plan as Attachment 3. The Tennessee Emergency Management Agency (TEMA) has headquarters in Nashville, Tennessee, and is chartered to coordinate all major emergencies, without limitation, in the State of Tennessee.

D. EMERGENCY CLASSIFICATIONS

By virtue of the small quantity of fissile material and negligible fission product inventory associated with operation of the AGN-201 Reactor, a release of radioactive material that would require offsite responses is not expected from any potential emergency involving the MSU/CNS facility. Radiological emergencies that may be possible are within the control capabilities of onsite personnel and predetermined responses are specified in the facility operating procedures.

Emergencies for which predetermined responses may be necessary by the organization outlined in this plan are described in the following classification.

D.1 Notification of Unusual Events (NOUE)

Man-made events or natural phenomena, existing or imminent, that can be recognized as creating a significant hazard potential that was previously nonexistent and that may be beyond the scope of normal operating procedures. Notification or mobilization of one or more elements of the Emergency Organization may be necessary to increase the state of readiness, prevent escalation of the emergency situation, or to mitigate the consequences of an accident should it occur.

E. EMERGENCY ACTION LEVELS

Classification

Action Level

Notification of Unusual Events

1. Bomb threat or civil disturbance directed toward the MSU/CNS AGN-201 Reactor Facility
2. Report or observation of severe natural phenomena, imminent or existing, such as tornados, hurricanes, or earthquakes that could strike the facility with the potential for degradation of the physical barriers that compose the operations boundary.
3. Fire within the Reactor Facility lasting more than 10 minutes.
4. Radiological Safety Incidents that result in any of the conditions specified under the notification requirements of 10 CFR 20.403.

F. EMERGENCY RESPONSE

F.1 Activation of the Emergency Organization

- a. Mobilization - The DEO shall be immediately notified of any situation, existing or imminent, equivalent to the Emergency Action Levels specified for Notification of Unusual Events. Notification will normally be initiated by reactor facility operators during working hours and by MSS officers during off-working hours. However, notification may be initiated by any individual recognizing the emergency. The DEO shall determine the extent to which other elements of the organization should be activated, commensurate with circumstances of the situation, and shall direct the most efficient method for further notification and/or mobilization.
- b. Notification Rosters - Notification Rosters that identify the Emergency Organization, Emergency Action Levels, the names and phone numbers of personnel in the line of succession for DEO, ROC, and DAC, and the phone numbers of contacts for fire, medical, and ambulance support services shall be posted at conspicuous locations in the following areas:
- (1) Reactor Control Room
 - (2) Building 113 corridor (ground floor)
 - (3) MSU South Campus Security Station
 - (4) MSU Security Services Headquarters near the central communications dispatcher
- c. Availability of Support Services - Local off-site support services such as fire fighting, ambulance, and medical services are provided by the Memphis Fire Department and City of Memphis Hospital, respectively. These agencies maintain emergency

communications/dispatcher services available on a 24-hour, 7 days a week basis. A roving patrol of MSS provides routine surveillance of the MSU Reactor Facility on a similar basis which provides assurance that these support agencies, and the DEO, can be contacted at any time including during an emergency where: (1) the facility is not occupied and (2) occupants of the facility may be otherwise incapacitated.

F.2 Assessment Actions

The DEO shall assess the severity of an emergency situation from first-hand knowledge. Decisions to escalate or de-escalate emergency response actions shall be made by the DEO based upon personal evaluation of the situation, existing or imminent, and after consideration of recommendations from facility staff, emergency organization coordinators, and/or off-site support teams that may be present.

F.3 Protective Actions

- a. For each of the Emergency Action Levels specified in this plan, the reactor shall be placed in the shutdown condition as defined in the Facility Operating License¹ and areas within the operations boundary shall be evacuated of all personnel. Except as described in F.3.b., personnel shall proceed to the Hold Station identified in Attachment 2 by the most direct route and await further instructions.

- b. Potentially contaminated personnel shall be segregated and proceed by the most direct route to the Decontamination Room identified in Attachment 2.
- c. Accountability of personnel shall be maintained at the Hold Station and/or Decontamination Room as appropriate, until release is approved by the DEO.
- d. If partial or complete evacuation of personnel from the assembly areas identified in this plan is required, evacuation shall be executed as directed by the DEO and based upon the specific circumstances of the emergency and potential dangers to the safety of personnel.
- e. TLD badges and/or self-reading pocket dosimeters shall be worn by all personnel who enter restricted areas. Additional measures such as protective clothing and breathing apparatus may be required as specified by the DAC or DEO. Emergency personnel shall be advised of the extent and locations of radiological hazards that may be present in the facility prior to entry into such areas and radiation exposures shall normally be limited to the permissible doses for individuals in restricted areas specified in 10 CFR 20. If warranted by the situation, emergency doses in excess of 10 CFR 20.101 (b) (1) may be authorized by the DEO for volunteers but shall be consistent with the Environmental Protection Agency (EPA) Emergency Workers and Lifesaving Activity Protective Action Guides.

- f. To minimize exposures to radiation and the spread of contamination, doors leading to and from the operations boundary and other affected on-site areas shall remain shut and locked. Restricted areas shall be posted and access shall be controlled as directed by the DEO consistent with the nature of the emergency.
- g. Radiation dose rates shall be monitored by recording readings from the normally installed continuous area gamma monitor and airborne particulate activity monitor, if accessible, and by conducting radiation surveys with portable radiation survey instruments. Smear surveys shall be performed to monitor loose surface contamination levels. The data from such surveys shall be reviewed and evaluated by the DAC and ROC who will transmit the collected data with recommendations for action to the DEO.
- h. Personnel exposures shall be monitored by TLD badge and/or self-reading pocket dosimeters. In the event that unmonitored personnel may have been exposed to radiation, an estimate of exposures shall be made by the DAC based upon surveys and air particulate samples of areas that were occupied, the potential for exposure from the emergency situation that existed during the time such areas were occupied, and using standard dose assessment practices.

F.4 Corrective Actions

The type of actions that could mitigate or correct the problems for each emergency class listed in this plan shall be specified in the implementing procedures.

G. EMERGENCY FACILITIES AND EQUIPMENT

G.1 Emergency Support Center (ESC)

The ESC shall normally be established in Rooms 134 and 136 of Building 113 (Attachment 2) and will be the center from which emergency control directions will be given. In the event that this location is inaccessible or otherwise considered inadequate for the emergency at hand, an alternate location should be established in Building 8, or as directed by the DEO.

Selection of the normal and alternate ESC is based upon the proximity of locations for portable radiation monitoring and sampling equipment, fixed systems for determining specific radionuclide identification and analyses, decontamination equipment, and availability of telephone communications.

G.2 Assessment Facilities

- a. Portable survey instruments of sufficient range to determine alpha, beta, gamma, and neutron radiation levels commensurate with potential radiological consequences of credible emergency situations and portable air sampling equipment shall normally be stored, except when actually in use, in Room 138 of Building 113 (Attachment 2).
- b. A fixed Area Gamma Monitor is permanently installed in Room 140A2 and a fixed, continuous flow Airborne Particulate Activity Monitor is permanently installed in Room 140A of Building 113 Annex (Attachment 2).

- c. A Multi-channel Pulse Height Analyzer with photon detector and a shielded GM Counting System with calibrated aluminum absorbers is permanently located in Room 144 of Building 113 for radionuclide identification and analysis.
- d. Self-reading pocket dosimeters for emergency use shall normally be stored in Room 138 of Building 113. TLD badges are normally provided by the MSU Radiation Safety Office.
- e. A smoke detector is installed directly above the reactor in Room 140A2 of Building 113 Annex and is an integral component of the permanently installed fire alarm system. A seismic displacement sensor is permanently installed in the reactor assembly and is described in the reactor facility operating license.¹

G.3 Facilities and Methods for Assisting Injured and Contaminated Personnel

- a. Decontamination Facilities - Washing facilities, soaps and detergents, first aid supplies, anti-contamination clothing, and waste disposal bags shall be available in Room 138 of Building 113 (Attachment 2). Decontamination of personnel and/or equipment shall be performed under the direction of the DAC.

- b. Transportation of Injured Personnel and Emergency Treatment - The Memphis Fire Department Ambulance Service shall transport injured personnel, including those who may be radioactively contaminated, to the City of Memphis Hospital for treatment (Attachment 3).

MSU and the Memphis and Shelby County Hospital Authority have entered into a written agreement whereas the City of Memphis Hospital will provide physician's services, emergency treatment and, if necessary, radioactive decontamination services for injured victims connected with the MSU Center for Nuclear Studies. This agreement is for an indefinite term beginning with the date of signing: August 1, 1978 (Attachment 3).

- c. Methods of Handling Contaminated Injured Personnel - The nature and severity of an injury will determine if first-aid and/or decontamination is possible prior to transporting a patient to the medical facility. Action shall be taken to prevent the spread of contamination into open wounds. Contaminated clothing should be removed by the best practical means and, if possible, contaminated areas of the skin rinsed with water.

If decontamination is not practical, then the extent to which a patient is contaminated shall be noted on a tag attached to the injured person and, as appropriate, measures shall be taken to prevent the spread of contamination to the ambulance and ambulance personnel. The DAC shall assign a member of the facility staff to accompany the victim to the medical facility to ensure that the attending physician is fully advised of the extent and type of contamination.

G.4 Communications

An emergency communications system consisting of two-way radio between the MSU South Campus Security Officers and Security Headquarters is maintained by MSU Safety and Security Services on a continuous basis.

Standard, commercial telephones are installed in the Reactor Control Room, ESC in Building 113, and in Building 8 (Attachment 1).

H. RECOVERY

Recovery operations to restore the facility to a safe status shall be determined after an assessment of existing radiation and contamination levels has been made by the DAC and ROC. When needed, written procedures shall be prepared by the ROC and submitted to the DEO for approval.

Recovery operations shall commence and/or reactor building re-entry shall be permitted only after plans for such action, written or verbal, have been approved by the DEO and reviewed with the facility staff.

If physical damage to the operations boundary has occurred, action shall be initiated to promptly reestablish a security system that is at least equivalent, in effect, to the requirements specified in the Reactor Facility Operating License.¹

I. MAINTAINING EMERGENCY PREPAREDNESS

I.1 Reviews and Approvals

- a. The Emergency Plan and Implementing Procedures shall be reviewed by the MSU Reactor Safety Committee (RSC) and the EPC at least once per 24 months and updated as necessary. Changes that would alter the scope of the plan or otherwise result in a reduction of Emergency Organization capabilities shall not be made without prior approval of the U.S. Nuclear Regulatory Commission (NRC). Changes that are made without prior approval shall be submitted to NRC within 30 days of the effective date.
- b. The procedural system governing the writing, revising, and updating of implementing procedures for this emergency plan shall be as specified in the Facility Operating License.¹
- c. Notification Procedures shall be updated as necessary and a visual inspection shall be made annually (intervals not to exceed 15 months) to verify that current Notification Rosters are posted in designated locations.

I.2 Training and Drills

- a. Operators of the AGN-201 Reactor Facility shall receive training in the Emergency Plan and Implementing Procedures during their initial license training program and shall review the plan and implementing procedures at least once each 12 months thereafter. Initial training and subsequent reviews shall be documented in the facility training records.

- b. Emergency drills shall be conducted annually (intervals not to exceed 15 months) to test the on-site integrated capability of the emergency plan, or a component thereof, and may include instruction periods to develop and maintain skills in a particular operation. At least every two years (intervals not to exceed 2½ years), communication links and notification procedures with off-site support agencies shall be tested. Drills will normally be scheduled by the EPC and may be initiated as either announced or unannounced events.
- c. The EPC, or an observer designated by the EPC, will provide a critique of each emergency plan drill and will distribute a written report within 30 days after each drill occurrence. The EPC shall be responsible for timely corrective action of identified deficiencies.

I.3 Equipment Maintenance

- a. Portable health physics instruments, including pocket dosimeters that may be used in an emergency, shall be calibrated semi-annually (intervals not to exceed 7½ months).
- b. Fixed radiation monitors shall be calibrated annually (intervals not to exceed 15 months).
- c. The facility smoke detector and fire alarm system shall be functionally tested annually (intervals not to exceed 15 months). The seismic displacement sensor shall be tested as specified in the Facility Operating License.¹
- d. An inventory of decontamination equipment shall be conducted annually (intervals not to exceed 15 months).

J. IMPLEMENTING PROCEDURES

Procedures for implementation of the Emergency Plan shall include:

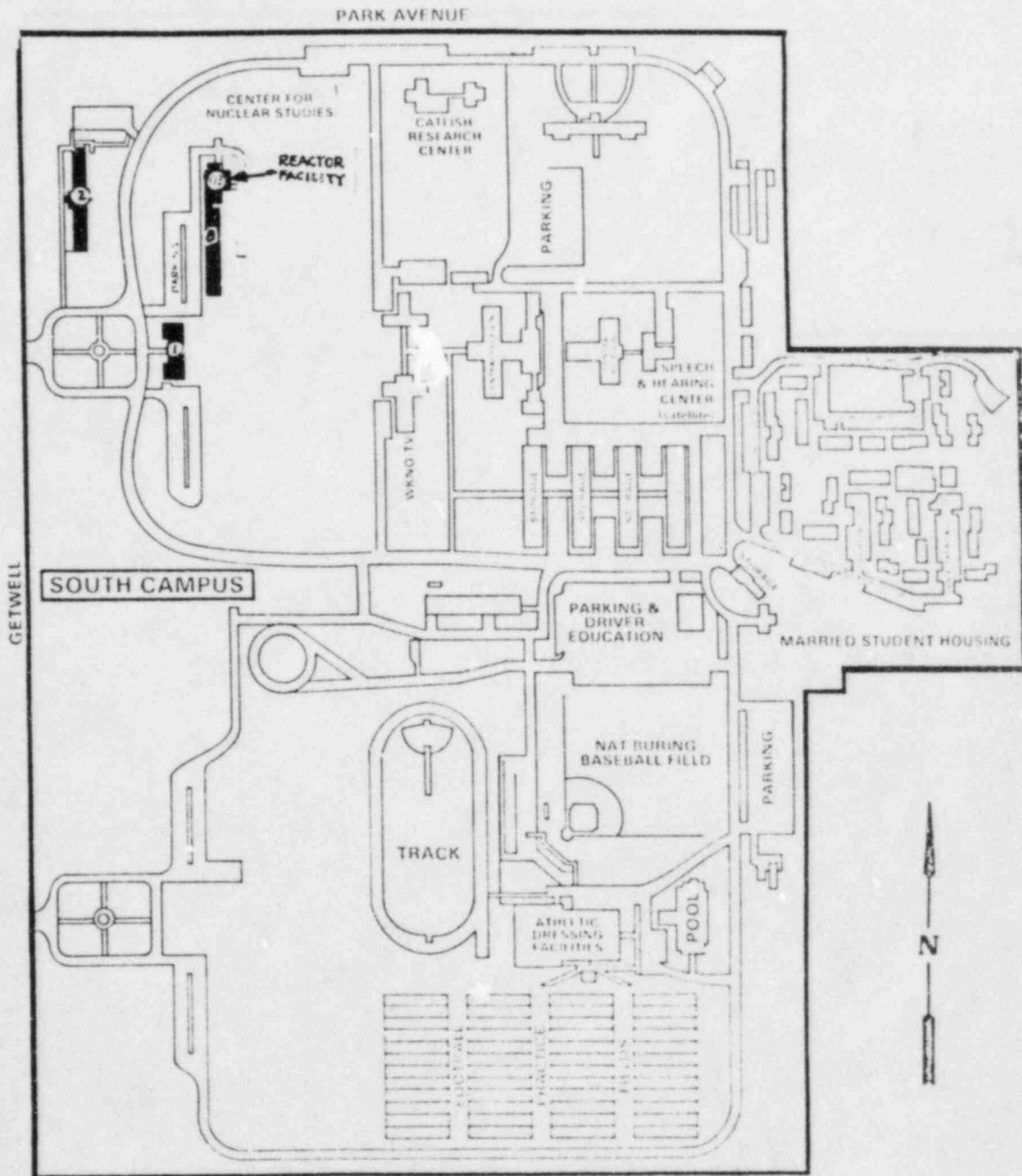
- a. Notification Procedures.
- b. Procedures for the evacuation of personnel from within the operations boundary of the facility.
- c. Procedures for corrective actions that could mitigate the consequences of situations matching the Emergency Action Levels specified in this Emergency Plan.

K. REFERENCES

1. Memphis State University Facility Operating License R-127, Docket No. 50-538, (USNRC: December 10, 1976), as amended.
2. American National Standard: "Emergency Planning for Research Reactors," ANSI/ANS-15.16-1982, (American Nuclear Society: 1982).
3. Standard Review Plan for the Review and Evaluation of Emergency Plans for Research and Test Reactors NUREG-0849 (USNRC: October 1983).
4. Proposed Revision 1 to Regulatory Guide 2.6, "Emergency Planning for Research and Test Reactors" (USNRC: March 1982).
5. Code of Federal Regulations, Title 10: Chapter 1, Part 50.

Memphis State University

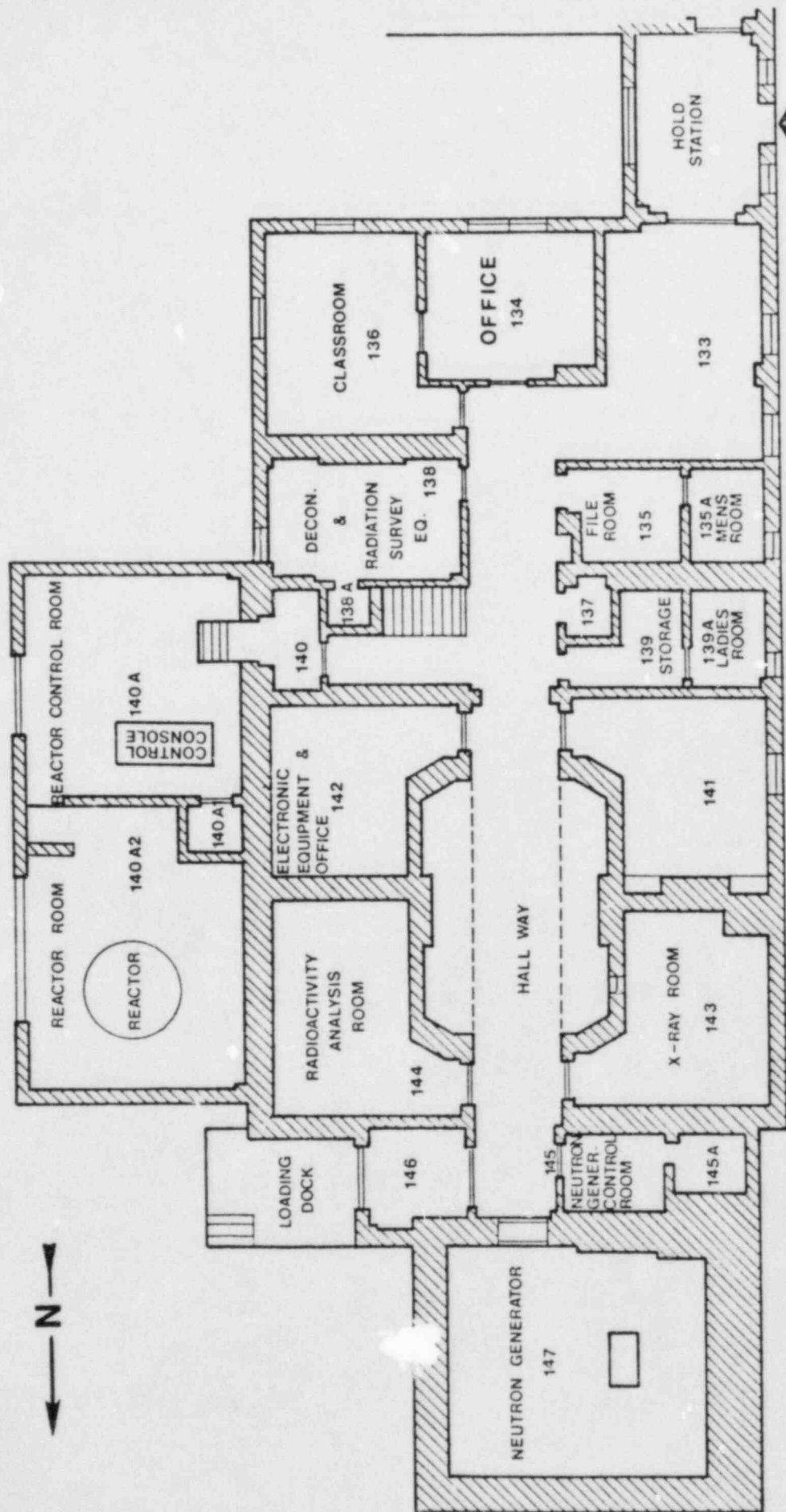
SOUTH CAMPUS



CENTER FOR NUCLEAR STUDIES: Buildings 1, 2, 8 & 113

BUILDING 113

FIRST FLOOR



RICHARD C. HACKETT
MAYOR

CITY of MEMPHIS



DIVISION OF FIRE SERVICES

July 30, 1984

Director
Center for Nuclear Studies
Memphis State University
Park and Getwell
Memphis, TN 38152

Dear Sir:

The Memphis Fire Department will respond to emergencies at the Memphis State University AGN-201 Reactor Facility and provide the following services:

1. Fire suppression and rescue services
2. Transportation and Emergency Medical Services involving those individuals affected by fire, explosion, and/or contamination

The furnishing of these services is in accordance with the August 1, 1978, letter of agreement between Memphis State University and the Memphis-Shelby County Hospital Authority and consistent with our basic responsibility throughout the city.

If you have further questions, please feel free to contact us.

Sincerely,


B. G. Hall, Deputy Director
Fire Services

BGH:gh

cc: Division II Deputy Chiefs
Fire Communications Bureau

Attachment 3-1
August 1, 1984

AGREEMENT #1274

WHEREAS, it is the desire of the Memphis and Shelby County Hospital Authority, a non-profit, public corporation, hereinafter referred to as the "Authority," and Memphis State University, An Equal Opportunity University, hereinafter referred to as the "University," to provide emergency treatment to those individuals connected with the Memphis State University Center for Nuclear Studies; and

WHEREAS, a comprehensive emergency plan for use if an accident occurs is required prior to the licensing of the reactor for use in training reactor operators and nuclear technicians; and

WHEREAS, the Authority would provide such services by the City of Memphis Hospital, a unit of the Memphis and Shelby County Hospital Authority.

NOW, THEREFORE, for and in consideration of the mutual promises, covenants and stipulations of each party to the other, the parties hereto enter into the following agreement.

THE AUTHORITY AGREES TO:

1. Provide emergency treatment for injured victims and including radioactive decontamination, if necessary.
2. Provide physician's services by Interns and Residents under the supervision of the medical staff of the University of Tennessee.
3. Submit billings for services rendered University authorized patients within thirty (30) days following date of treatment.

THE UNIVERSITY AGREES TO:

1. Provide the City of Memphis Hospital with an authorization which specifically indicates that the services required for treatment of the individual referred from Memphis State University Center for Nuclear Studies will be reimbursed immediately upon receipt of invoice.
2. Reimbursement for services rendered shall be based on one hundred (100%) percent of itemized charges.

BE IT FURTHER AGREED THAT:

1. Any and all claims for injuries and property damages arising out of the execution or the implementation of this Agreement shall be subject to the provisions of the Tennessee State Board of Claims, Tennessee Code Annotated, Title 9, Chapter 8.
2. During the performance of this Agreement, the parties hereto shall not discriminate against any person on the basis of handicap, race, color, religion, sex or national origin. Breach of this provision shall be cause for immediate termination.

3. Nothing in this Agreement shall be construed as limiting the right of either party to affiliate or contract with any other hospital or clinic on either a limited or general basis while this Agreement is in effect.
4. This Agreement may be modified only by the written consent of both parties thereto.
5. This Agreement shall be for an indefinite term beginning with the date of signing hereof and may be terminated by sixty (60) days written notice to the other party.

IN WITNESS WHEREOF, the parties hereto have caused these presents to be executed this 1st day of August, 1978.

MEMPHIS STATE UNIVERSITY

Billy M. Jones
Billy M. Jones, President

MEMPHIS AND SHELBY COUNTY
HOSPITAL AUTHORITY

S. F. Langley
S. F. Langley, President

ATTEST:

Marjorie McElroy
Marjorie McElroy, Asst. Secretary

APPROVED AS TO FORM:

Daniel F. B. Rhoads
Daniel F. B. Rhoads, Attorney

THE CITY OF MEMPHIS HOSPITAL

W. B. Lipes
W. B. Lipes, Administrator

FOR SHELBY COUNTY

Shelby County Mayor
Shelby County Mayor



MEMPHIS STATE UNIVERSITY
MEMPHIS, TENNESSEE 38152

February 15, 1985

Center for Nuclear Studies
(901) 454-2687

Director of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
Washington, DC 20555

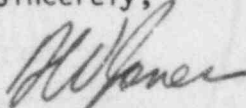
ATTN: Document Control Desk (DCD)

SUBJECT: Facility Operating License
R-127, Docket No. 50-538

Gentlemen:

Copies of the Memphis State University 1984 Annual Report of Nuclear Reactor Operations are transmitted herewith for your review and records. The report is provided in compliance with Facility Operating License R-127, Docket 50-538. Information contained in the report is considered by the licensee to be non-proprietary.

Sincerely,



D. W. Jones

RLD/DWJ/mlm

Enclosures (12 copies)

cc: Mr. R. L. Dietz

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