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Special

OPERATING PROCEDURE FOR THE BULK SHIELDING FACILITY

F. C. Maienschein
K. M. Henry

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OPERATING PROCEDURE FOR THE BULK SHIELDING FACILITY

During the five-year operation of the Bulk Shielding Reactor at Oak Ridge National Laboratory, a routine operating procedure has been developed. As experience indicates changes that should be incorporated, the procedure is revised. This is the third edition of the procedure, and all reactor operators at the BSF must be thoroughly familiar with it.

I. Authorized Personnel for Reactor Operation

Appendix A contains the current list of reactor supervisors and operators. This list may be modified as changes in personnel occur. Any new operators or supervisors will be approved by F. C. Maienschein or K. M. Henry.

A reactor supervisor for the BSF has the responsibility for the operation and safety of the Bulk Shielding Reactor. In the event of an emergency connected with the reactor in any way, the reactor supervisor has the responsibility and authority to take the proper remedial action. An emergency is defined as any reactor abnormality which cannot be corrected by the controls on the reactor console.

One of the supervisors listed in Appendix A will usually be at the BSF during reactor operations. For routine operations, the reactor may occasionally be left with a reactor operator. In such a case, the operator will act as a supervisor. All unusual operations, however, will require the presence of a supervisor. Unusual conditions are described in Sections III and IV.

II. Standard Operating Procedure for Startup and Steady Operation

Startup will be carried out by one of the reactor operators or supervisors. The detailed procedure to be followed is described in Appendix B. When operation at a steady power level has been achieved, the level will be announced over the BSF public address system. The fission chamber monitor may then be connected with the P-A system and the operator may work elsewhere within the Bulk Shielding Facility.

III. Standard Operating Procedure for Reactor Loading

A new loading for the BSR will be undertaken only when two or more supervisors are present. However, a single supervisor plus an operator may load a known configuration. Chamber tests, Appendix E, will be performed by the supervisor in attendance.

Whenever a new loading is required by an experimental arrangement, the reactor frame (unloaded) will be positioned. Then as fuel elements are added the approach to criticality will be carefully determined by the method of subcritical multiplication. The excess reactivity will be limited to that required by the operating conditions of the experiment and will usually be much less than the maximum specified by the Reactor Safeguard Committee.

Whenever experimental apparatus is placed against the reactor in such a manner as to significantly reduce the reactivity, the fuel added to maintain criticality will be unloaded before the reactor is left unattended.

IV. Standard Operating Procedure for Moving Reactor Bridge

The reactor bridge will be moved only under the direction of one of the reactor supervisors. The key to the reactor bridge will be handled in the same manner as the reactor controls key (see Appendix B). The reactor will be partially unloaded whenever it is moved into a position which changes the reflector adjacent to the reactor.

V. Emergency Operating Procedure

Whenever the operator is in doubt about the safety of further reactor operation he should scram the reactor. Unnecessary scrams are not prohibitively expensive for this reactor so the operator should not hesitate to scram the reactor. Scram buttons are located in the positions listed in Appendix C. A list of typical conditions that might require an operator scram is given in Appendix D.

Scramming the reactor is the only emergency procedure normally available during reactor operation. During critical experiments, however, the person adding fuel elements to the reactor retains physical control of the element until notified by the operator at the console that the element may be released. Thus, until this notification is given at the console, the element may be jerked from the reactor as an emergency procedure. Such an action would be dictated by one of the two reactor supervisors on duty during such experiments.

After any scram for emergency reasons, the operator should notify the senior reactor supervisor and should not operate the reactor again until given a clearance by the supervisor. On a night shift when a reactor operator is in charge of the reactor, he should not start up again unless the cause of the conditions leading to the scram are completely understood. This procedure should be followed for either an operator or an instrument scram.

Appendix A

Reactor Supervisors and Operators

The following persons are designated as reactor supervisors:

F. C. Maienschein	Phone 5-3805, Oak Ridge
K. M. Henry	Phone 5-1544, Oak Ridge
E. B. Johnson	Phone 5-6429, Oak Ridge

The following persons are designated as reactor operators:

J. N. Anno

T. A. Love

E. G. Silver

Appendix B

Reactor Startup Check List

To take the reactor critical, the operator should follow the procedure outlined below. If any instrument or circuit is not functioning in accordance with this procedure, the reactor is not to be taken critical.

1. Check gas cylinder gauges to insure an adequate supply of gas. (Cylinders may be changed during a run without reactor shutdown.)

2. Observe gas flow at reactor console, it must be $>$0.25 cu ft/hr for all chambers.

3. Calibrate log N meter:

(a) Turn selector switch from "operate" to "ground" position. Log N meter should read 0.0001 (extreme left black mark on meter dial). To change meter pointer position, turn adjustment marked "ground."

(b) Turn selector switch to "Lo calibrate." The meter pointer should now be aligned with the Lo calibrate red mark on the left side of meter face. To correct meter pointer position, turn adjustment knob marked "calibrate."

(c) Turn selector switch to "Hi calibrate." The meter pointer should now be aligned with the Hi calibrate red mark on the right side of meter face. To correct meter pointer position, turn adjustment control marked "gain."

Note: If adjustment is needed in any position, the whole procedure (a,b,c) should be repeated until the meter shows correct readings. Return selector switch to "Operate" position.

4. Check interlocks: Indicator light should be on; if not,

(a) Ascertain that all rods are at low limit.

(b) Check to see if bridge monitron power is on and radiation indication is below the scram level.

(c) Push scram button to energize holding relay in the circuit.

5. Insert key (key furnished only to approved operating personnel) in lock and turn on power.

6. Check to see that the voltages of the ionization chamber power supplies are within the operating range and that magnet supplies indicate current flow.

7. Turn on instrument recorders.

8. Calibrate fission chamber log count rate meter: Turn switch to "calibrate" position and adjust gain until recorder indicates 60 counts/sec. Return calibrate switch to "use" position.

9. Make sure fission chamber is in the "down" position and recorder is indicating at least 2 counts/sec. If counting rate is below the required level, investigate neutron source position.

10. Test scram circuits:

(a) Check each sigma amplifier by raising the safety rods independently about 1 in. and inserting a small probe into the hole marked "scram" on the sigma amplifiers.

(b) Turn log N switch to "ground."

(c) Raise each rod about 1 in. by means of rod interlock bypass switch. Push scram test button; period sigma should scram.

(d) Return selector switch to "operate" position.

(e) Raise rods about 1 in. again and depress red scram button on console; both rods should drop.

11. Check microammeter: Be sure multiplier is on lowest position and external shunt switch is on Position 1.

12. Check servo potentiometer: Set demand helipot for desired scale reading on Brown recorder (calibration curve posted above control).

13. Take reactor critical as follows:

(a) Announce over the public address system that the reactor is being taken critical.

(b) Check critical experiment data in reactor log book for particular loading in use to determine safety rod positions. Then carefully pull safety rod to the predetermined position, watching fission chamber recorder reading for any indication of criticality. Pull regulating rod until fission chamber count rate meter indicates a slight period. When the chambers have been withdrawn for 1-megawatt operation, the fission chamber will give the best initial level indication. Above 0.1 watt, the period meter, the log N recorder, and the recorder on the microammeter should indicate a power increase. Always determine the period from all three of these instruments -- never from just the period meter. A 20- to 30-sec period is normally sufficiently fast to bring reactorup to power.

(c) After proper power level is reached put reactor on "servo." Adjust fission chamber count rate to about 1 register per second and connect to public address system. Announce the reactor power.

14. Write on Brown charts the date, time, experiment number, run number, and scale factor.

15. Record same data specified in No. 14 in reactor log.

16. Fill out reactor log sheets at hourly intervals.

Appendix C

Location of Scram Buttons for BSR

Class A Scram

On the reactor console (only red button).

Class B Scram

Room 100, pool room, 2 large red buttons on both east and west walls.

Room 101, laboratory room, 1 red button in black box.

Room 104, instrument room, 1 red scram button and 1 black scram reset in black box.

Room 201, upstairs at north stairway, 1 red button in black box.

Room 203, upstairs at south stairway, 1 red button in black box.

Bldg. 3080, storage room, 1 red button in black box.

All operators should locate and memorize the positions of all of these scram buttons.

A Class A scram removes the A-C regulated power from the control rod magnet power supplies. These supplies may be reactivated by pushing the scram button on the console.

A Class B scram removes the A-C regulated power supply from the reactor. This power may only be restored by pushing the scram reset in Room 104.

Appendix D

List of Conditions That Might Require an Operator Scram

The most probable conditions calling for a reactor scram lead to an automatic instrument scram. However, the following are examples of situations that might lead to an operator scram.

Person falling in pool.

Building evacuation for any reason.

Erratic readings of magnet amplifier current.

Oscillations of increasing magnitude showing on servo recorder.

Appendix E

Control and Safety Chamber Tests

The reactor chambers are normally located at one of three distances from the core. The three positions are:

1. Fully Inserted. This position is used when the reactor is to be operated at a fraction of a watt power level or when critical tests are being executed.

2. 100-kw Position. This power position is factual only when it monitors loading 33; with other loadings it is a relative power indication.

3. 1-Mw Position. The statements made for position 2 are applicable.

Control Chambers

The control chambers must be checked for compensation after each change of either fuel or chamber position. The linearity of response should be checked by comparison with the response of the reactor fission chamber. The compensation should be adjusted to give a parallel slope for the response of the two chambers. The period response is then checked by scramming the reactor with a 4-sec period when this can be achieved without exceeding the maximum power level for the core.

Safety Chambers

The safety chambers, when located in either the fully inserted or 100 kw position, are used to scram the reactor on power excursions.

When the BSR has "hot" fuel in the core, the excursion will be produced by increasing the power on a long period. The chamber output, as noted on the sigma amplifier, should be compared against the excursion power level. The chambers are checked independently only if there is a large difference of sigma amplifier voltage readings. When "cold" fuel is in the core, an excursion cannot be produced without exceeding the operating level of the cold fuel.

When the chambers are in the 1-Mw position, the sigma amplifier readings are to be compared to the power level as before. However, unlike the test in the previous paragraph, the reactor cannot be scrammed by an excursion without exceeding the approved maximum power of 1 Mw.