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U.S. Nuclear Regulatory Commission
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Gentlemen:

Attached is the Annual Operating Report for the Idaho State University AGN-201 Nuclear Reactor, License R-110, Docket No. 50-284, for the calendar year 1993.

Respectfully submitted,

R. David Clovis

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Reactor Supervisor

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IDAHO STATE UNIVERSITY
REACTOR ANNUAL OPERATING REPORT
FOR 1993

1. Brief Narrative of Changes:

   a. There were no changes to the facility design or performance characteristics relating to reactor safety during this reporting period. There were changes to Experimental Procedure #19, the General Operating Rules, and the Procedure Authorization form for the facility, but none of these changes decreased the effectiveness of reactor safety.

   b. Results of major surveillance tests and inspections.

      1) Channel tests on all safety channels were performed and all scram interlocks were tested and found to be satisfactory and within specification.

      2) Power and period calibrations were performed with satisfactory results.

      3) The shield tank was inspected and no leaks or excessive corrosion were noted.

      4) a) The control rod drive mechanisms were inspected and tested with satisfactory results.

         b) Scram times were measured and found to be less than 120 milliseconds.

         c) Control and safety rod worths and run-up times were measured; and from these values the reactivity insertion rates were determined to be less than 0.058% per second for any rod.

         d) The shutdown margin was determined to be greater than 1.68% with the most reactive rod fully inserted.

2. The total operating time for the reactor during 1993 was nearly 134 hours with a total thermal energy output of approximately 103 watt-hours. The monthly breakdown of operation time follows:

Month	Hours	Month	Hours
January	6.1	July	3.0
February	8.5	August	8.0
March	8.8	September	31.7
April	16.5	October	23.2
May	3.0	November	12.3
June	0.0	December	13.2

3. Unscheduled shutdowns:
There were no unscheduled shutdowns.

4. Safety related maintenance included the following:

   a. Various electronic tubes were replaced in the Nuclear Instrument (NI) Channel #2 circuitry and the Safety Chassis circuitry. The High Voltage Power Supply's for NI Channel #2 and NI Channel #3 were replaced by a dual high voltage power supply. The hydraulic dashpot for Safety Rod #1 was replaced.

5. Changes to the Facility:

   a. There have been no changes to the facility as described in the application for license.

   b. There were changes to the procedures as described in this facility's Technical Specifications. As described in Part 1.a of this report, the Experimental Procedure #19, the General Operating Rules, and the Procedure Authorization form were revised and are attached to this report.

   c. No new or untried experiments or tests were performed during the reporting period.

6. There is one summary of a safety analysis being submitted at this time, because there was a change to Experimental Procedure #19 during the 1993 calendar year. This analysis is attached to the copy of the revision to Experimental Procedure #19.

7. No radiation effluents were released or discharged to the environment during 1993.

8. Neutron and beta/gamma radiation surveys performed on the exterior walls of the facility indicated that maximum combined contact radiation levels were less than 2 mrem/hr.

9. No person using the facility received a whole body exposure of greater than 100 millirem during 1993.

OPERATION OF THE REACTOR

The purpose of this section is to describe the proper procedures for routine operation of the AGN-201 reactor. The general operating rules that are presented shall be followed by all operators.

GENERAL OPERATING RULES

1. The Reactor Supervisor or Reactor Administrator are the only persons who my grant explicit permission for each operation of the reactor. Each operation must follow detailed operating procedures.

2. Only persons who hold an SRO license are authorized to have keys to the console power switch. Power must be turned on by the SRO, the key removed from the switch and retained by the SRO.

3. The reactor may not be operated at power levels greater than those authorized for the particular experiments in progress and never at power levels greater than five watts.

4. The excess reactivity of the reactor, including the effect of any installed experiments or equipment, shall not exceed 0.55%. If the actual excess reactivity measured at startup exceeds 0.55%, the reactor shall be shutdown immediately and the Reactor Supervisor notified.

5. At least two persons must be present in the Nuclear Reactor Laboratory whenever the reactor is in operation. At least one of those persons, who will be the person in charge, must hold a valid Reactor Operator (RO) or SRO license.

6. During operation an authorized operator must remain at the console at all times and devote his or her full attention to operation of the reactor.

7. The above mentioned authorized operator need not be licensed by the USNRC provided he or she has been trained to the satisfaction of the Reactor Supervisor and operates the reactor under the direct supervision of a licensed operator.

8. No material of any kind may be inserted into or removed from any of the experimental facilities of the reactor, either prior to or during operation, without explicit authorization and approval of the NRC licensed operator in charge.

9. Any person desiring access to a High Radiation Area must inform the licensed reactor operator of the reason for entry. The operator will provide information on the expected radiation level, provide a portable radiation monitor which must [illegible] entry, and grant permission if appropriate.

10. In case of any unusual or unexpected incident (such as instrument failure or malfunction, abnormal instrument readings, mechanical problems, etc.) the reactor will be immediately shutdown and the Reactor Supervisor informed prior to any further operation.

11. Performance of any maintenance procedure, surveillance procedure, calibration procedure, or a procedure which opens either the primary or secondary containment barrier must have explicit authorization of the Reactor Supervisor and be performed under the supervision of an SRO.

12. Personnel monitoring devices shall be worn by all persons in the Reactor Laboratory whenever the reactor is in operation or when reactor maintenance is being performed.

13. Whenever the Reactor Laboratory is to be left unattended the reactor shall be shutdown and the laboratory door locked with the dead bolt.

IDAHO STATE UNIVERSITY
AGN-201M
PROCEDURE AUTHORIZATION

PROCEDURE ____________________

IDENTIFICATION NUMBER ____________ REVISION ____________

SUBMITTED BY ____________________ DATE ____________

10 CFR 50.59 UNREVIEWED SAFETY QUESTION: ________ YES ________ NO

REACTOR SUPERVISOR REVIEW: ____________________

DATE ____________

REACTOR ADMINISTRATOR APPROVAL ____________________

DATE ____________

REACTOR SAFETY COMMITTEE APPROVAL: ____________________
REACTOR SAFETY COMMITTEE CHAIR

DATE ____________

COMMENTS:

EXPERIMENT NO. 19

SAMPLE TRANSFER BY PNEUMATIC TUBE

Introduction:

In order to analyze irradiated samples efficiently, a pneumatic sample transfer system has been installed to allow transfer of a sample from the isotope lab into the core of the AGN-201 reactor for irradiation and back into the counting room after irradiation for analysis.

The transfer system is constructed of polyethylene tubing, and the propulsion gas is nitrogen. The sample holder is also made of polyethylene and will hold a sample not more than 1.33 cm in diameter and 5 cm long. The transfer system layout is shown in figure 1.

Administrative Control:

The reactor operator must have the final control of the transfer system since sample transfer will change the reactivity in the reactor. Since the experimenter will be in the isotope lab, a communication system is installed between the isotope lab and the reactor console.

The sequence of events for an irradiation is referred to as a "transfer cycle" and consists of the following steps:

1. The operator informs the experimenter that the agreed on power has been reached.
2. The experimenter initiates a ten second count down. Either the operator or the experimenter may stop a countdown by requesting a "hold".
3. At time zero in the count down the experimenter will open the send gas valve to the "send" position to transfer of the sample into the reactor.
4. The operator will acknowledge that the sample is in the reactor and move the control rods to maintain the proper power level.
5. Upon receiving the acknowledge message, the experimenter will move the send valve to the "vent position to relieve system pressure.
6. Ten seconds prior to the time for removal of the sample the experimenter will initiate a second count down.
7. If the reactivity change upon removal will be positive, the operator will lower the control rods during the count down.
8. At time zero in the count down, the experimenter will open the return gas valve to the "return" position to transfer the sample back to the counting system.
9. The experimenter will inform the oper[illegible] sample has reached the counting [illegible] return valve to the [illegible]

Procedure:

1. Adjust the excess reactivity of the reactor by removing one graphite reflector cylinder from reflector port #3. (IMPORTANT: Read the Safety Analysis section following the Procedure .)

2. Install the sample transfer tube into the reactor.

3. Initiate a transfer cycle to test the transfer system.

4. Start up the reactor in the normal manner and bring to a power level of 0.1 watts or less. Take care to ensure that the excess reactivity is less than 0.55%

5. Determine the reactivity change caused by insertion of the sample if the change is not already known by the following action:

   a) Stabilize power level at 0.1 watts or less with the sample out of the reactor.
   b) Record position of Fine Control Rod (FCR) & Course Control Rod (CCR).
   c) Initiate a transfer cycle to insert the sample.
   d) Stabilize the power level by moving the F.C.R. only if possible.
   e) Record the new position of F.C.R. and C.C.R.
   f) Terminate the transfer cycle to remove the sample.
   g) Determine the reactivity change induced by the sample from the control rod calibration curves.

6. Adjust the reactor operation power to the desired level but not to exceed the limits based on the induced sample reactivity change as given below:

$\Delta\rho$ %	Max Power (watts)
$-0.30<\Delta\rho<-0.15$	2
$-0.15<\Delta\rho<-0.10$	3
$-0.10<\Delta\rho<0.10$	4
$0.10<\Delta\rho<0.15$	3

7. Initiate the transfer cycle to irradiate the sample.

8. If no more samples are to be irradiated, secure the reactor. If additional samples are to be irradiated go back to step 4.

Safety Analysis:

The transfer system is be made of polyethylene and the polyethylene tubing is extended through the center of the reactor core. The inner diameter of the transfer tube is 0.625 inch and the outer diameter is 0.875 inch. From previous it has been determined that inserting this much polyethylene in the glory hole increases the excess reactivity by 0.216%. Since the excess reactivity without the tubing is about 0.36% at 15° C, the excess reactivity with the tubing inserted (and no other changes) would exceed the administrative limit of 0.55%. Therefore, it will be necessary to reduce the excess reactivity prior to inserting the tubing.

The reduction may be accomplished most easily by removing one of the graphite reflector cylinders from reflector port #3. This removal reduces the excess reactivity by 0.18% so that the excess reactivity at 15° C will be 0.40%. Further, since the small sample holder, even when filled with fuel, will not add more than 0.05% reactivity so the administrative limit of 0.55% will not be exceeded.

NOTE: RETURN ALL OF THE SHIELD PLUGS TO PORT #3 AFTER REMOVAL OF THE GRAPHITE. MAKE SURE THAT THE INNER LEAD SHIELDS AND THE WOODEN PLUG ARE NOT PUSHED IN FARTHER THAN NORMAL. IF THEY ARE PUSHED IN TOO FAR, A VOID SPACE WILL NOT BE LEFT WHERE THE GRAPHITE WAS AND THE REACTIVITY DECREASE WILL NOT BE AS LARGE AS EXPECTED.

The outer lead shields will not fit into the inner part of the reflector port and will, thus, keep anyone from inadvertantly pushing the wooden plug in farther.

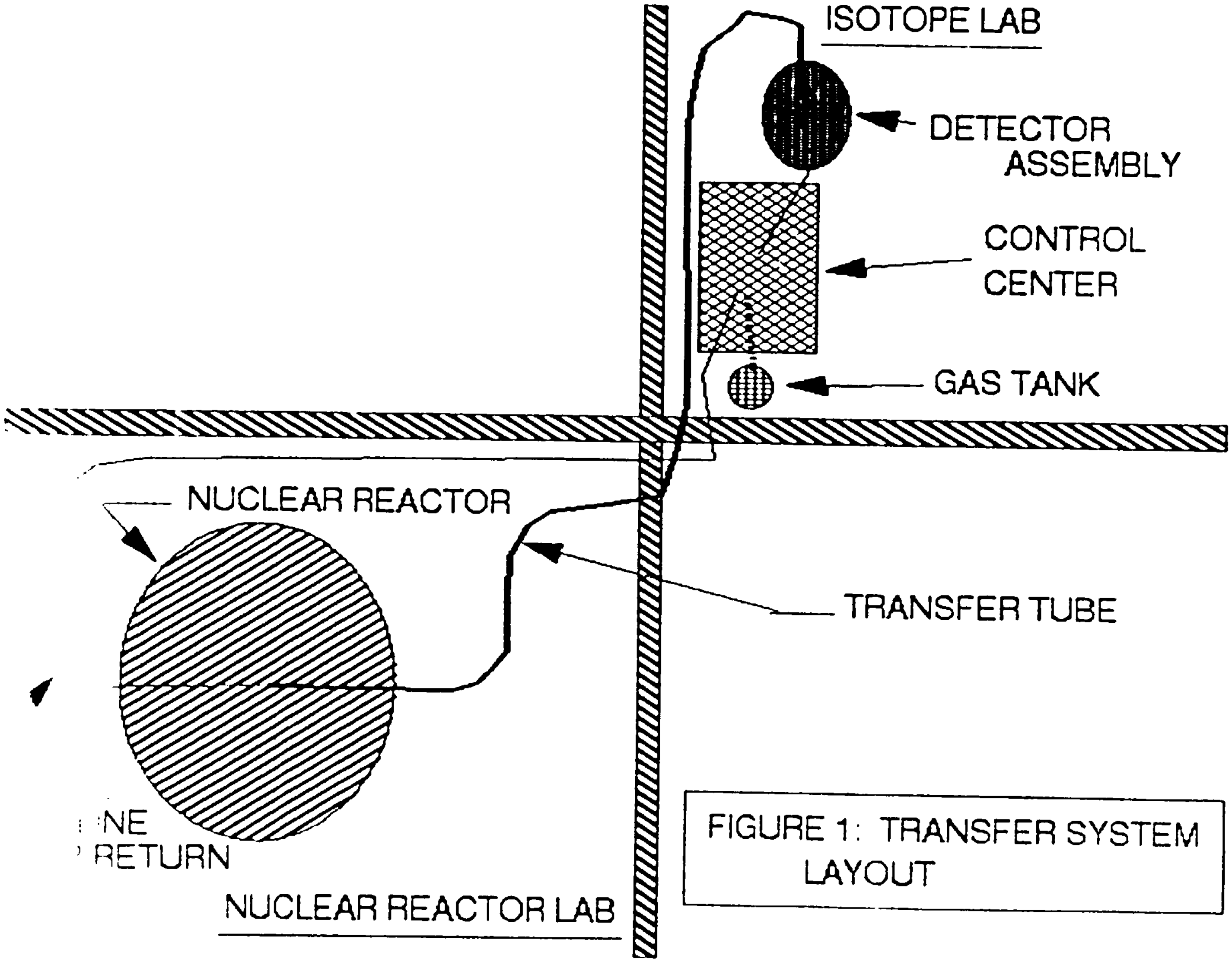

FIGURE 1: TRANSFER SYSTEM LAYOUT