

Center for Nuclear Studies Memphis State University

1983
Annual Report
Nuclear Reactor Operations

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

MARCH , 1984

An Equal Opportunity University



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Center for Nuclear Studies
Memphis State University

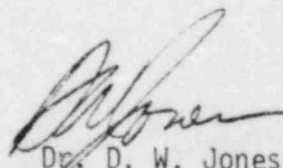
1983 ANNUAL REPORT
of
NUCLEAR REACTOR OPERATIONS

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

March 1, 1984



R. L. Dietz
Supervisor
Nuclear Operations



Dr. D. W. Jones
Director

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ABSTRACT

The 1983 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, 1983.

Reactor operations during 1983 were primarily for purposes of operator training. New or previously untried experiments were not conducted. A total of 563 startups were performed, 215.63 hours of critical operations were accumulated, and the maximum steady state power level achieved was 54 milliwatts. Ten unscheduled shutdowns are described in Section B of the report and an additional 19 training scrams were experienced throughout the operating year. One of the shutdowns was a reportable occurrence and a copy of the followup report for this event is contained in Appendix A. The reactor did not require any Safety-related Maintenance. Routine, annual reactivity measurements of core parameters were made in December, 1983, and do not significantly differ from data contained in previous reports of AGN-201 performance.

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 .087 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 eight independent audits were performed in various areas of facility operation and are listed in Section L.

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A. REACTOR OPERATING EXPERIENCE

1. Student Training Programs

Forty-three 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, 28 students from MSU's specialized on-campus Nuclear Skills Training Program performed reactor startups and related training exercises as part of the program's normal curriculum. A total of 531 reactor startups were conducted for purposes of student training.

2. Staff Operator Training

Eleven reactor startups were conducted for purposes of maintaining and evaluating licensed operator proficiency. As of December 31, 1983, the MSU Center for Nuclear Studies Staff held two Senior Operator and two Operator Licenses for the AGN-201 Reactor.

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

4. Operations Summary

<u>Month</u>	<u>Hours Critical</u>	<u>Max. Power (Milliwatts)</u>	<u>Month</u>	<u>Hours Critical</u>	<u>Max. Power (Milliwatts)</u>
Jan	50.27	54	Jul	42.72	43
Feb	16.77	44	Aug	22.87	45
Mar	0	0	Sep	0.88	50
Apr	0	0	Oct	17.82	48
May	3.97	52	Nov	28.02	49
Jun	16.63	52	Dec	15.68	50

TOTAL NUMBER OF REACTOR STARTUPS DURING 1983: 563

TOTAL HOURS OF CRITICAL OPERATION DURING 1983: 215.63

B. UNSCHEDULED REACTOR SHUTDOWNS

Ten unscheduled (non-training) reactor scrams were experienced during 1983. 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. However, one of the shutdowns was considered to be a reportable occurrence as defined in the facility license and a copy of the follow-up report for that event is contained in Appendix A.

CHANNEL 1 HIGH LEVEL TRIP (2).

On February 17 and again on December 16, 1983, high level trips occurred on the Channel 1 Neutron Flux Monitor due to operators not properly upranging the instrument while increasing reactor power. This channel employs an eight-step range switch and has a High Level Trip set at 90-95% of full-scale indication to prevent over-ranging the instrument. The highest power level corresponding to the maximum setting of this trip point is approximately 53 milliwatts.

CHANNEL 1 LOW LEVEL TRIP (3).

On January 4, January 26, and August 4, 1983, low level trips occurred on the Channel 1 Neutron Flux Monitor. The Low Level Trip for this instrument is set at 12-15% of full scale indication to ensure that an adequate source level is observed for reactor startup. Two of the trips resulted from setpoint drift (upscale to 17-20% fs) and the other resulted from vacuum tube failure in the high voltage supply to the Channel 1 Neutron Detector.

CHANNEL 3 LOW LEVEL TRIP (3).

On February 25 and twice on October 25, 1983, low level trips occurred on the Channel 3 Neutron Flux Monitor due to spurious electrical noise transients. The low level trip for this instrument is set at 5-10% of

full scale indication to ensure that an adequate source level is observed for reactor startup. The spurious noise transients were eliminated by thoroughly cleaning and drying the electrical contactor for the 20-step range switch used in Channel 3.

REACTOR PERIOD TRIP (1).

On October 21, 1983, a reactor period trip occurred from an electrical noise transient of unknown origin. The reactor was at a subcritical power level of less than one milliwatt in preparation for a training startup at the time of the transient. Attempts to reproduce the noise transient were unsuccessful and the period circuit and trip function tested satisfactorily.

LOSS OF ELECTRICAL POWER (1).

This unscheduled scram is described in Appendix A.

TRAINING.

Nineteen additional scrams were caused by trainees during the conduct of student training programs. Most of these trips resulted from improperly positioned instrument range switches during power level transients.

C. PREVENTIVE AND CORRECTIVE MAINTENANCE.

1. Safety Related Corrective Maintenance: None required.
2. Results of Major Surveillance Tests and Inspections:
 - a. Control Rod Drive Assembly Inspection and Lubrication.
This annual surveillance procedure was completed on December 2, 1983. The drive assemblies were found in satisfactory condition with no evidence of abnormal wear or deterioration.

- b. Measurement of Safety and Control Rod Scram and Insertion Times. This annual surveillance procedure was completed on December 8, 1983, with the following results:

	<u>Insertion (cm/sec)</u>	<u>Scram (m sec)</u>
Safety Rod No. 1	0.446	122
Safety Rod No. 2	0.471	104
Coarse Control Rod	0.397	120
Fine Control Rod	0.441	N/A

- c. Reactivity Measurements: This annual surveillance procedure was completed on December 16, 1984, with the following results:

<u>Parameter</u>	<u>% Reactivity</u>
------------------	---------------------

Control Rod Integral Worth:

Fine	0.322
Coarse	1.24

Reactivity Insertion Rate:

Safety Rod No. 1	.033/sec
Safety Rod No. 2	.034/sec
Coarse Control Rod	.029/sec
Fine Control Rod	.01/sec

Excess Reactivity (Glory Hole empty, 20°C, all rods IN)	0.198
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Shutdown Margin (Most reactive rod IN)	2.69
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D. CHANGES IN FACILITY DESIGN, PERFORMANCE CHARACTERISTICS, OR PROCEDURES RELATED TO REACTOR SAFETY

None.

E. CHANGES WHICH WOULD AFFECT THE FACILITY DESCRIPTION

None.

F. CHANGES TO ADMINISTRATIVE PROCEDURES

1. Revision 7 (2/83) to the AGN-201 Nuclear Reactor Facility Organization and Regulations Manual was approved and issued on February 25, 1983. This revision updated the Emergency Plan Notification List to reflect proper phone contacts and numbers.

2. Revision 3(3/83) to the AGN-201 Reactor Operations Manual was approved and issued on March 24, 1983. This revision incorporated editorial changes to Part I of the Manual (Description of the Reactor and Systems) and provided clarification of procedural steps and statements contained in:

Operating Procedure No. 3, Reactor Startup
Operating Procedure No. 4, Critical Operation
Operating Procedure No. 8, Radiation Monitoring Equipment
Emergency Procedure No. 4, Reactivity Excursions

The revisions were reviewed and approved by the Reactor Safety Committee and do not involve a change to the Facility Technical Specifications nor do they involve an unreviewed safety question as defined in 10 CFR 50.59.

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 19, 1983, 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.

Random wipes/smears of surfaces both inside and outside the reactor facility did not reveal any loose surface contamination above natural background levels.

The reactor was not operated at steady-state power levels above 54 milliwatts during 1983. 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 105 persons during 1983. The highest cumulative exposure for an individual was .087 Rem. The average exposure for the 105 individuals monitored was .0042 Rem.

2. Statistical Summary:

<u>Estimated Whole Body Exposure (Rems)</u>	<u>Number of Individuals In Each Range</u>
No measureable exposure	90
Measureable exposure less than 0.1	15
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 1983. 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 Emergency Plan (6-27-83)
 - b. Review of the Facility Radiological Controls Program and records (3-15-83)
 - c. Review of the Facility Security Plan (1-14-83)
 - d. An evaluation of the conformance of facility operation to the Technical Specifications (1-12-83)

- e. Review of the performance, qualifications, and training of the facility staff (1-11-83)
- f. Review of the results of actions taken to correct deficiencies that affect reactor safety (1-10-83)

2. American Nuclear Insurers (ANI)

Nuclear liability inspection including a review of various aspects of the MSU Safety Committee, Radiation Protection Program, Operations Program, Training Programs, and Emergency Planning Programs (6-8-83).

3. U.S. Nuclear Regulatory Commission (USNRC) - Region II

A routine, unannounced, safety inspection in the areas of Organization; Logs and Records; Review and Audit; Requalification Training; Procedures; Surveillance; Experiments; Followup on Previously Cited Noncompliance and Previous Unresolved Items (May 24-26, 1983. USNRC Region II Inspection Report 50-538/83-01).

APPENDIX A

FOLLOW-UP REPORT

TO

REPORTABLE OCCURRENCE NO. 83-1

APPENDIX A
(4 pps)



MEMPHIS STATE UNIVERSITY
MEMPHIS, TENNESSEE 38152

January 5, 1983

Center for Nuclear Studies
Office of the Director
(901) 454-2687

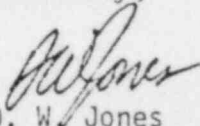
Director
Region II, USNRC
Office of Inspection and Enforcement
101 Marietta Street, Suite 3100
Atlanta, GA 30303

Dear Sir:

Enclosed is the follow-up report to a reportable event that occurred at the Memphis State University AGN-201 Nuclear Reactor Facility on January 3, 1983. The report is submitted in accordance with section 6.9.2 of Appendix A to Facility Operating License R-127, Docket No. 50-538.

An unscheduled momentary power outage occurred during reactor operation which directly caused reactor shutdown. Restoration of electric power service was completed in approximately 30-45 seconds and conditions returned to normal. Initial notification was made to your office by telephone and confirmed by mailgram on January 4, 1983.

Sincerely,


D. W. Jones
Director

RLD/mm

Enclosures: Follow-up Report to
Reportable Occurrence #83-1

cc: Mr. A. Hardin, USNRC, Region II
Dr. V. N. Oliphant, MSU
Dr. D. K. Holmes, CNS/RSC
Mr. R. L. Dietz, MSU/CNS
Mr. J. R. Caves, CNS
Mr. C. V. Holm, CNS
Mr. J. P. Williams, CNS

MEMPHIS STATE UNIVERSITY
AGN-201 NUCLEAR REACTOR FACILITY
LICENSE R-127, DOCKET NO. 50-538

FOLLOW-UP REPORT TO REPORTABLE OCCURRENCE NO. 83-1

Date of Report: January 5, 1983.
Date of Occurrence: January 3, 1983.
Date of NRC Notification: January 4, 1983.

1. Reactor.

AGN-201, Serial 108. Located at the Center for Nuclear Studies, Memphis State University, Memphis, Tennessee. Facility Operating License R-127, Docket No. 50-538.

2. Reportable Occurrence.

Electric power service to the Memphis State University Center for Nuclear Studies Facilities was unexpectedly interrupted. The unscheduled power outage occurred during AGN-201 reactor operation and, as a direct result of the event, caused reactor shutdown. Item 6.9.2.a.(7) of the Facility Technical Specifications applies.

3. Conditions at Time of Occurrence.

- a. An operator training program was in progress for the purpose of providing reactor startup experience for students from the Public Service Electric and Gas Company of New Jersey.
- b. The reactor was subcritical and a 1/M approach to critical was in progress. Control Rods were fully inserted (24 cm), Fine Control Rod at 10 cm, and the Coarse Rod was being inserted to increase the subcritical neutron level. Estimated margin to critical was approximately .03% reactivity at 19.1 °C.

4. Narrative.

A momentary loss of electrical power to the Center for Nuclear Studies Facilities occurred at 4:34 p.m. (CST) on January 3, 1983. The AGN-201 Reactor was being operated by a student under the direct supervision of licensed facility operators. At the time of the unscheduled event, the operator was inserting the Coarse Control Rod to increase the subcritical neutron level as part of a reactor training startup procedure using a 1/M approach to criticality. The reactor was subcritical by approximately .03% reactivity.

The reactor scrammed, as designed and required by the Facility Technical Specifications, due to loss of Reactor Control Power which interrupted electrical current to the Control Rod Holding Magnets. The Fine Control Rod (no scram function) remained inserted to 15 cm. and the Safety and Coarse Rod Magnet Assemblies remained at the pre-scram positions.

Approximately 30-45 seconds later, at 4:35 p.m. (CST), the electric distribution feeder system was restored to normal. The Senior Operator reenergized Reactor Control Power to allow the Fine Control Rod and the Holding Magnet Assemblies to be returned to their fully withdrawn positions. The reactor was secured at 4:44 p.m. (CST). Subsequent control and instrumentation checks revealed no abnormalities as a result of the power failure.

The Reactor Supervisor and the Facility Director were notified. The event was reported to the USNRC Region II Office of Inspection and Enforcement (Mr. A. Hardin, via telephone and confirmed by mailgram on January 4, 1983, in compliance with section 6.9.2 of the MSU Facility Technical Specifications.

5. Safety Significance of the Occurrence.

None. A loss of electrical power de-energizes the Safety and Coarse Control Rod Holding Magnets causing a reactor scram and thus assures safe and immediate shutdown in case of a power outage. Reactor systems performed as designed and as required by technical specification 3.3.

6. Cause of Failure.

The momentary interruption of electrical power was caused by a power perturbation of unknown origin on the main distribution feeder to the Center for Nuclear Studies which is maintained by the Memphis Light, Gas and Water Company.

7. Corrective Action.

None. Corrective action to restore and maintain the South Campus electric service feeder is under the cognizance and control of organizations outside the Center for Nuclear Studies and the AGN-201 Reactor Facility.

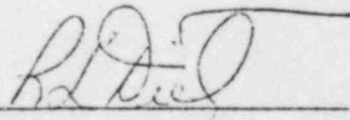
8. Measures to Prevent Recurrence.

None. Measures to prevent recurrence of an electric power outage of the nature described in this report are not within the capabilities of the Center for Nuclear Studies or AGN-201 Reactor Facility staff.

9. Similar Reportable Occurrences.

MSU Follow-up Reports: #79-1 (1/29/79), #79-2 (3/10/79), #81-1 (6/11/81).

Prepared by:


Reactor Supervisor



MEMPHIS STATE UNIVERSITY
MEMPHIS, TENNESSEE 38152

March 19, 1984

Center for Nuclear Studies
Office of the Director
(901) 454-2687

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

Attention: Document Control Desk (DCD)

Gentlemen:

Subject: Facility Operating License
R-127, Docket 50-538

Copies of the Memphis State University 1983 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
Director

DWJ:RLD/mrm

Enclosures - (12 copies)

cc: Mr. R. L. Dietz

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