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POLICIES AND PRACTICES PERTAINING TO THE SELECTION, QUALIFICATION REQUIREMENTS, AND TRAINING PROGRAMS FOR NUCLEAR-REACTOR OPERATING PERSONNEL AT THE OAK RIDGE NATIONAL LABORATORY

W. H. Culbert

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Prepared by the
Oak Ridge National Laboratory
Oak Ridge, Tennessee 37831
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Martin Marietta Energy Systems, Inc.,
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ABSTRACT

This document describes the policies and practices of the Oak Ridge National Laboratory (ORNL) regarding the selection of and training requirements for reactor operating personnel at the Laboratory's nuclear-reactor facilities. The training programs, both for initial certification and for requalification, are described and provide the guidelines for ensuring that ORNL's research reactors are operated in a safe and reliable manner by qualified personnel. This document gives an overview of the reactor facilities and addresses the various qualifications, training, testing, and requalification requirements stipulated in DOE Order 5480.1A, Chapter VI (Safety of DOE-Owned Reactors); it is intended to be in compliance with this DOE Order, as applicable to ORNL facilities. Included also are examples of the documentation maintained amenable for audit.

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W. H. Culbert

DEFINITIONS

Certification: The formal process of reviewing and approving an individual's qualifications, by Oak Ridge National Laboratory's (ORNL's) upper management, to operate the controls of an ORNL reactor and/or the controls of a reactor's auxiliary systems. ("Certification" for reactor operating personnel at ORNL, under DOE jurisdiction, shall be considered equivalent to the "licensing" of operators at the nuclear reactors under the jurisdiction of the NRC.)

Solo Operation: The operation of certain controls and/or equipment by an individual without the need for supervisory surveillance or without the presence of a certified operator as a backup at the facility.

Reactor Facility: The reactor facility includes the reactor building and any auxiliary buildings providing some function in the operation of the reactor (e.g., electrical building, chemical treatment building, office building, etc.).

Nuclear Reactor: Any apparatus that is designed or used to sustain nuclear chain reactions in a controlled manner, including critical and pulsed assemblies and research, test, and power reactors.

Critical Experiments Facility: A special facility located at the Y-12 Plant at which shutdown margin tests are performed on new HFIR fuel elements. Since the facility is designed to perform both subcritical and critical experiments, it shall be considered a nuclear reactor.

Senior Reactor Operator: An individual certified by Martin Marietta Energy Systems, Inc., upper management to direct the activities of reactor operators at an ORNL reactor facility. Senior Reactor Operators are the supervisors; however, they must also be certified as Reactor Operators.

Reactor Operator: An individual certified by Martin Marietta Energy Systems, Inc., upper management to operate the controls and/or auxiliary equipment of a nuclear reactor at ORNL. Their official title at ORNL is "Nuclear Reactor Controllers"; however, to coincide with the more universally recognized terminology, "Reactor Operator" will be the preferred usage in this document.

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ACRONYMS

A/EOI - Abnormal/Emergency Operating Instructions
ANP - Aircraft Nuclear Propulsion
ANS - American Nuclear Society
ANSI - American National Standards Institute
ALARA - As low as reasonably achievable
BSR - Bulk Shielding Reactor
CAM - Constant Air Monitor
CEF - Critical Experiments Facility
CPR - Cardio-Pulmonary Resuscitation
CC - Criticality Committee
DOE - U.S. Department of Energy
DOE-ORO - U.S. Department of Energy - Oak Ridge Operations
DOSAR - Dosimetry Application Research
DSO - Division Safety Officer
ECC - Emergency Control Center
FSAR - Final Safety Analysis Report
FEMA - Federal Emergency Management Agency
FFED - Faulty Fuel Element Detector
FRCAS - Facility Radiation and Contamination Alarm System
GED - General Education Development
HASRD - Health and Safety Research Division
HFIR - High Flux Isotope Reactor
HPERC - High Pressure Equipment Review Committee
HPRR - Health Physics Research Reactor
I&C - Instrumentation and Control
INPO - Institute of Nuclear Power Operation
JTA - Job Task Analysis
LERAC - Laboratory Emergency Review and Advisory Committee
LITR - Low Intensity Test Reactor
MTR - Materials Testing Reactor
NRC - U.S. Nuclear Regulatory Commission
ORNL - Oak Ridge National Laboratory
ORR - Oak Ridge Research Reactor
P&E - Plant and Equipment
PPM - Policy Procedure Manual
QA - Quality Assurance
RCO - Radiation Control Officer
REAC/TS - Radiation Emergency Assistance Center/Training Site
RERC - Reactor Experiment Review Committee
RO - Reactor Operator
ROC - Radiation Operations Committee
RORC - Reactor Operations Review Committee
RWP - Radiation Work Permit
SAR - Safety Analysis Report
SNM - Special Nuclear Materials
SPERT - Special Power Excursion Reactor Test
SPP - Standard Practice Procedures
SRO - Senior Reactor Operator
TRU - Transuranium
TSR - Tower Shielding Reactor
TSRC - Transportation Safety Review Committee
TVA - Tennessee Valley Authority
UOR - Unusual Occurrence Report

2. OVERVIEW OF THE REACTOR FACILITIES

2.1 ORGANIZATION

The Oak Ridge National Laboratory (ORNL), operated by Martin Marietta Energy Systems, Inc., is a unique DOE research facility. Over 40% of the 5,500 employees have college degrees; there are nearly 900 Ph.D-level scientists and nearly the equivalent number of visiting scientists using the ORNL research facilities.

There are 29 divisions at ORNL, one being the Operations Division in which over 300 persons are employed. One of the Sections in the Division is the Reactor Operations Section. (Refer to the Operations Division Organization Charts in Appendix A.) In this Section, there are approximately 50 people, most of whom are required to be certified as Reactor Operators or supervisory Senior Reactor Operators.

2.2 OPERATING AND OTHER PERSONNEL AT THE ORNL REACTOR FACILITIES

2.2.1 Introduction

The Category-A reactors (i.e., reactors having a steady-state power level of 20 MW or above) are operated on a 24-hours-per-day basis; the Category-B reactors (i.e., reactors operating below 20 MW) are normally operated only on the day shift. All Category-A facilities are required to have a minimum operating staff of two certified Reactor Operators and one certified Senior Reactor Operator. Normally, however, there are more operators on duty on the day shifts at the Category-A facilities, and there are many other people, from other divisions, that have access to the reactor buildings in order to perform some type of job-related activity. To give an overview of all the personnel working at a nuclear-reactor facility, these individuals are identified by title in this section. All persons having access to a reactor building are required to have the general employee training. (For a summary of the staffing status of the ORNL reactors, refer to Appendix A.)

2.2.2 Operations Division Personnel

Certain Operations Division personnel and/or Reactor Operations Section personnel are responsible for the management and safe operation of the reactor facilities at ORNL. These individuals and their responsibilities are listed below. For a more detailed listing of the responsibilities of certain key personnel in the Operations Division, refer to the Position Task Analyses in Appendix A.

2.2.2.1 Operations Division Director

The Director of the Operations Division is the highest level in the ORNL management required to certify an individual to operate a reactor or direct the activities of others at an ORNL reactor facility. (Upon the finalizing of the certification process, a plaque, with the signature of the Laboratory Director affixed, will be prepared for the individual and placed on display adjacent to the reactor control room to give recognition to the individual's achievement. The Laboratory Director, however, is not involved in the actual certification process.)

2.2.2.2 Reactor Operations Section Head

The Section Head is directly responsible for the safe operation of all the reactor facilities at ORNL; he/she reports to the Division Director. This position is the first level of upper management in which certification shall not be required; general employee training is required, however.

2.2.2.3 Reactor Supervisor

A Reactor Supervisor is the highest level of supervision at a reactor facility; he is the plant manager and is responsible for the safe operation of the facility. He/she reports to the Reactor Operations Section Head. There is one Reactor Supervisor for each facility. This is the highest level of management required to be certified as a Senior Reactor Operator. Above this level, the requirement is not practical since the next line of management, i.e., the Reactor Operations Section Head is responsible for all reactor facilities at ORNL.

2.2.2.4 Assistant Reactor Supervisor

An Assistant Reactor Supervisor is an individual who has some administrative responsibilities and would normally serve in a dual capacity (e.g., he/she may serve as a Training Manager or Maintenance Manager). There is one for each Category-A reactor facility; he/she reports to the Reactor Supervisor. The individual is required to be certified as a Senior Reactor Operator.

2.2.2.5 Maintenance Coordinator/Manager

A Maintenance Coordinator/Manager schedules and coordinates maintenance-type work with the Instrumentation and Control (I&C) or Plant and Equipment (P&E) Division personnel. This will normally be a dual-capacity-type job. The individual is required to be certified as a Senior Reactor Operator. The Maintenance Managers, one for each facility, report to the Assistant Reactor Supervisor.

2.2.2.6 Techical Manager

A Technical Manager is any supervisor, at any level of management, to whom technical personnel, with assignments at a reactor facility, report. The Technical Managers report either to the Division Director or to the Technical Section Head. The Technical Section Head is in charge of the Critical Experiments Facility. The Technical Managers are not required to be certified; however, the general employee training is required for reactor-facility access.

2.2.2.7 Technical Personnel

Technical personnel are those responsible for conducting periodic operational-type tests, monitoring reactor performance, performing certain engineering and technical tasks, and/or serving in the capacity as a technical advisor on call (via radio) at a reactor facility. A technical person is not required to be certified as a Senior Reactor Operator unless his/her supervisor feels that the level of knowledge needed to perform certain projects would be acquired by going through the operator training program. Hence, some technical personnel are certified as Reactor Operators and Senior Reactor Operators; all must have the general employee training for reactor-facility access.

2.2.2.8 Experiment Coordinator

The Experiment Coordinator ensures that an evaluation has been made of all experiments to be irradiated in a reactor facility. He/she reports to the Technical Section Head. General employee training is applicable for reactor-building access.

2.2.2.9 Training Coordinator

The Training Coordinator is an individual independent of the Reactor Operations Section who informs the Training Managers of the DOE training requirements, industry standards, and other training-related matters. He/she reports to the Section Head of the Division's Technical Support group. The Training Coordinator is not required to remain certified; however, he/she should have been certified as a Senior Reactor Operator at one time on at least one of the ORNL reactor facilities. This is a dual-capacity job; normally, the Training Coordinator will also be the Examiner. General employee training is applicable.

2.2.2.10 Training Manager

The Training Managers (one at each facility) are responsible for implementing the various Reactor Operator and Senior Reactor Operator training programs. Although they will do a majority of the teaching, they can utilize members of the technical or operating staff to assist as instructors. This is a dual-capacity-type job. Training Managers are required to be certified as Senior Reactor Operators.

2.2.2.11 Instructor

Instructors are individuals who have expertise in specialized fields and conduct classes upon request of the facility's Training Manager. All instructors are not required to be certified as operators; however, general employee training is applicable for reactor-facility access.

2.2.2.12 Examiner

The Examiner prepares, administers, and evaluates the written, oral, and operating examinations required for certification at all the ORNL reactor facilities. He is independent of the Reactor Operations Section and reports to the Head of the Technical Support Group. Although maintaining certification status is not mandatory, certification as a Senior Reactor Operator is recommended on at least one of the ORNL reactor facilities. This is normally a dual-capacity job; the Examiner will also serve in the capacity of the Training Coordinator for the Reactor Operations Section. General employee training is required for building access.

2.2.2.13 Senior Reactor Operator (SRO)

Senior Reactor Operators are the qualified supervisory personnel (one in charge of each shift); they direct the activities of the Reactor Operators and report to a day-shift supervisor or the Assistant Reactor Supervisor. In some cases, technical-support personnel are certified SROs. In addition, several Reactor Operators are certified as SROs although they do not perform in a supervisory capacity.

2.2.2.14 Reactor Operator (RO)

Reactor Operators are members of a bargaining group. Their official title is "Nuclear Reactor Controllers"; however, to coincide with the more universally recognized terminology, "Reactor Operator" will be the preferred usage in this document. In addition to several day-shift operators, there is a minimum of two ROs on each shift at those facilities operating 24 hours a day. Reactor Operators report to the Senior Reactor Operator in charge.

2.2.2.15 Technicians

Technicians are individuals who perform drafting work, assist in performing certain experiments and inspections, procure materials, etc. They work for the technical personnel and report to a group leader. At this time, they are not required to be certified; however, general employee training is applicable for reactor-facility access.

2.2.2.16 Quality Assurance Personnel

The quality control inspectors are persons responsible for the inspections and examinations of the various equipment, components, hardware, etc., at a reactor facility. The Quality Assurance Coordinator primarily conducts audits or surveillance of facility operations and procedures. There are three persons within the Operations Division who have QA responsibilities in reactor operations; they report to either a Technical Manager or the Head of the Technical Support Group. General employee training is applicable for reactor-facility access.

2.2.2.17 Hot Cells/Chemical Operators

The Hot Cells/Chemical Operators are bargaining unit personnel (within the Operations Division but not in the Reactor Operations Section) who monitor stack effluents at a remote station and perform certain other work at various facilities throughout the ORNL complex. They will, on occasion, be at a reactor facility to perform some work on auxiliary equipment or to operate hot-cell equipment. They are required to be qualified in accordance with Chapter V of DOE Order 5480.1A and must have the general employee training for access to a specific reactor facility.

2.2.2.18 Other Operations Division Personnel

Some of the other types of Operations Division employees at a reactor facility will include persons on the secretarial staff, laundry staff, janitorial staff, etc. They are all required to have general employee training, as applicable.

2.2.3 Personnel from Other Divisions

The majority of the people normally found on a reactor facility access list are those from other divisions; the various individuals, or groups to which they belong, are identified below.

2.2.3.1 Instrumentation and Control (I&C) Personnel

The I&C personnel are responsible for the maintenance, calibration, and testing of instruments and controls on the reactors and certain auxiliary equipment. They report to an I&C supervisor. All I&C personnel have their own training/qualification programs. They are also required to have the general employee training for reactor-facility access.

2.2.3.2 Plant and Equipment (P&E) Personnel

The P&E personnel are responsible for performing periodic and corrective maintenance on reactor components such as motors, electrical systems, piping, etc. This group includes welders, pipefitters, lead burners, millwrights, riggers, painters, carpenters, etc. They report to a P&E supervisor. All P&E personnel have their own training/qualification programs. They are also required to have the general employee training for reactor-facility access.

2.2.3.3 Health Physicist

Health Physicists conduct radiation surveys and other radiation-monitoring tasks. They report to a group leader. Normally, one is stationed at each Category-A reactor on the day shift; on the off-shifts and at the Category-B reactors, they are readily available by Pagemaster radio. They have their own training/qualification program and are required to have the general employee training, as applicable, for reactor-facility access.

2.2.3.4 Experimenters

Experimenters are the scientists from within the ORNL organization, from various universities, from industry, or from foreign countries who perform research work at the beam-tubes or other research facilities available at the reactors. They are required to have the general employee training for reactor-facility access.

2.2.3.5 Analytical Chemists

Analytical chemists are primarily experimenters; however, they do provide a service to Reactor Operations personnel when certain non-routine requests are made for radiochemical analysis. They are required to have the general employee training for reactor-facility access.

2.2.3.6 Quality Assurance/Inspection Personnel

The Laboratory's Quality Department is another group of individuals who perform inspections, tests, and audits at reactor facilities but who are independent of the Quality Assurance organization of the Reactor Operations Section. They have their own training programs but are required to have the general employee training for reactor-facility access.

2.2.3.7 Independent Review Personnel

Several independent review committees at ORNL are responsible for conducting in-depth reviews and/or audits of reactor operations. These committees report to the Laboratory's upper management. Members of these committees are required to have the general employee training for reactor-facility access. (Refer to the list of review groups in Appendix A.)

2.2.3.8 Laboratory Protection Personnel

Laboratory Protection Personnel consist of the security guards, the specialized tactical security-response team, and the fire department. All of these groups have their own training programs; however, since they do have an emergency-assistance function for the reactor facilities, they are required to have the general employee training for reactor-facility access.

2.2.3.9 Medical Personnel

The doctors and nurses in the ORNL medical department are responsible for responding to emergency situations at all the reactor facilities. They are trained for radiological-type emergencies. They are also required to have the general employee training, as applicable, for reactor-facility access.

2.2.3.10 Other Personnel

Some of the other types or groups of individuals that will, from time to time, perform some function at a reactor facility include: (1) Public

Relations personnel (while escorting visitors), (2) Stores/Purchasing personnel (while delivering equipment), and (3) Industrial Hygiene personnel (while taking routine samples of water, etc.). All of these individuals are required to have the general employee training for reactor-facility access.

Reiterating, all persons having access to a reactor building must have the general employee training, as applicable. Subsequent approval by the Reactor Supervisor will allow entering the individual's name on the computer access list; building entry is via the individual's security badge and automatic reader. Individuals not having the required training must remain escorted while in a reactor building or have special exemption by the Division Director.

2.3 BRIEF DESCRIPTION OF THE REACTORS AND FACILITIES

To put the research/production reactors at ORNL in the proper perspective, relative to the nuclear power plants, the ORNL reactors are far less complicated, are considerably smaller, use highly enriched uranium, are highly automated, do not produce steam for the purpose of turning a turbine to generate electricity, and do not have the need for the many complex emergency-core-cooling systems as do the nuclear power plants.

The High Flux Isotope Reactor (HFIR) and the Oak Ridge Research Reactor (ORR) are Category A reactors (i.e., having operating power levels 20 MW or greater). The Bulk Shielding Reactor (BSR), the Health Physics Research Reactor (HPRR), the Tower Shielding Reactor (TSR), and the Pool Critical Assembly (PCA) are Category B reactors (i.e., having operating power levels less than 20 MW). To acquaint the reader with the type of reactor and the relative complexity of each facility, a brief description of each is given in Appendix B.

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1. INTRODUCTION AND APPLICATION

The type of equipment and the nature of the work performed at a nuclear reactor are indeed unique and are subjected to requirements far beyond those required of more conventional industries. Of primary importance are those requirements pertaining to the qualifications and training of the individuals performing work at all nuclear-reactor facilities, whether or not they are large nuclear power plants or small research reactors, and whether or not they are under the jurisdiction of the Nuclear Regulatory Commission or the Department of Energy. This document deals with the policies and practices of the Oak Ridge National Laboratory (ORNL) in regard to the selection, training, qualification, and requalification of nuclear-reactor operating personnel in the Reactor Operations Section of the Operations Division.

ORNL is operated by Martin Marietta Energy Systems, Inc., for the Department of Energy. There are six research/production reactors and one critical facility (located at the Y-12 Plant) operated by ORNL; these are: (1) the High Flux Isotope Reactor, (2) the Oak Ridge Research Reactor, (3) the Bulk Shielding Reactor, (4) the Tower Shielding Reactor, (5) the Health Physics Research Reactor, (6) the Pool Critical Assembly, and (7) the Critical Experiments Facility.

This document applies to the reactor operating personnel at all these facilities. Rather than to identify the different types of groups and/or individuals from within the ORNL organization performing some job-related activity at a reactor complex (e.g., maintenance people, technical-support personnel, etc.), the training programs of other personnel are addressed in this document only in regard to the requirements pertaining to general employee training.

This document supersedes the existing training-plan document entitled, Qualification Requirements and Training Program for Reactor Operating Personnel at the Oak Ridge National Laboratory, W. H. Culbert, January 29, 1982.

3. BACKGROUND AND POLICY OF ORNL IN REGARD TO THE QUALIFICATION AND TRAINING OF PERSONNEL AT REACTOR FACILITIES

3.1 BACKGROUND

Since 1943, the Oak Ridge National Laboratory (ORNL) has had the opportunity to operate ten different research reactors of various types. It has trained not only the operating personnel for these reactor facilities, but at one time, operated a school of reactor technology to which many U.S. organizations and foreign countries sent people for training. The Laboratory has placed considerable emphasis on training over the years, and the training requirements have become considerably more demanding in recent years.

The requirements pertaining to nuclear reactors are stipulated in a myriad of different yet interrelated documents. Initially, when all nuclear facilities were under the jurisdiction of the Atomic Energy Commission (AEC), the Code of Federal Regulations, ANSI Standards, Manual Chapters, Regulatory Guides, etc., were the main documents which served as guidelines for establishing policies and practices at the nuclear power plants and research reactors. Although at present all the power plants and a number of small research reactors are under the jurisdiction of the Nuclear Regulatory Commission (NRC) and the reactors at ORNL are under the jurisdiction of the Department of Energy (DOE), the literature in which the various requirements applicable to nuclear reactors is stipulated remains either common to both the NRC and DOE or is interrelated by requirements such as Martin Marietta Energy Systems, Inc., Standard Practice Procedures and DOE's Manual Chapters.

3.2 POLICY

In the aftermath of the Three Mile Island incident, the NRC imposed a number of new, more stringent regulations on operator training and qualification at the nuclear power plants. For some time, these NRC requirements were directed primarily at the nuclear power plants; they did not address the smaller, less complicated research reactors until recently. The most demanding of the NRC requirements are still directed at the nuclear power plants. It has been the practice of ORNL, however, to be cognizant of and to evaluate for potential applications at ORNL, all new requirements regarding operator training/qualification, whether such requirements are originated by the DOE, NRC, or INPO (Institute of Nuclear Power Operations).

Although the six nuclear reactors and one critical facility presently operated by ORNL perhaps should be compared more appropriately to the NRC research reactors rather than to the far more complex nuclear power plants, it has been the general practice of the Reactor Operations Section to follow the commercial-power-plant guidelines whenever such guidelines were considered appropriate for reactor operations at ORNL.

In order to maintain the high standards for which ORNL has acquired some recognition, the management of Martin Marietta Energy Systems, Inc., places a great deal of emphasis on the qualification and training of ORNL personnel, and special emphasis is placed on those training programs for reactor operating personnel.

The policies and procedures for the selection, training, certification, and recertification of reactor operating personnel at ORNL are covered in this document and are based on requirements and/or guidelines stated primarily in DOE Orders 5480.1A (Chapter VI), 5500.2, and 5500.3. Other documents used as guidelines and/or references in preparing this training plan are listed in the References.

3.3 COMMENTS AND/OR JUSTIFICATION FOR ANY DEVIATION FROM DOE ORDER 5480.1A, CHAPTER VI

The DOE Order 5480.1A, Chapter VI (Safety of DOE-Owned Reactors), is written as a general document to address the qualification and training requirements of personnel at all DOE nuclear-reactor facilities; the majority of the requirements are actually in the ANSI/ANS 3.1 (1980 Draft Revision) standard which the Order adopts. This latter document originated as a standard for the far more complex nuclear power plants, and much of the terminology remains in this context. The DOE Order, however, recognizes the fact that there are considerable differences in the various reactor facilities under their jurisdiction and has incorporated a provision to allow deviations from those requirements that are either not applicable or are impractical with which to comply. Since the Order requires that justification for any deviation from the stated requirements be incorporated in the facility's training plan, those deviations which the Reactor Operations Section of ORNL believes to be justified are given in Appendix A.

4. REQUIREMENTS FOR REACTOR OPERATING PERSONNEL

4.1 GENERAL REQUIREMENTS

The requirements for reactor operating personnel are numerous and are stated mainly in DOE Order 5480.1A, Chapter VI (Safety of DOE-Owned Reactors). This Order, in essence, endorses the October 1980 Draft version of ANSI/ANS-3.1 (Standard for Selection, Qualification, and Training of Personnel for Nuclear Power Plants).

In general, it is required that reactor-facility personnel shall have a combination of education, experience, health, and skills commensurate with their functional level of responsibility which provides reasonable assurance that decisions and actions during normal, abnormal, and emergency situations will be such that the facility will be operated in a safe and efficient manner. Reactor operations, maintenance, and fuel-handling activities shall be performed and supervised by, or under the direct supervision of, only those individuals who have been certified in accordance with the requirements stipulated in the above-mentioned document as applicable to the operations of the reactor facilities at ORNL.*

Since the work performed at a nuclear reactor is considerably different from the work performed at more conventional industries, the qualification and training requirements are more demanding. By far, the most stringent of the requirements are directed at the reactor operators and supervisors who operate the reactors; these individuals are required to be certified by upper management and are required to participate in a continuing training program and to be recertified biennially. To further emphasize the importance placed upon operational safety by DOE, regulations dictate that <u>all</u> persons regularly employed in a nuclear facility are required to have training in the following areas, commensurate with their job duties:

1. general description of the plant and facilities,
2. job-related procedures and instructions,
3. radiological health and safety,
4. emergency plans,
5. industrial safety,
6. fire protection,
7. security, and
8. quality assurance.

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*"Certification" for reactor operating personnel at ORNL, under DOE jurisdiction, shall be considered equivalent to the "licensing" of operators at the nuclear reactors under the jurisdiction of the Nuclear Regulatory Commission (NRC).

These required subjects are to be covered by a combination of the Reactor Operator training programs, administered by personnel in the Reactor Operations Section, and the general employee training program, administered by personnel in other training groups within the ORNL organization. (Refer to Section 6.0 for further information on general employee training.)

4.2 MEDICAL REQUIREMENTS

In order to minimize the probability of accidents occurring at a reactor facility as a result of operating personnel having health problems, the hire-in process, the initial certification process, and the requalification process shall be dependent on relatively stringent health requirements. These requirements and/or guidelines are stipulated in ANSI N546-1976 and USNRC Regulatory Guide 1.134 (March 1979) and were used as guides to develop ORNL's medical requirements.

An individual invited to visit ORNL for a job interview shall be informed of the fact that a job offer will be contingent upon his/her meeting the health requirements. The ORNL medical section will perform the physical examination during the stay of the interviewee and shall report the results to the Reactor Operations Section Head prior to finalizing any job offer.

Periodic physicals are to be conducted by the ORNL Medical Section to ensure continued compliance with the established standards.

Approval of individuals by the ORNL Medical Section shall be in writing prior to finalizing the initial certification and on a biennial basis thereafter. (Physical examinations for Reactor Operations personnel are normally scheduled on an 18-month basis.)

Minor health problems, which may result in temporary work restrictions, shall also be in writing and submitted to the individual's supervisor. Individuals developing more serious health problems will be reviewed by the Reactor Operations Section Head and the Director of the Health Division to determine if that individual should or should not be allowed to perform solo operations at a reactor facility.

(For more detailed information pertaining to the requirements for medical certification of nuclear reactor operators at ORNL, refer to Appendix A.)

4.3 SECURITY REQUIREMENTS

One of the requirements for reactor operating personnel is that they receive a Q-level security clearance (blue photo badge). The investigation into the individual's background for this level of clearance is very thorough, and considerable importance is placed on this requirement, not only from the standpoint of security regulations, but also as a measure, in part, of a personality/dependability profile.

5. SELECTION OF REACTOR OPERATING PERSONNEL

The selection of personnel to enter ORNL's Reactor Operator and Senior Reactor Operator Training Programs is the initial and a very important phase of ensuring that competent and qualified people operate the reactor facilities at ORNL.

5.1 REACTOR OPERATORS

Candidates for the position of Reactor Operator shall preferably be selected for interview from among those prospective applicants having the following prerequisites:

1. a high school diploma and a license (or certification) to operate a nuclear reactor other than those at ORNL or

2. completion of the Nuclear Navy Training Program.

If no candidates meeting the above requirements are available, applicants having a high school diploma may be accepted for training as reactor operators on a probationary basis, pending approval by the Reactor Operations Section Head.

Additional selection considerations shall include an evaluation of the individual's

1. willingness to undergo the ongoing training and testing which the job requires,

2. willingness to work under conditions of both high and low stress during rotating shifts,

3. interest in scientifically oriented subjects,

4. indications of manual dexterity, mechanical ability, and absence of being accident prone,

5. ability to communicate orally,

6. indications of reliability and good judgment,

7. willingness to cooperate with various levels of supervision, and

8. willingness to abide by established performance standards.

It is recognized that it is relatively difficult to judge these attributes accurately without administering certain types of examinations; however, the interviewers should assess each as objectively as possible. Unless dictated by special circumstances, there are no plans to administer any qualification examinations other than that required by the ORNL Health Division.

5.2 SENIOR REACTOR OPERATORS*

Candidates for the position of Senior Reactor Operator shall preferably be selected for interview from among those prospective applicants having the following prerequisites:

1. a college degree in engineering or one of the sciences; or
2. a minimum of one year of experience as a Reactor Operator at an ORNL reactor facility, during which time the individual has achieved a high grade average in the requalification written examinations and has displayed a high degree of supervisory potential, technical ability, decision-making ability, and responsibility in reactor operations; or
3. similar experience at another reactor facility.

The additional selection considerations, as stated for the operator candidates, shall also apply for the supervisory positions.

5.3 GENERAL PROCEDURES

Prior to inviting an applicant to ORNL for an interview, his/her application will be reviewed by several individuals. Intially, a preliminary screening will be performed by personnel at the Martin Marietta Energy Systems, Inc., Central Employment Office. If the application is of interest, it will then be reviewed further by ORNL's Employee Relations Division.

An individual considered for employment will subsequently be invited to visit ORNL for a personal interview. While at ORNL, the applicant will be interviewed by individuals in ORNL's Employee Relations Division and then by the Reactor Operations Section Head and the Reactor Supervisor. An applicant having a college degree, being considered for technical assign- nts in addition to supervisory (Senior Reactor Operator) status, will also be interviewed by the Operations Division Director or his representative.

In view of the stringent medical requirements for Reactor Operators, an individual selected for employment shall be informed that acceptance into the Reactor Operator Training Program will be dependent on the results of his/her medical examination. If the individual chooses to accept the agreement, the medical examination will be performed by ORNL's Health Division on the day of the interview. Since the medical requirements are

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*The Shift Supervisors are Senior Reactor Operators; they are salaried employees and are considered part of management. It should be noted, however, that some Reactor Operators voluntarily participate in the Senior Reactor Operator Training Program and are certified as Senior Reactor Operators even though they remain in the bargaining group.

The security investigation is performed either by the Federal Bureau of Investigation (FBI) or the Office of Personnel Management, at the request of the Department of Energy, and may require as long as a year to complete. To avoid potential problems with the element of time, a preliminary check is made into the individual's character and background by the Martin Marietta Energy Systems, Inc., Personnel Section. The purpose of this is to allow a job offer to be made. To allow the individual to start in the training program, either a red photo badge (no clearance) or a yellow photo badge (limited clearance) will be issued. This will allow the individual to temporarily perform work where or when it is not mandatory to have the Q-level clearance.

If the individual fails to qualify for a Q-level security clearance, the situation will be evaluated by the Security Section Head and the Reactor Operations Section Head, and the individual will be considered for a position not requiring a clearance. This policy shall apply to the initial investigation as well as periodic re-investigations over the years.

Entry into the ORNL complex, or a specific reactor area, is via a photo badge presented at the respective guard gates; however, at the Category-A reactor facilities, access is further restricted to automatic badge readers at the entrance to the buildings.

4.4 PERFORMANCE STANDARDS

To further emphasize the importance of establishing and maintaining a high level of dependability on the performance of ORNL reactor operating personnel, certain standards have been established. These standards are listed in Appendix A.

If an individual fails to meet the established performance standards, the Reactor Operations Section Head shall evaluate the individual's potential to either complete the initial training program leading to certification, or if already certified, his/her capability to continue assuming the responsibilities of a Reactor Operator or Senior Reactor Operator. If it is decided to retain the individual in the program, the individual will be informed of those areas of performance where improvement is needed. If an improvement is not observed within a reasonable period of time, a re-evaluation shall be made. If the individual's second appraisal is unsatisfactory, as determined by the Section Head, the individual will be considered for another position.

somewhat special for Reactor Operators, the Health Division Director will notify the Reactor Operations Section Head of the results soon after the examination is completed. A job offer shall not be finalized until all required input has been evaluated by the Reactor Operations Section Head and/or the Operations Division Director.

6. REACTOR-OPERATIONS-SECTION TRAINING PROGRAMS

6.1 INTRODUCTION

There are several programs which are designed to provide qualified people to work at the various ORNL reactor facilities. Those programs for reactor operators and supervisors are by far the most demanding and are covered in detail in this document. Training programs for reactor support groups have not been addressed in this document.

The various support groups at each reactor facility have their own, specialized training programs. These groups include emergency-response personnel, chemical operators (who monitor stack effluents and process liquid wastes), maintenance personnel, health physicists, quality assurance personnel, etc. Individuals in these support groups are required to demonstrate their performance capabilities to the training personnel in their respective divisions or sections.

6.2 OBJECTIVES

The training programs for reactor operating personnel have been developed to ensure that qualified personnel operate the reactor facilities at ORNL and that such training, testing and documentation, etc., are in compliance with DOE and ORNL requirements.

The objectives of the program are to:

1. describe the functional positions to which the training program applies,

2. describe the training requirements which are commensurate with the degree of skill, knowledge, and responsibility required,

3. describe the required content and depth of material to be covered,

4. specify the nature of the oral, written, and operating examinations administered for the purpose of certification,

5. specify the requirements for operating personnel to remain qualified,

6. maintain required documentation amenable for internal and external audits by the various review committee and/or auditors,

7. provide a means for the dissemination of significant information regarding changes in ORNL, DOE, or industry standards, procedures, and/or requirements, and

8. emphasize training on operational procedures, especially those pertaining to abnormal and emergency conditions.

6.3 REACTOR-OPERATOR TRAINING PROGRAM FOR INITIAL CERTIFICATION

6.3.1 Prerequisites and Special Exemptions

Since the current policy is to preferably select candidates for the Reactor-Operator Training Program from among applicants having completed the Nuclear Navy Training Program or from among those already licensed or certified at a reactor facility other than at ORNL, the candidates will usually already have the necessary prerequisites. In addition, the basic prerequisites would be those attributes (listed in Sect. 5.1) that were evaluated, in part, by the interviewers.

Certain exemptions from parts of the training program may be allowed in cases where: (1) an individual has had experience in a particular field and can demonstrate proficiency in a certain job task (e.g., someone that had been a health physicist would not be required to spend as much time on radiation safety as someone that may have been a millwright); (2) the individual has had previous experience in a similar job at another facility; (3) certain material is not applicable to that facility (e.g., the same degree of training on cooling systems would not be appropriate at both the HFIR and HPRR); and (4) the individual's academic background is such that it may be only necessary to review certain material (e.g., nuclear engineers or persons trained by the nuclear Navy would not be expected to need as much time achieving the level of knowledge required in reactor physics as would the high school graduate not having had the nuclear Navy training). For such cases, some of the material listed in the training schedule may be either omitted or covered lightly, as needed. The reasons for such exceptions, however, shall be documented.

Individuals who do not possess the formal educational requirements shall not be automatically eliminated from a training program (or from their job) where other factors provide sufficient evidence of their abilities. These other factors (e.g., certification of academic ability and knowledge, a high school diploma or GED, sixty semester hours of related technical education taught at the college level, qualification as a Senior Reactor Operator at the assigned plant, two years experience in his/her area of responsibility, two years of supervisory or management experience, an associate degree in engineering or related science, etc.) will be evaluated on a case-by-case basis by the Reactor Operations Section Head and/or the Operations Division Director.

6.3.2 Subject Material and Depth of Coverage

The training program for Reactor Operator candidates shall include instructions on the following topics, as applicable to the reactor facility to which the individuals will be assigned, and in other areas in which they are expected to be proficient, commensurate with their duties and responsibilities as Reactor Operators. On theoretical subjects, it is not intended to bring the level of knowledge of the high school graduate up to that of the nuclear engineer. The subject and depth of material is based, in part, on recommendations in various documents, on an analysis of the level of knowledge needed to perform the various job tasks, and on the many years of experience in training reactor operators. It shall apply to both Category-A and Category-B reactors, as appropriate.

1. Mathematics - In sufficient depth to develop a practical understanding of high-school-level mathematical manipulations (e.g., use of exponentials, ratios, basic problem-solving techniques, etc.), the use of graphs, the presentation of certain routine data on various reactor systems, the conversion of units, etc.

2. Basic chemistry - In sufficient depth to develop a practical understanding of certain chemical processes, as applicable to water systems (e.g., ion-exchange columns, pH control, corrosion, etc.).

3. Basic physics - In sufficient depth to develop a practical understanding of basic electricity, heat production and transfer, basic properties of fluids and matter, fluid statics, fluid dynamics, change of phase, flow instability, etc.

4. Elementary reactor physics - In sufficient depth to develop a practical understanding of the fission process; neutron multiplication; neutron kinetics (e.g., prompt and delayed neutrons, neutron lifetime and generation time, etc.); reactor kinetics (e.g., reactivity, period, startup rate, etc.); reactor control; coefficients (e.g., temperature, Doppler, etc.); fission product poisons; reactor core characteristics; and fuel loading (e.g., subcritical multiplication, 1/M plots, approach to critical, etc.).

5. Design features - In sufficient depth to develop a practical understanding and working knowledge of the reactor core and vessel components (for assembly and disassembly purposes) and of all the other equipment at a reactor facility which Reactor Operators are expected to operate without supervisory assistance.

6. Operating characteristics - In sufficient depth to develop a practical understanding and working knowledge of the plant and/or equipment response to planned changes effected by the operator or effected by unplanned transients resulting from various postulated failures and/or abnormal operating conditions.

7. Control mechanisms - In sufficient depth to develop a practical understanding and working knowledge of the operating characteristics of certain controllers and/or control instrumentation associated with the reactor or auxiliary equipment for the purpose of operating such equipment under normal and abnormal conditions.

8. Safety systems - In sufficient depth to develop a practical understanding and working knowledge of the nuclear instrumentation's block diagrams, purpose, actuating set points, sensing-element locations, interlocks, automatic/manual features, consequences of failure, limitations, etc.

9. Process systems - In sufficient depth to develop a practical understanding and working knowledge of the various process systems (e.g., water, electrical, steam, off-gas, etc.) so that the individual is able to draw schematic diagrams of the various systems and operate the systems under normal conditions and correct, if possible, abnormal conditions.

10. Standby and emergency equipment - In sufficient depth to develop a practical understanding and working knowledge of the purpose, capacity, and applicability of equipment intended to mitigate core and equipment damage and/or prevent the release of radioactive effluents to the environs. Such equipment includes emergency core-cooling systems, radiation-monitoring equipment, off-gas filtering systems, liquid-effluent retention systems, and fire-fighting equipment.

11. Radiation control and safety - In sufficient depth to develop a practical understanding and working knowledge of potential radiological hazards associated with specific job tasks, plant and environment protection systems, shielding requirements, limitations on exposure, Radiation Work Permits, contamination and radiation zones, and use of radiation monitors.

12. Standard operating procedures - In sufficient depth to develop a practical understanding and working knowledge of the use of checklists and written procedures, the location of valves and other controls associated with various components or auxiliary equipment, and the precautions applicable in order to operate the reactor and auxiliary systems without the need of supervision.

13. Abnormal and emergency procedures - In sufficient depth to develop a practical understanding and working knowledge of the actions to take in response to various postulated abnormal and/or emergency situations (this shall include the mitigation of accidents involving a degraded core, the response to failures of instrumentation, the response to losses of electrical power and other utilities, the response to individual annunicator alarms, the response to water leaks, etc.).

14. Process waste systems - In sufficient depth to develop a practical understanding and working knowledge of the handling and/or categorizing process waste, the methods by which they are processed, the potential radiological hazards involved, the limitations on radioactive effluents, and filter efficiencies.

15. Fuel handling - In sufficient depth to develop a practical understanding and working knowledge of the hazards and requirements associated with the handling of new and irradiated fuel. This shall include the use of special handling tools, refueling, vessel-component replacement, pool work, and loading of shipping carriers.

16. Technical specifications - In sufficient depth to develop a practical understanding and working knowledge of the limiting conditions of operation and their bases, surveillance requirements, abnormal occurrences, and reporting requirements.

17. Electrical systems - In sufficient depth to develop a practical understanding and working knowledge of the various electrical systems at the facility, consequences of electrical failures, procedures for surveillance, placing systems in service or removing them from service, and performing special tests.

18. Experiments - In sufficient depth to develop a practical understanding and working knowledge of the types of irradiation facilities and the services provided each so that the individual can draw schematic diagrams of the beam tubes and operate the local valve manifolds for filling and draining the beam-tube cavities.

19. Control manipulations - In sufficient depth to prepare the individual for solo operation of the reactor console and other control-room switches, buttons, etc., during startup, shutdown, and transient conditions.

20. Security - In sufficient depth to develop an awareness of the ORNL requirements pertaining to security at a reactor facility and as applicable to badge-readers, locked files, telephone conversations, classified information, etc.

21. Quality assurance - In sufficient depth to develop a practical understanding and working knowledge of the subject, the importance of maintaining proper documentation, the various forms to fill out and records to keep, the reporting requirements, and the identification of QA personnel.

22. Performance standards - In sufficient depth to develop a continued awareness of an expected on-the-job code of behavior and performance. (Refer to Appendix A for performance standards requirements.)

23. Industrial safety - In sufficient depth to develop a practical understanding and working knowledge of the use and location of respirators and other protective equipment, the sources of safety information (references), the control of certain toxic materials, the reporting requirements, the effects of smoke and toxic gases, and the handling and disposal of hazardous materials.

(For more specific detail of the depth of material coverage, refer to the facility checklists in Appendix C.)

6.3.3 Training Materials and Resources

The training materials that will be maintained in a study room or that will be made available shall include:

1. The NUS Reactor Operator Training Program - This consists of 72 one-hour color videotapes and manuals which parallel the taped material.

2. Several videotapes on radiation safety/hazards.

3. One video tape on security and safety requirements at the facility.

4. Various safety-oriented videotapes (on loan from the Safety Department).

5. The facility's descriptive and procedure manuals.

6. The facility's Technical Specifications, Safety Analysis Reports (SARs), and Unusual Occurrence Reports (UORs).

7. The programmed instruction manuals on the generic subjects (i.e., reactor physics, radiation control and safety, instrumentation and control, heat transfer and fluid flow, and mathematics).

8. The question-and-answer manuals on the generic subjects (i.e., reactor physics, heat transfer fluid flow, and radiation safety).

9. The ORNL safety manuals (e.g., the Health Physics Manual, the Safety Manual, the Environmental Protection Manual, and the Respirator Program Manual).

10. The emergency manuals (i.e., the Local Emergency Manual and the Laboratory's Emergency Manual).

Lecturers/Instructors - In addition to those individuals in the Reactor Operations Section who perform training, there are a number of other individuals in other groups that also assist in the training of reactor operating personnel. Such individuals are from the Instrumentation and Controls Division, the Health Physics organization, the Health Division, and the ORNL Plant Protection Division. Persons from within the Operations Division are primarily from the Reactor Technical Support groups and have expertise in reactor technology, reactor physics, electrical systems, quality assurance, etc.

There are no simulators for any of the reactor facilities at ORNL.

6.3.4 Training Methods

Due to the relatively small turnover of reactor operating personnel, operator candidates are not hired on a mass basis; normally, only one person will be in training at a time at any one facility. This allows for the benefit of more individual attention.

In general, training will be accomplished by the following means:

1. Lectures/talks/tours

   a. Initially, a new employee will be given an orientation session covering items listed under General Employee Training. This training is given by personnel in another ORNL training group.

   b. A new employee will then be given a further orientation session covering organization, quality assurance, affirmative action, etc.; this will be administered by personnel in the Operations Division.

   c. Once assigned to a particular facility, a new employee will be given a plant tour by the Training Manager (or designated alternate) and be given the safety/security instructions required for reactor-facility access.

   d. During the training period to qualify as a Reactor Operator, the trainee will have a number of one-on-one-type training sessions with the Training Manager on plant specifics.

   e. The trainee will attend lectures by individuals from specialized reactor-support groups (e.g., personnel from Instrumentation and Controls, Health Physics, electrical maintenance, etc.).

   f. The trainee will be given talks by individuals from the Plant Protection Division on security, the use of fire-fighting equipment, the use of respirators, etc.

   g. The trainee and the Training Manager (or his designated alternate) will go over each item on the Facility's Training/Qualification Checklist.

2. Viewing videotapes - There are approximately 72 videotapes that the individual will view in conjunction with studying the literature. (It is not necessary to view all the tapes prior to certification; some may be viewed in the requalification training sessions.)

3. Self-study

    a. The trainee's predominant method of covering required material will be by reading the various manuals.

4. Observing routine operations

    Initially, a most important method of training is having a trainee observe the activities of certified Reactor Operators as they record daily and/or hourly readings, regenerate demineralizers, refuel the core, perform startup checks, etc.

5. Performing "hands-on" activities

    As the trainee becomes acclimated to the operations at the reactor facility, certain "hands-on" control manipulations will be allowed and expected. This may include operating the reactor under the direct supervision of a Trainer and/or Reactor Operator, handling refueling tools, placing certain auxiliary equipment in service, etc. (Even though an individual is stationed at a Category-A reactor, he/she may be given training at one of the Category-B facilities since some of the other reactors are more suitable for illustrating such things as subcritical multiplication, xenon decay, etc.)

6. Participating in "walk-through" exercises

    For certain abnormal or emergency situations where it is impractical to perform "hands-on"-type exercises using the reactor (e.g., loss of cooling, loss of electrical power, etc.), "walk-through" exercises will be conducted.

6.3.5 Training Schedule

The training of a candidate for the position of Reactor Operator is usually accomplished in four to eight months. This time schedule, as indicated, is flexible and may vary since it is dependent on such things as the background of the individual, the operating schedule and availability of the reactor for training, the training received during refueling and other outages, and the overall progress of the individual in general. (The Training Schedule for Reactor Operator trainees is included in Appendix D.) Periodic deviations from the training schedule shall be the prerogative of the Training Manager and shall be performed on an individual basis.

6.3.6 Evaluation of Trainees During the Training Period

Approximately every six weeks, the Training Manager will evaluate the operator trainee's Training Checklists, the results of any oral and written examinations administered during the training period, and the individual's attitude and willingness to learn. Based on these evaluations, the

Training Manager will fill out a Reactor Operations Section Training Progress Review form (refer to Appendix D) and then discuss the individual's progress with him/her, the Reactor Supervisor, and the Reactor Operations Section Head.

6.3.7 Policy Toward Trainees Not Performing as Expected

In the event the trainee does not display an acceptable degree of progress during the time he/she is preparing for the Reactor Operator certification examination, as determined by the Training Manager, the matter will be called to the attention of the Reactor Supervisor and Reactor Operations Section Head. If, at that time, it is decided that the trainee would not qualify as a Reactor Operator in accordance with the established standards, placement in another field of employment shall be required. If the trainee's performance is marginal, the Reactor Operations Section Head, the Reactor Supervisor and/or Assistant Reactor Supervisor shall inform the trainee of his/her areas of weakness and reiterate the expected standards of performance. An additional period of time, not to exceed four weeks, shall be given the individual for an opportunity to display improvement. If, after that time, the individual's capability is still in question, he/she shall be considered for placement in a less demanding job or he/she may be terminated.

6.4 SENIOR REACTOR-OPERATOR TRAINING PROGRAM FOR INITIAL CERTIFICATION

6.4.1 Prerequisites and Special Exemptions

For the Category-A reactor facilities (HFIR, ORR, and BSR*), the usual policy is to select candidates for the Senior Reactor Operator (SRO) training from among those individuals having a minimum of one year's experience as a Reactor Operator (RO); hence, the candidate will already have the necessary prerequisites for the Senior Reactor Operator's training program. On occasion, however, an individual is hired who has had no previous experience in reactor operations (but who has a bachelors degree in engineering or one of the sciences) for the purpose of serving in a technical group or in an administrative capacity for which SRO certification is required. In such cases, the individual may be exempt from the one year service as an RO and may be allowed to take the SRO examination shortly after taking the RO examination.

For Category-B reactors (HPRR, TSR, and PCA) and the Critical Experiments Facility (CEF), the policy is to have all personnel certified as SROs soon after certifying as ROs. The personnel intended to operate these facilities are not in the bargaining group, and in the past, they have all been college graduates. This policy shall be continued.

As in the case of the RO candidates, certain exemptions from parts of the training program may also be allowed in cases where: (1) an individual has had experience in a particular field and can demonstrate proficiency in a particular job task (e.g., someone that had been a health physicist would not be required to spend as much time on radiation safety as someone who had a degree in chemistry); (2) the individual has had previous experience in a similar job at another facility; (3) certain material is not applicable to that facility (e.g., the same degree of training on cooling systems would not be appropriate at both the HFIR and HPRR); and (4) the individual's academic background is such that it may only be necessary to review certain materials (e.g., nuclear engineers would not be expected to need as much time on reactor physics as might the mechanical engineer). For such cases, some of the material listed in the training schedule may be either omitted or covered lightly. The reasons for such exemptions, however, shall be documented.

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*The BSR is a Category-B reactor; however, it is operated by remote control from the ORR control room during steady-state operations by the same personnel who operate the ORR. For convenience, the literature will refer to the ORR-BSR complex. The training requirements for the BSR personnel shall be the same as for the ORR.

6.4.2 Subject Material and Depth

The training program for SRO candidates shall include instruction on the following topics, as applicable to the reactor facility to which the individual will be assigned, and in other areas in which supervisory personnel are expected to be proficient. In general, most of the subject material is essentially the same as in the RO program; however, for the SROs, the depth of material coverage is expected to be greater.

1. Reactor theory - In sufficient depth to develop a practical understanding of the fission process, neutron multiplication, neutron leakage, the six-factor formula, reactivity effects, criticality indications, etc., and to develop an understanding of certain problem solving above the Reactor Operator's level.

2. Theory of fluids and thermodynamics - In sufficient depth to develop a practical understanding of fluid statics, fluid dynamics, change of phase, burnout and flow instability, reactor thermal limits, etc., as applicable to the ORNL research reactors.

3. Design and operating limitations of the reactor - In sufficient depth to develop a practical understanding of the bases for the limiting conditions of operation and surveillance requirements stipulated in the Technical Specifications.

4. Radiation hazards - In sufficient depth to develop a practical understanding of the subject as related to supervisory responsibilities and to allow recognition of potential radiological-type problems before they worsen, to instill a methodical approach to job planning in order to minimize the potential for radiation hazards, to respond to abnormal/emergency situations involving radiological hazards, to have an understanding of shielding problems, to be familiar with precautions associated with handling and shipping of radioactive materials, etc.

5. Fuel handling - In sufficient depth to allow the individual to supervise an operating crew during refueling, to be familiar with the required records associated with fuel handling, and to have a continued awareness of the various types of potential problems (e.g., criticality, damage, etc.) and/or radiological hazards associated with new and irradiated fuel.

6. Specific operating characteristics - In sufficient depth to develop a practical understanding of reactor-systems' response to postulated transients, including the effects of changes in temperature, pressure, flow rate, etc.

7. Core parameters - In sufficient depth to develop a practical understanding of the magnitude of neutron fluxes in various sections of the core, the variables that might affect these flux levels, and the changes in neutron poison concentrations during an operating cycle.

8. Instrumentation and controls - In sufficient depth to develop a practical understanding of the reactor's safety systems, control systems, electrical-distribution systems, and related block diagrams and prints to allow for a degree of troubleshooting during abnormal situations.

9. Administrative procedures - In sufficient depth to develop a practical understanding and working knowledge of supervisory duties and responsibilities during reactor startups, shutdowns, refuelings, and other day-to-day operational activities in accordance with ORNL and DOE regulations, to be familiar with the follow-up response to all abnormal/emergency procedures, and to be cognizant of the reporting requirements associated with abnormal occurrences, radiological problems, safety limit violations, etc., as stated in the facility's Technical Specifications.

10. Leadership - In sufficient depth to develop a practical understanding of how to effectively supervise a crew of Reactor Operators during routine activities and during abnormal/emergency situations.

11. Interpersonal communication - In sufficient depth to develop a practical understanding of how to communicate effectively with Reactor Operators, crafts personnel, other supervisors, Shift Technical Advisors, experimenters, public relations personnel, etc.

12. Command responsibilities and limits - In sufficient depth to develop a practical understanding and working knowledge of the organization's chain of command when issuing orders, requesting maintenance work, etc., and to know when approval and/or consultation on certain matters is required.

13. Motivation of personnel - In sufficient depth to develop a practical understanding of how to motivate his/her crew to function in a safe, reliable, and efficient manner, both individually and as a team effort, in accordance with the established performance standards.

14. Problem and decisional analyses - In sufficient depth to develop a logical and systematic approach to the reasoning process necessary to resolve certain problems that may arise during various operational activities and which are unique to supervisory personnel in the field of reactor operations.

(For further details on the depth of material coverage, refer to the checklists for each facility in Appendix C.)

6.4.3 Training Materials and Resources

The training materials and resources shall be the same for the Senior Reactor Operator candidates as outlined in Sect. 6.3.3 for the Reactor Operator candidates with the exception that Senior Reactor Operators will also attend supervisory training courses given by another group at the Laboratory.

6.4.4 Training Methods

The method of training individuals to become Senior Reactor Operators is basically the same as outlined in Sect. 6.3.4 for the Reactor Operators. Candidates that are selected from among the Reactor Operators are already fairly familiar with the facility. However, the Senior Reactor Operator certification examinations are more difficult academically, and the candidates will be required to review the material on reactor theory, heat transfer, instrumentation, etc. This is achieved primarily by self-study with instructor assistance, as needed. For some of the supervisory-skill requirements, the individual shall be scheduled to attend classes given by another ORNL training group specializing in these subjects.

It should be noted that a number of Reactor Operators have voluntarily taken the Senior Reactor Operator's certification examination and continue to take the periodic requalification examinations. These individuals are categorically certified Senior Reactor Operators; however, they remain in the bargaining group and do not have supervisory responsibilities. When given this responsibility, via promotion, they are no longer in the bargaining group, and they will be required to attend the supervisory classes mentioned previously.

6.4.5 Training Schedule

The training of a candidate for the position of supervising Senior Reactor Operator, who is already certified as a Reactor Operator at a specific reactor facility, is usually accomplished in approximately one month; however, this time frame is flexible and may vary since it is dependent on the individual's background and overall performance as a Reactor Operator. The amount of training and, hence, the actual time required to be spent on the subjects shall be decided by the Training Manager. (Refer to Appendix D for a Training Schedule for Senior Reactor Operators.) The time spent on training in some of the required supervisory skills may be allotted at a later date since classes in these subjects are given by another ORNL training group and are scheduled at different times throughout the year.

6.4.6 Evaluation of Trainees During the Training Period

It shall be the responsibility of the Training Manager to monitor the progress of an individual in the Senior Reactor Operator's training program. The evaluation shall be based on interviews, general observations, and/or any oral and/or written examinations the Training Manager considers appropriate to administer.

6.4.7 Policy Toward Trainees Not Performing as Expected

In the event the trainee selected from among the Reactor Operators does not display an acceptable degree of progress at any time he/she is preparing for the Senior Reactor Operator certification examination, as determined by the Training Manager, the matter will be called to the attention of the Reactor Supervisor and Reactor Operations Section Head. If it is decided at that time that the trainee will not make an acceptable supervisor, he/she will be disqualified as a candidate and will be reviewed for a less demanding job.

Should an unfavorable rating be given to a Senior Reactor Operator candidate having a college degree and participating in both the Reactor Operator and Senior Reactor Operator Training Programs simultaneously (prior to taking both examinations), the individual will also be disqualified as a candidate and considered for another position.

6.5 GENERAL EMPLOYEE TRAINING

As stated earlier, DOE Order 5480.1A, Chapter VI, requires that all persons regularly employed in a nuclear facility are required to have training in the following areas, commensurate with their job duties:

1. general description of the plant and the facilities,
2. job-related procedures and instructions,
3. radiological health and safety,
4. emergency plans,
5. industrial safety,
6. fire protection,
7. security, and
8. quality assurance.

The intent of this requirement is primarily safety related, and it is directed not only at reactor operating personnel but also at the experimenters, the janitors, the maintenance personnel, and the secretaries at a reactor facility.

The Oak Ridge National Laboratory has a General Employee Training Program which addresses all but item 2 of the required subjects and is intended for all ORNL employees. Item 2 is a facility-specific training requirement. All subjects are covered again, in greater detail and as needed, by training personnel in the various groups in which new personnel will be located.

To further emphasize the importance of training to the general employee having access to a reactor building, certain additional training requirements have been established and implemented by the Reactor Operations Section. In essence, for someone to have his/her name added to the computer list to allow reactor-building access (via badge readers), the individual is required to view a 20-min video tape and have someone cover with them the various items on a "Dos and Don'ts"-type checklist. These checklists, which have the signature of the trainer and trainee, are maintained by the Training Coordinator for auditing purposes. (Refer to Appendix D for an example of the Instructions for ORNL Employees Working at a Reactor Facility Checklist.)

operating examination may include a demonstration of the candidate's ability to operate any auxiliary equipment and shall include a demonstration of the use of selected radiation detectors.

During the oral/operating examinations, the Examiner shall use the Oral/Operating Examination Evaluation form to document his/her evaluation of the candidate's response to questions and demonstrated ability to operate equipment. (Refer to Appendix D for an example of this form.)

7. INITIAL CERTIFICATION

7.1. GENERAL

In accordance with the requirements of DOE Order 5480.1A, Chapter VI, and as applicable to the reactor facilities at the Oak Ridge National Laboratory (ORNL), certification of Reactor Operators and/or Senior Reactor Operators shall be the responsibility of upper management. At ORNL, this level of management has been designated as the Operations Division Director.

The certification evaluation shall be based on the successful completion of the required training program; the written, oral, and operating certification examinations administered by the Examiner, and a satisfactory medical report on the candidate from the Health Division. This information must be submitted to the Division Director in order for him/her to evaluate the individual and finalize the necessary certification documentation.

Certification is for a specific time (i.e., two years) and shall apply to a specific reactor; it shall not allow the individual to operate another ORNL reactor. An interim certification shall be initially required for individuals who have not completed the required probationary period (which, for bargaining unit employees, is six months for new employees and three months for those who entered the job via the bid procedure).

All initial certification procedures apply to the reactor operating personnel and certain other personnel at both the Category-A and Category-B reactor facilities.

7.2 PROCEDURES FOR CERTIFICATION

1. Upon completion of the individual's training (for Reactor Operator and/or Senior Reactor Operator), the Training Manager will initiate the handling of the required documentation for certification by signing and dating that section of the form applicable to his/her approval of the candidate. These forms are (1) the Interim Certification for Reactor Operator, (2) the Initial Certification for Reactor Operator, or (3) the Initial Certification for Senior Reactor Operator. (Examples of these forms are included in Appendix D.)

2. The Training Manager will inform the Examiner of the candidate's status and arrange a schedule for administering the certification examinations.

3. The written part of the certification examination will be scheduled by the Examiner. The written examination will normally be scheduled first, followed by the oral examination usually on the next day. The operating portion of the examination is relatively flexible but will normally be scheduled during a reactor startup after refueling.

4. Upon completion of the written, oral, and operating examinations, the Examiner will record the grades and other results, then sign and date those sections of the certification forms applicable to his/her approval of the candidate. The forms will then be delivered by him/her to the Reactor Operations Section Head.

5. The Examiner will obtain a statement, in writing, from the Director of the Health Division verifying that the individual has met the medical requirements for the position of Reactor Operator. This information will be conveyed to the Reactor Operations Section head.

6. The Reactor Operations Section Head will review and evaluate the candidate's qualification record, sign and date the form, and then deliver it to the Operations Division Director.

7. If all the required input to the Operations Division Director indicates a satisfactory appraisal, he/she will sign and date the qualification form. At this time, the candidate becomes officially certified as a Reactor Operator (or Senior Reactor Operator) for the particular reactor facility at which the individual was trained.

8. The Operations Division Director will notify the Reactor Operations Section Head of the certification process. The latter, in turn, will notify the Reactor Supervisor. The newly certified operator subsequently will be informed and then assigned to a shift. At this time, he/she is permitted to perform solo operations, as applicable.

NOTE: An interim certification is applicable if the Reactor Operator candidate is still in the probationary period; it shall be limited to the duration of this period. At the end of the probationary period, the individual's performance must be re-evaluated in order to extend certification to cover the remainder of the two-year period of time. The Initial Certification form must then be completed to document this re-evaluation.

7.3 TESTING AND GRADING REQUIREMENTS

1. The initial certification examinations shall not be administered by the individuals performing the training (i.e., the Training Managers). These examinations, as well as all subsequent requalification examinations shall be prepared, administered, and graded by the Examiner or, in some cases, his/her designated alternate.

2. All examinations shall be reviewed by the Reactor Operations Section Head prior to their being administered. This shall be documented by his/her signing the examination's cover page.

3. The written, oral, and operating examinations shall be prepared and administered in accordance with DOE standards (i.e., similar to the NRC licensing examinations given to operator candidates at the nuclear power plants).

4. The point value for each question on the written examination will be indicated on the test paper and will be based on such factors as the level of knowledge required, the relative importance of the subject, the complexity of the expected answers, and the amount of time estimated to answer the questions in acceptable depth.

5. The Senior Operator's written examination will be different and more demanding than the Operator's examination; <u>it shall also be supplemental to the Reactor Operator's examination</u>.

6. In order to pass the written examination, the candidate must achieve a score of 70% or above in each category and achieve an overall score of 80% for the entire examination (e.g., an overall grade of 87% with a 65% in one category would be a failing grade). (There are seven categories in the Reactor Operator examination and five categories in the Senior Reactor Operator examination.)

7. A quantitative evaluation shall also be made of the oral/operating examinations. (Refer to the Oral/Operating Evaluation Report form in Appendix D for an explanation of the numbering scheme.)

8. The time limits for the Reactor Operator and Senior Reactor Operator written examinations will be approximately eight hours and seven hours, respectively. The tests will be given in two sessions (i.e., morning and afternoon) and will be proctored by the Examiner or his/her designated alternate.

9. Completed examination papers shall be graded by the Examiner and reviewed by the Reactor Operations Section Head.

7.4 TYPES OF TEST QUESTIONS

In regard to the types and/or complexity of test questions, the following guidelines should apply:

1. Questions that could be easily answered by a visitor who has had a 30-minute tour of the facility should be avoided. With respect to depth of knowledge, written questions can be segregated into five categories; these are (in ascending order of depth of knowledge required):

   a. Knowledge and Recall (e.g., Define nucleate boiling.)

   b. Comprehension and Interpretation (e.g., Give two examples of natural circulation and include sketches.)

c. Application of Rules and Principles (e.g., Explain how the steam-jet air eductors work.)

d. Analysis and Deduction [e.g., What has failed if the following parametric changes occur at the HFIR: (1) there is an increase in makeup water to the head tank and (2) there is an increase in level in the storage tank?

e. Synthesis and Evaluation (e.g., While escalating power to 50 MW, a problem developed with a piston for the No. 4 control element and the No. 4 seat light was actuated; however, all other indications showed that the element had not actually dropped. It was learned also that the No. 4 element could not be inserted. Since there was a seat light, why was there not an automatic fast insert, and why could the No. 4 element not be inserted? What action should be taken?)

These five knowledge areas are cumulative; that is, a question that involves application of rules and principles will, of necessity, also test the respondent's knowledge, recall, and comprehension. The Examiner should try to have a fair representation of all the first four categories on the Reactor Operator's examination along with an occational question in the fifth category. On the Senior Reactor Operator's examination, the third, fourth, and fifth categories should predominate.

2. True/false-type questions shall be avoided unless they are a part of a more thought-provoking question.

3. Questions in subject areas of infrequent use shall not be avoided. On the contrary, questions relating to abnormal/emergency procedures should be emphasized.

7.5 CERTIFICATION EXAMINATIONS FOR REACTOR-OPERATOR CANDIDATES

7.5.1 Categories and Scope of the Written Examination

The written examination required for Reactor Operator certification shall cover the seven categories listed below. The general content and depth of each category are indicated along with the point value.

1. Principles of reactor operation (Point value: 12 ± 3)

This category is intended to include questions relating to basic, nuclear-reactor behavior, elementary nuclear-reactor theory, technical terminology, subcritical multiplication, and some problem solving.

Also included in this category may be questions on controlled and variable characteristics expressed as normal or operating parameters (e.g., flow rates, pressure, temperatures, etc.), The operating examination covers those manipulations which can better be demonstrated rather than described and allows the Examiner to perform an evaluation of the candidate's manual dexterity, attentiveness, and overall ability to operate the reactor console and/or other equipment at the facility.

Items which normally are included in all operating and/or oral examinations are indicated below; however, the specific characteristics and status of the reactor must be considered to ensure that the examination accomplishes its objectives. Therefore, for each examination, additions, deletions, or modifications to the following list may be appropriate. (Refer to the Oral/Operating Examination Evaluation form in Appendix D for an explanation of how a quantitative evaluation of the individual should be performed.)

In general, the oral and operating examinations last from three to five hours, depending on the complexity of the particular reactor facility. As applicable to the job tasks performed by the Reactor Operator or Senior Reactor Operator candidate, these examinations shall include:

1. Describing the operation and pertinent design features of the reactor and auxiliary systems and indicating acceptable familiarity with the overall facility; this will include the ability to locate and identify significant components and instrumentation.

2. Going over the items on the startup checklist on the reactor and any other checks (e.g., daily checks, recovery from scram, checklists, etc.) that a certified operator would normally perform. (When complete performance of all applicable checks requires excessive time, the Examiner may select portions of the checklists, spot-check items, or use other methods that he/she considers suitable to determine competence, within a reasonable time period.)

3. Starting up the reactor from a subcritical condition and raising the power level to a preselected value to use all nuclear-instrumentation channels, or starting up the reactor following a scram or control element drop. (Note: all reactor startups and/or related shutdown work at the Category-A reactors must be documented. Refer to Appendix D.)

4. Describing the response of the system to control changes. Normally, the candidate will be required to make one or more changes in power level and on a period specified by the Examiner and permitted by administrative procedures and/or reactor controls.

5. Predicting the approximate readings of all pertinent instrumentation for the operating conditions.

6. Describing the required actions and/or responses to each alarm and annunciator signal and indicating the probable causes and significance thereof. (The candidate should show a high degree

of familiarity with procedures of this nature and should distinguish between actions or checks which are logical followups, depending on the circumstances. For reactors with a large number of alarms, the Examiner may spot-check or select portions that he/she considers suitable; normally, all are covered.)

7. Describing the influence of experiment instrumentation upon the reactor control system.

8. Performing startup, or describing the procedure therefore, of auxiliary and emergency systems.

9. Demonstrating the use of portable radiation and other monitoring equipment used at the facility.

10. Demonstrating or describing the actions to be taken in the event an abnormal/emergency situation occurs. (A high degree of familiarity with the emergency procedures is required; the candidate should be able to distinguish between those actions he/she must take immediately as an operator, or supervisor, and those that all persons at the facility must follow.)

11. Describing rules and/or procedures regarding safety equipment and Radiation Work Permits. (The candidate should be able to demonstrate a logical, safety-oriented approach to questions involving radiological problems, including hypothetical situations.)

12. Demonstrating familiarity with and following all operating procedures and standards of the facility. (Operating personnel should be familiar with the facility's Technical Specifications and notification requirements and procedures. They should also be familiar with requirements regarding needed approval from line supervision, when applicable, in order not to exceed their authority.)

7.6 CERTIFICATION EXAMINATIONS FOR SENIOR REACTOR-OPERATOR CANDIDATES

7.6.1 Categories and Scope of the Initial Written Examination

The written examination required for Senior Reactor Operator certification consists of the five categories listed below. The general content and depth that shall be covered is indicated; the point value for each category is also given. In general, the intent is to reflect the greater depth in required subjects expected of Senior Reactor Operator candidates as compared to that for the Reactor Operator candidates.

1. Theory of nuclear plant operation (Point value: 15 $\pm$ 3)

   This category is intended to contain questions on principles of reactor theory including details of the fission process, neutron multiplication, shutdown margins, source and control-element effects, reactivity anomalies, and criticality indications. It also contains questions on specific operating characteristics of values determined as resultant characteristics (e.g., temperature coefficient, reactivity worth, pressure drop, etc.), and the manner in which power, reactivity, rod worths, or other parameters of the reactor would change in response to control-element manipulations, heatup, core burnup, experiment insertion, or other perturbations.

2. Features of facility design (Point value: 12 ± 3)

This category is intended to contain questions on the design features of the particular facility, with emphasis on those systems that are designed to maintain core integrity, mitigate core damage, and protect against the uncontrolled release of radioactive materials into the coolant or environs. The applicant will be required to reproduce, from memory, fairly detailed sketches or descriptions of various hydraulic, pneumatic, electrical-distribution, cooling, and/or cleanup systems. Questions will be asked on design intent, construction, operation, and interrelationships of those systems most directly associated with normal plant operation and reactor safety. The applicant should be familiar with the conditions which require the use of safety and emergency systems and why such protection is required or specified in the facility's Technical Specifications.

3. Instrumentation and controls (Point value: 18 + 3)

This category is intended to contain questions on the characteristics and interrelationships of the nuclear and non-nuclear instrumentation and control systems, which include principles of operation of detectors, locations and set points of instruments, interlocks, diagrammatic representation of various instrument-control systems, and details of control-element drive or other reactivity-control mechanisms. A candidate is not expected to be an instrument technician; however, questions should probe the individual's ability to recognize the indications of improper instrument performance (e.g., resulting from power failure, air-supply failure, signal failure, etc.) and to understand the potential consequences of such failures.

4. Safety and emergency systems (Point value: 16 ± 3)

This category is intended to contain questions on the design, construction, operation, and interrelationships of systems associated with reactor safety, such as scram and other power-reduction systems, pressure-relief devices, suppression and containment systems, poison-injection systems, spray systems, emergency-power systems, etc.

5. Normal, abnormal, and emergency procedures (Point value: 25 ± 3)

This category is intended to contain questions on the facility's normal, abnormal, and emergency operating procedures. The applicant is not expected to have all the normal procedures committed to memory, but he/she should be able to explain certain sequential steps and the precautions and limitations associated with some of the more important operating procedures. For the abnormal/emergency procedures, the applicant should be able to demonstrate complete knowledge and understanding of the symptoms, automatic actions, and immediate action steps associated with each procedure. Administrative procedures including operating restrictions, limitations in the facility license, and Technical Specifications may be included, to the extent they are directly applicable to the job tasks of a Reactor Operator.

6. Radiation control and safety (Point value: 10 $\pm$ 3)

This category is intended to contain questions on the terminology, radiation hazards, radiological safety practices, discharging and monitoring of radioactive releases, personnel exposure limits, shielding, and some elementary problem solving.

7. Fundamentals of thermodynamics, heat transfer, and fluid flow (Point value: 7 $\pm$ 3)

This category is intended to contain questions on the fundamentals of hydraulics, fluid flow, heat transfer, thermodynamics, and some elementary problem solving. Questions shall test the applicant's knowledge and understanding of the concepts of temperature measurement, density, viscosity, pressure, volume, and the effects of various changes on fluids. The principles of heat transfer by conduction, convection, and radiation as well as characteristics of heat-exchanger operation and natural circulation will be covered in this categoy. Also included may be questions concerning the applicability of these fundamentals to operational transients during accident situations that may result in core damage.

7.5.2 Contents and Scope of the Oral and Operating Examinations

The oral and operating examinations complement the written examination by exploring in depth those areas not amenable to the written examination. The oral and operating examinations should be administered in a manner similar to the examinations given by the NRC to candidates for operating licenses at the nuclear power plants (i.e., one examiner examining one applicant).

The oral examination may explore those areas of the written examination in which the candidate appears to be in doubt or has not expressed himself/herself to the satisfaction of the Examiner. The examination may also explore those areas which require such voluminous wording to describe that inclusion in the written examination would be too time-consuming. The examination may also explore those areas which are important but may not be considered as important by the Examiner as some others to include in the written examination (e.g., questions on security, communications, leadership, etc.).

the reactor and auxiliary systems, including nuclear, hydraulic, thermal, pneumatic, and electrical. Furthermore, it contains questions relating to fuel-element characteristics, the effects of cladding failure, the effects of boiling, and coolant chemistry.

This category is intended to include questions on the understanding and use of curves depicting reactor behavior which may be beyond the scope of knowledge needed by operators for routine operation. These may include, as applicable, differential and integral control-element worth curves (single or group), period versus reactivity curves, void coefficient curves, and poison (xenon, samarium, boron, etc.) worth curves.

The applicant should be able to demonstrate quantitative as well as mathematical expressions regarding reactor behavior; however, these expressions (or formulae) and nuclear constants (fission factors, half lives, etc.) usually need not be committed to memory and will be supplied in the examination when questions requiring them are included. Further, this category may contain questions concerning some aspects of basic, reactor-core and vessel-design limits, as applicable.

(The primary emphasis throughout the examination should be on understanding and practical application of the theory rather than mere memorization of technical facts.)

2. Theory of fluids and thermodynamics (Point value: 10 $\pm$ 3)

This category is intended to contain questions on understanding heat and energy cycles involved with nuclear-plant operations, heat-transfer processes involved with reactor core cooling, reactor thermal limits, identification of plant parameters which can be used to quantify plant heat generation, and heat-transfer information. Questions on understanding the mechanisms of fluid flow as they are encountered in nuclear plants during normal and casualty conditions may also be asked. The applicant should understand the relationship of fluid properties and flow characteristics to the thermal condition of a nuclear reactor and be able to identify plant parameters which can be used to determine fluid flow within the nuclear plant systems associated with heat removal from the reactor core.

Furthermore, this category may contain questions on the alternate methods of core cooling that are available when primary systems are inoperable, the variable parametric changes that affect cooling mechanisms, the effects of gas/steam binding, and the ability to recognize and mitigate the consequences of core damage.

Note: For one of the Category-B reactors (the HPRR), where there is essentially no cooling system, this category may be omitted, in part, on the initial certification examination; however, additional questions on reactor theory and/or pulse operation should be substituted.

3. <u>Plant systems: design, control, and instrumentation</u> (Point value: 25 ± 3)

This category is intended to contain questions about the design features of the particular facility with emphasis on those systems which are designed to maintain and protect against the uncontrolled release of radioactive materials. The applicant should be able to reproduce, from memory, fairly detailed sketches or descriptions of various hydraulic, pneumatic, or electrical distribution systems and mechanical components. Questions may be asked about design intent, construction, operation, and interrelationships of those systems most directly associated with normal plant operation and reactor safety.

Furthermore, this category may contain questions on the characteristics and interrelationships of the nuclear, process, and radiological instrumentation and control systems. These questions may inquire into the principles of operation of detectors, location and set points of instruments, and diagrammatic representation of instrument and control systems. An applicant is not expected to have the knowledge of an instrument technician; but his/her answers should indicate the ability to recognize the indications and consequences of improper performance (e.g., over-compensation, power failure, air-supply failure, signal failure, etc.), including the traces that recorders would show. He/she should also be able to make use of all available instrumentation to provide checks or verification of observed readings.

4. <u>Procedures - normal, abnormal, and emergency, and radiological control</u> (Point value: 25 ± 3)

This category is intended to contain questions on the procedures for the operation of the reactor and auxiliary systems, including administrative controls and technical specifications requirements. In general, an applicant must demonstrate complete knowledge and understanding of the symptoms, automatic actions, and immediate-action steps specified by off-normal or emergency operating procedures. The applicant should be able to describe the objectives and methods used in the normal, off-normal, and emergency operating procedures including how to perform the manipulations or verifications. Operating precautions, restrictions, and limitations, as covered in procedure manuals or in the facility's Technical Specifications, may be included to the extent they are directly applicable to a Senior Reactor Operator.

This category may also contain questions on radiation hazards which conceivably could arise during normal operations or maintenance activities. A reasonable familiarity with the provisions of 10 CFR, Part 20, and/or facility regulations is required as well as a good common sense approach to radiological safety situations. The applicant should be familiar with the concept of ALARA and be able to demonstrate his/her knowledge regarding same.

Also included may be questions relating to procedures and equipment (processing and monitoring) available for handling and disposal systems of the facility and the hazards associated therewith.

This category may also contain questions regarding fuel, fuel handling, and core loading, including procedures and limitations concerning core loading and alteration, fuel transfer and storage, and detection and prevention of criticality.

5. Administrative procedures, conditions, and limitations (Point value: 25 ± 3)

This category is intended to include questions on administrative and procedural items which affect operation of the reactor and those administrative items covered in the Technical Specifications. Also included may be questions on design and operating considerations and limitations, the general procedures required to obtain authority for design changes, the requirements pertaining to the generation and approval of operating procedures, and the source of authority to approve deviations from operating procedures on either a permanent or temporary basis. Questions may also cover the requirements for certain personnel to be present at certain times, the types of records that must be maintained, and certain provisions of pertinent DOE regulations.

7.6.2 Contents and Scope of the Oral and Operating Examinations

The contents and scope of the oral and operating examinations for the Senior Reactor Operator candidate are essentially the same, in general, as those for the Reactor Operator candidate which are covered in Sect. 7.5.2. However, Senior Reactor Operator candidates will be expected to respond in greater detail and be more knowledgeable in such areas as:

1. the academic subjects (i.e., reactor physics, heat transfer, etc.),
2. print reading,
3. transient analysis and reactivity effects,
4. followup actions to all abnormal/emergency operating procedures,
5. logs and records (maintenance, shift turnover procedures, etc.),
6. radiation exposure and/or release limits,
7. laboratory and facility emergency plans,
8. security,
9. safety precautions associated with fuel handling, reactor startups, and all procedures,
10. administrative responsibilities and limits,
11. leadership,
12. industrial safety and environmental protection,

13. problem and decisional analyses,

14. interpersonal communications,

15. line organization requirements, and

16. quality assurance.

In the case of an upgrade Senior Reactor Operator, who had previously passed an oral/operating examination, the facility walk-through for these candidates shall be limited primarily to aspects of reactor-facility operations for which a supervising Senior Reactor Operator is responsible or for which a Senior Reactor Operator's responsibilities are significantly different from those of a Reactor Operator.

7.7 REVIEW OF EXAMINATION PAPERS WITH THE CANDIDATES

After a candidate has completed the initial certification examination, the Examiner will grade the paper as soon as practical; this shall be documented by the Examiner signing and dating the cover page on the date the grading is completed. The Examiner will then schedule a meeting with the candidate for the purpose of reviewing the test paper with him/her. Incorrect answers to questions shall be pointed out; areas of deficiency shall be indicated to the candidate and later to his/her Training Manager. All examination papers, regardless of the grade, shall be reviewed by the candidate; this shall be documented by having the examinee sign and date the cover page of his/her exam on the date the exam is reviewed.

7.8 POLICY TOWARD CANDIDATES WHO FAIL THE EXAMINATIONS

After the Examiner has evaluated the written, oral, or operating examinations, and if it is learned that the candidate has failed one or more of the testing requirements, the information shall be conveyed to the Training Manager, Reactor Supervisor, and Reactor Operations Section Head. The group will review the magnitude of the failure and the overall performance of the candidate during the training program. If the failure is considerably more than marginal, the candidate may be reviewed for possible other employment. If the failure is marginal, the candidate will be given additional training in the weak areas pointed out by the Examiner.

If a candidate is to be re-examined, a suitable period of time will be allowed for retraining (two weeks for a single-subject examination and four weeks for an entire examination). After this time, the Training Manager will request that the Examiner re-examine the candidate.

If the candidate fails only one category of the written examination, but has made an overall grade of 80% or higher, he/she will be required to repeat only that one category. If he/she made less than 80% on the overall test, he/she will be required to repeat the entire certification examination.

If a candidate makes less than 80% overall on the oral/operating examination, he/she will be required to repeat the entire examination. If the candidate fails only portions of the oral/operating examinations, he/she will be required to repeat those portions in which he/she did poorly.

If the candidate already has Reactor Operator certification and fails the Senior Reactor Operator qualification examination, he/she may be permitted to return to his/her Reactor Operator position unless the failure was marginal. If the failure was marginal, he/she will be allowed to prepare for the Senior Reactor Operator examination a second time. If the individual did very poorly on the Senior Reactor Operator exam, he/she will be evaluated on the Reactor Operator level; and he/she may be required to take the Reactor Operator certification examination if he/she had not done so within the last year.

Candidates who fail the Reactor Operator and/or Senior Reactor Operator examination a second time will be seriously reviewed prior to any further training and subsequent re-examination.

7.9 CONDUCTING EXAMINATIONS

7.9.1 Written Examinations

All written examinations for initial certification shall be administered and proctored by the Examiner, or his/her designated alternate, in the office building at the High Flux Isotope Reactor, or a similar, quiet place chosen by the Examiner. There shall be no study aides available in the room in which the examinations are to be given, and the Examiner shall instruct the examinee(s) to:

1. Remove all last-minute study material from the examination area.

2. Verify that all pages in the morning-session of the examination are accounted for and that a list of formulae has been provided on the last page.

3. Use separate paper for answers unless specifically instructed to write on the exam page.

4. Fill out the cover page of the exam.

5. Consecutively number all pages and write "last page" on the last page, then sign and date it.

6. Not use red pencil or red ink.

7. Not waste time by copying each question on the answer sheet.

8. Start a new page for the start of each subject category <u>and</u> draw a line after each answer so that answers do not "run together."

9. Number each answer according to category (e.g., A-3, C-4).

10. Not use abbreviations unless they are very commonly used in facility literature.

11. Show all calculations used to solve any problems.

12. Not write on the back of a page.

In addition, the Examiner shall inform the examinee(s):

1. Of the passing-grade criteria and that the point value for each question appears in parentheses to the right of each question.

2. To write clearly.

3. To ask the Examiner for an explanation if a test question is unclear.

4. To place finished papers face down.

5. To be cognizant of the approximate time frames in which the examination is expected to be completed.

6. To turn in the completed portion of the examination prior to taking a lunch break. (The remainder of the test categories will be issued after re-assembling in the examination room.)

7.9.2 Oral Examinations

The oral examination shall be a one-on-one-type examination, as found to be preferred by industry standards (e.g., the NRC-type examinations administered at the nuclear power plants).

The oral examination shall be in two parts: [illegible] shall be a session in an office where the Examiner will cover the response to all annunciators, startup and other checklists, selected emergency procedures, and selected areas of academic subjects (i.e., reactor physics, heat transfer, etc.); the second part shall be a walk-around in the control room and all major areas of the facility.

7.9.3 Operating Examinations

In general, the operating demonstration will require the candidate to manipulate the console controls to effect either a routine startup of the reactor, a scram recovery, or a dropped control-element recovery. During this phase of the examination, the Examiner shall inform the supervisor in charge that there should also be a certified operator sitting at the console with the examinee and that he/she should assume control if the trainee does anything that may jeopardize the safety of the reactor; however, for some minor stumbling blocks, the examinee should be allowed the opportunity to correct his/her own mistakes. The number of personnel in the reactor control room and the conversational activities should be minimized. The

8. PEQUALIFICATION

8.1 INTRODUCTION

As required by DOE Order 5480.1A, Chapter VI (Safety of DOE-Owned Reactors), a retraining program has been established to maintain the proficiency of the reactor operating personnel through periodic training exercises, lectures, and review covering those items and equipment which relate to the safe operation of the facility.

8.2 GENERAL REQUIREMENTS

An individual's certification to operate an ORNL reactor facility expires automatically two years from the date the Operations Division Director signs the initial certification form. If it is intended that the individual continue to perform in the capacity of a Reactor Operator or Senior Reactor Operator, he/she must have participated in, and satisfactorily completed, a continuing-type retraining program during the two years his/her certification was in effect. This, along with certain other critieria outlined in this section, must be met before a renewal of the certification is issued by the Operations Division Director.

As an overall requirement, all subjects in which training was required for initial certification (as outlined in Sects. 7.5 and 7.6) are to be repeated on a biennial basis; all subjects relating to emergency equipment and procedures are to be repeated on an annual basis. To help achieve this goal, a minimum of six lectures per year, on-the-job training, and certain control manipulations will be required.

It is also required that written, oral, and operating requalification examinations, equivalent to those required for initial certification, be given biennially and examinations on emergency systems and procedures be given annually.

If a certified operator or supervisor has not completed all of the requalification program within two years (not to exceed 27 months) from the previous or initial certification, the individual shall not be allowed to function as a certified operator or supervisor.

If a certified Reactor Operator or Senior Reactor Operator displays serious deficiencies which indicate he/she may operate in an unsafe manner, he/she will be decertified even through the time of his/her previous certification has not expired. Conditions for decertification will be evaluated by the Reactor Operations Section Head, and decertification will be effected by the Section Head.

If a certified operator or supervisor has been away from reactor operations for a significant period of time (but less than twelve months), and then returns, selected retraining and oral and/or written and operating examinations shall be given as deemed necessary. However, if the absence is greater than twelve months, appropriate comprehensive written, oral, and operating examinations (as required for initial qualification) shall be given. Retraining and retesting shall be required in areas where deficiencies have been indicated.

Each Senior Reactor Operator will be required to take all Reactor Operator's written (requalification) examinations in addition to the Senior Reactor Operator's written examinations.

8.3 MEDICAL REQUIREMENTS

A medical examination shall be required of reactor operating personnel on a biennial basis (not to exceed 27 months), or more frequently if circumstances warrant to ensure continued physical stamina, coordination, manual dexterity, vision, hearing, etc. The criteria for acceptability shall be the same as for the initial qualification. (Refer to Sect. 4.2 and Appendix A.)

In addition, if an operator or supervisor has been unable to report to work for an extended period of time (i.e., more than two working days) for reasons of health, an evaluation must be made by the Health Division prior to allowing the individual to resume his/her duties.

To facilitate the handling of qualification documents, toward the end of each two-year certification period, the Medical Division will send to the Examiner a list of names of all those individuals that have met the ORNL medical requirements. This document shall be signed by the Medical Division Director or his/her designated alternate.

For individuals on any restrictions, temporary or otherwise, the Medical Division shall state the restriction, in writing, and send this information to the individual's Reactor Supervisor.

8.4 SECURITY REQUIREMENTS

Periodically, various individuals will be randomly selected for a DOE-type security check, equivalent to the initial security investigation.

9. REQUALIFICATION TRAINING PROGRAMS

9.1 INTRODUCTION

It is recognized that Reactor Operators, as everyone else, tend to lose their overall proficiency in areas of infrequent exposure, such as in the execution of certain procedures covering abnormal and/or emergency situations. In order to minimize the probability of human error and to maintain a high degree of proficiency in required subjects, a comprehensive retraining program has been established, as applicable to the operation of the ORNL reactor facilities.

9.2 OBJECTIVES OF THE RETRAINING PROGRAMS

9.2.1 Reactor Operators and Senior Reactor Operators

The primary objective of the Reactor Operator and Senior Reactor Operator retraining programs is to ensure that all reactor operating personnel maintain a high degree of proficiency in their specific job assignments and continue to operate the ORNL reactors in a safe and reliable manner.

The specific objectives of the retraining programs for Reactor Operators and Senior Reactor Operators are the same as those listed for the initial training programs (Sect. 6.2). In general, it is intended that most of the requirements for the initial certification be repeated on a biennial basis and that all material relating to safety and/or emergency systems and procedures be covered on an annual basis. The only significant difference will be that the academic-type subjects, intended initially as foundation/background material, will not be emphasized as much.

A reasonable amount of Company time will be provided for retraining purposes. The Training Managers and Shift Supervisors will assume responsibility for the scheduling of guest lecturers and the viewing of videotapes. They will also conduct safety meetings and general-information meetings to cover such things as facility and/or procedural changes.

The documentation indicating the participation and performance of certified Reactor Operators and Senior Reactor Operators in the requalification training programs will be maintained amenable for audit. (Refer to the Subject and Study-Time Checklist in Appendix D.)

9.2.2 General Employee Training

At this time, the training responsibilities of the Reactor Operations Section to the general employee entering reactor facilities will be limited to the initial training requirements and the coverage/completion of the "Dos and Don'ts"-type checklists. Since the Laboratory is currently implementing a General Employee Training Program, there are no further plans to have any additional training given by Reactor Operations personnel, unless specifically requested.

9.3 SUBJECT MATERIAL AND DEPTH

The subject material and depth to be covered in the requalification training programs shall be, for the most part, the same as that required in the initial training programs (refer to Sects. 6.3.2 and 6.4.2). However, there will be an effort to approach the academic-type subjects (e.g., reactor physics, heat transfer, etc.) from the standpoint of practical applications, and some further emphasis may be placed on unusual occurrences, changes in operating procedures, review of ORNL safety-oriented literature, etc.

9.4 TRAINING MATERIALS AND RESOURCES

The training materials and resources that will be used in the requalification training programs shall be same as those used for the initial training, as outlined in Sects. 6.3.3 and 6.4.3.

9.5 TRAINING METHODS

The various methods that will be used to accomplish retraining will be essentially the same as those used for the initial training (refer to Sects. 6.3.4 and 6.4.4); however, there will be less emphasis on the one-on-one-type training conducted by the Training Manager with a trainee. One-on-one-type training may be used for special topics and/or circumstances. For the most part, training will be accomplished by self-study; however, live lectures shall not be excluded.

As appropriate for a particular facility, retraining should be accomplished primarily as a shift or group effort. For example, the Shift Supervisor should lead a walk-through response to each abnormal/emergency operating procedure with his/her crew. The Training Manager and/or Shift Supervisor will assume the responsibility of scheduling guest lecturers, conducting safety meetings or general-information meetings, and/or conducting training sessions themselves.

9.6 TRAINING SCHEDULE

Notification of the subjects to be covered in the requalification program shall be accomplished, in part, by issuing schedules (to each operator) on which are listed the specific subjects that are to be covered and the months when examinations will be given. (An example of a Subject and Study-Time Checklist is included in Appendix D.)

Upon completion of the training at the Category-A reactors, written examinations will be administered on the required subjects, as scheduled by the Examiner. At the Category-B reactors, an all-subject written examination will be given toward the end of the two-year certification period and examinations on emergency procedures will be given during the in-between years.

10. RECERTIFICATION

10.1 GENERAL

The recertification of Reactor Operators and/or Senior Reactor Operators is the responsibility of the Operations Division Director. He/she is the highest level of ORNL management necessary to certify reactor operating personnel.

The evaluation of an individual for recertification shall be based, in part, on the successful completion of required written, oral, and operating examinations administered by the Examiner and a satisfactory medical report on the operator or supervisor from the Health Division. Evaluations of each individual will also be made by the Training Managers, the Reactor Supervisors, and the Reactor Operations Section Head prior to the final evaluation by the Operations Division Director.

10.2 PROCEDURE FOR RECERTIFICATION

Throughout the two-year certification period, the requalification program will be in progress. The Examiner will prepare, administer, and evaluate all the examinations given during this requalification period. This will include the periodic, individual-subject exams given at the Category-A reactors and one Category-B reactor (the BSR) and the biennial, all-subjects exams given at the remaining Category-B reactors. During the last two months that certification remains in effect, the following procedure will be followed:

1. The Examiner will review the grades that the Reactor Operators and Senior Reactor Operators made on the written examinations. He/she will also review the results of the oral and operating examination and any checklists applicable during the two-year period of time that certification was in effect.

2. The Examiner will obtain a statement from the Director of the Health Division verifying that all the reactor operators continue to meet the medical requirements. This information will be verbally conveyed to the Reactor Operations Section Head. (In the event someone does not meet the medical requirement, an evaluation of the individual's status will be made by the Reactor Operations Section Head and the Health Division Director.)

3. The Examiner will report the overall status of the individuals to the Training Manager, Reactor Supervisor, and Reactor Operations Section Head one month prior to the certification expiration date.

4. If the individual has satisfactorily completed all phases of the requalification training and testing requirements and the Reactor Supervisor requests that his/her certification be renewed, the

Examiner will initiate the required documentation for recertification. If the individual has not satisfactorily completed all the required work, he/she will be given an opportunity to catch up during the remaining few weeks. This may include taking makeup exams or repeating categories that were failed during the periodic exams.

5. The Examiner will sign and date the Renewal of Reactor Operator Certification form and/or the Renewal of Senior Reactor Operator Certification form, as applicable to his/her approval for recertification. (An example of these forms are included in Appendix D.)

6. The Examiner will deliver the above-mentioned forms to the Training Manager who, in turn, will sign and date each document, as applicable to his/her approval.

7. The document will then be delivered to the Reactor Supervisor who, in turn, will sign and date each document, as applicable to his/her approval.

8. The Reactor Supervisor will then deliver the document to the Reactor Operations Section Head who will also sign and date each form, as applicable to his/her approval.

9. The Reactor Operations Section Head will deliver the document to the Operations Division Director; if all the required input to the Operations Division Director indicates a satisfactory appraisal, he/she will sign and date the renewal document. At this time, the individual's certification is officially renewed for another two years.

10. The Operations Division Director will notify the Reactor Operations Section Head of the completion of the recertification process and send to the Training Coordinator copies of the finalized, certification-renewal forms. The Section Head will notify the Reactor Supervisor who, in turn, will inform the new Reactor Operator and his/her immediate supervisor.

10.3 TESTING AND GRADING REQUIREMENTS

The testing and grading requirements for the requalification oral and operating examinations shall, in essence, be the same as for the initial certification as described in Sect. 7.2; however, there shall be some differences. These are:

1. The Examiner need not spend as much time with each individual as he/she did for the initial examination, and the oral examinations need not be as formal (e.g., the Examiner may ask questions and observe the performance of an operator while he/she performs scheduled, routine tasks).

2. The Examiner will return the original, filed checklists to the facility's Training Manager who, in turn, will distribute them to the shift supervisors. The shift supervisors will cover selected portions of the checklists to ensure that the operators on his/her shift remain knowledgeable about certain items. This will serve, in part, as an oral examination for the individuals on his/her shift. [The second set of columns (i.e., Trainer/Trainee, Date) on the Qualification Checklists has been provided for this purpose.]

3. At various times during the certification period, the Examiner may request that the operating personnel perform dropped control-element, scram recoveries, and/or other control manipulations, as the availability of the reactor allows.

4. In addition, the operating personnel at the Category A reactors and one Category B reactor (the BSR) are required to take single-subject written examinations approximately every three months. At the remaining Category B reactors, operating personnel take an all-category-type written examination on a biennial basis. For the biennial examinations, the Examiner will grade the examination papers and provide feedback to the individuals as soon after the testing as practical.

5. In those cases where significant changes have been made at a reactor facility (e.g., installation of a new servo system), the Examiner will include questions on the instrument modifications on the next scheduled requalification examination even though the prescheduled subject might be Radiation Control and Safety or some other non-related subject.

All requalification examinations shall be administered and proctored by the Examiner, or his designated alternate, in Building 7910 or some similar area selected by the Examiner.

10.4 RECERTIFICATION EXAMINATIONS

10.4.1 Categories and Scope of the Requalification Written Examinations

10.4.1.1 For Reactor Operators

The requalification written examination for Reactor Operators shall be made up of the following categories:

1. Principles of Reactor Operation (Reactor Physics, Heat, Fluids)
2. Features of Facility Design
3. Instrumentation and Controls
4. Safety and Emergency Systems
5. Normal, Abnormal, and Emergency Procedures
6. Radiation Control and Safety

The scope of the examination subjects shall be the same as described in Sect. 7.5.1.

The point value for each category will be 100% when it is a single-subject examination (at the Category-A reactors and the one Category-B reactor, the BSR). The point value for each category will be 12, 15, 23, 15, 25, and 10, respectively, when a single, all-subject examination is given.

10.4.1.2 For Senior Reactor Operators

The requalification written examination for Senior Reactor Operators shall be made up of the following categories:

1. Theory of Nuclear Plant Operations (Reactor Physics, Heat, Fluids, Thermodynamics)

2. Plant Systems: Design, Control, and Instrumentation

3. Procedures: Normal, Abnormal, Emergency, and Radiological Control

4. Administrative Procedures, Conditions, and Limitations

The scope of the examination subjects shall be the same as described in Sect. 7.6.1.

The difference between the initial certification examinations and the requalification examinations for both the Reactor Operator and Senior Reactor Operator is that the single-subject category of heat transfer and fluid flow was omitted from both requalification examinations. The subject material will still be covered, in part; however, it shall now be incorporated in Category 1. The rationale for this is that it is believed that more emphasis should be placed on the academic-type subjects initally to establish a good background for all the new training material to be assimilated. For the requalification examinations, it is intended that a more practical application of the academic material be taken.

10.4.2 Contents and Scope of the Requalification Oral and Operating Examinations

The content and scope of the requalification oral and operating examinations shall, in essence, be the same as described in Sects. 7.5.2 and 7.6.2 for the initial certification; however, they need not be as long in duration unless the Examiner feels that an individual may require further testing in order to make an evaluation.

10.5 REVIEW OF EXAMINATION PAPERS WITH THE CANDIDATE

To allow the candidate to be aware of the correctness and/or acceptance of his/her responses to the questions on the written examination, the Examiner will review the individual's paper with him/her as needed. In the case of the examinations given on a biennial basis, this review will be performed shortly after the entire test is graded by the Examiner. Examinations given on the three-month basis will be reviewed as soon as practical after the exams are graded. Since the overall grades on the requalification examinations have been consistently higher than those on the initial certification examinations, the need for the detailed review of the graded paper by the Examiner may not be necessary; however, the reason for point deductions shall be written on the examination paper adjacent to the incorrect answer. After reviewing the graded paper, the examinee shall sign and date the front page.

10.6 POLICY TOWARD OPERATORS AND SUPERVISORS WHO FAIL THE EXAMINATIONS

When it has been determined by the Examiner that a certified Reactor Operator or Senior Reactor Operator has not made a passing grade on a requalification examination (i.e., he/she did not make 70% or above in each category and 80% overall), the Examiner will inform the Reactor Operations Section Head of the individual's examination status.

The Reactor Operations Section Head will review any information supplied by the Examiner and then inform the Reactor Supervisor at the facility at which the individual is assigned that the individual has not satisfactorily met the requalification testing requirements and that the individual must repeat either the entire examination or a certain portion of the examination, as applicable.

If the individual did poorly on an entire, all-categories examination (i.e., less than 80% overall), he/she will be required to repeat the entire examination. If the individual did poorly in one or more categories (i.e., less than 70%) but made 80% or higher in the overall examination, he/she will be required to repeat only the failed categories.

If the individual did poorly on a periodic (single-subject) requalification examination (i.e., less than 70%), he/she will be required to repeat the examination. A grade less than 80% will require further training in the one category but not retesting unless the trend in grades indicates that the overall average grade will be less than 80% at the end of the two-year period of time. In this case, the individual will be required to take a written test on selected categories at the end of the two-year period so that the overall grade may be raised to 80% or higher if deserved.

An individual will be allowed a reasonable period of time to prepare for re-examination (i.e., up to two weeks for a single-subject examination and up to four weeks for an entire recertification examination). If the second requalification examination is not administered within two months, the individual shall be automatically decertified.

Until the individual repeats a required requalification examination and makes a satisfactory grade, he/she will be allowed to perform his/her normal duties as a Reactor Operator with the permission of the Reactor Operations Section Head; however, if the individual does not pass the second requalification examination satisfactorily, the Examiner will inform the Reactor Operations Section Head, who, in turn, will decertify the individual. If there are extenuating circumstances, the individual will be considered for retesting a third time; if there are none, he/she will no longer be permitted to be a candidate for recertification. Reinstatement as a Reactor Operator will require repetition of the initial certification examination and approval by the Operations Division Director.

10.7 DECERTIFICATION

An individual may be decertified at any time during the two-year period his/her certification is in effect for any of the following reasons:

1. failure to meet or comply with the training/testing requirements stated in this document,

2. failure to meet the ORNL medical requirements for reactor operating personnel, or

3. failure to meet the established performance standards.

Although an individual may be relieved from doing a particular job by his/her immediate supervisor because of unsatisfactory or unsafe performance, the authority for officially decertifying anyone will be that of the Reactor Operations Section Head and the Operations Division Director. The Section Head will inform the Training Coordinator and Reactor Supervisor; the latter individual will inform the decertified person and his/her immediate supervisor.

11. ADMINISTRATION

11.1 IMPLEMENTATION OF THE TRAINING PROGRAM

It shall be the responsibility of each facility's Reactor Supervisor, along with all those individuals involved in training or in the certification process, to implement this training plan for reactor operating personnel in accordance with the requirements and/or guidelines stipulated in this document. The responsibilities of Reactor Operations personnel for the training of support personnel, experimenters, maintenance personnel, secretaries, visitors, etc., shall be limited to the general-employee-type training required for reactor-building access.

The implementation date shall be that date on which the Operations Division Director completes his/her review and approval of this document and affixes his/her signature to the cover page. (At that time, the existing training plan, Qualification Requirements and Training Program for Reactor Operating Personnel at the Oak Ridge National Laboratory, W. H. Culbert, January 29, 1982, shall be cancelled.)

11.2 EVALUATION OF TRAINING PROGRAM EFFECTIVENESS

The effectiveness of the Reactor Operator and Senior Reactor Operator training programs shall be evaluated periodically by those individuals responsible for the overall operation of the facility and by those responsible for the training. The following factors shall be considered in the evaluation process; inadequacies should be reported to the Training Coordinator.

1. Examinations. The written, oral, and operating examinations shall be evaluated by the Examiner. Indications of deficiencies in training will be reported to the Training Managers and the Section Head.

2. Unusual Occurrence Reports (UORs). The UORs generated at each facility shall be reviewed by the Training Coordinator and the Training Managers for operator error, or any other cause, that may be indicative of training deficiencies.

3. Solicited Feedback. The Section Head, Training Coordinator, and Training Managers shall periodically solicit comments from the operators on their evaluation of the training given to them, from the trainers on their evaluations of the training sessions, and from the supervisors on their appraisals of their operators' performance.

4. Maintenance Problems. The Maintenance Managers at each facility shall report all problems or potential problems associated with the performance of maintenance to the facility's Reactor Supervisor if such problems are training related.

5. Audits by the Reactor Operations Review Committee (RORC). One or more members of the RORC will periodically spot-check and/or conduct interviews, as they consider appropriate for their evaluation process. Comments on training effectiveness are reported in writing to upper management.

6. Drills. The operating crew's response to planned emergency drills shall be critiqued by the Shift Supervisor and the various observers. Indications of training deficiencies shall be reported to the Training Managers, Section Head, and Examiner.

7. Informal Interviews by Upper Management. During routine surveillance of reactor operations, the Section Head and the Division Director will, in essence, be evaluating the competence of the operating staff as they question various individuals on specific details of current activities. Noted deficiencies and/or needed improvements in training will be called to the attention of all those concerned.

Correcting reported inadequacies in training shall be the responsibility of the Training Coordinator.

11.3 INITIAL AND PERIODIC REVIEW OF THE TRAINING PROGRAM DOCUMENT

The training programs for ORNL's reactor operating personnel described in this document shall be reviewed and approved initially by the Reactor Operations Section Head, the ORNL Office of Operational Safety, and the Operations Division Director. The date on which the Division Director signs the cover page of this document is the date on which implementation shall become effective. On an annual basis thereafter, this document shall be reviewed by the Training Coordinator and approved by the Reactor Operations Section Head. All these reviews/approvals shall be documented. (Refer to the Training Program Review Checklist in Appendix D.)

11.4 DOCUMENT REVISIONS AND DISTRIBUTION

From time to time, revisions will be made to this training plan and associated appendices as changes in policy, training methodology, and content of training material may require.

Items which should be considered and which may necessitate issuing a revision to this document are:

1. A significant change in DOE Order 5480.1A, Chapter VI, or in any other DOE Order which addresses the qualification requirements of reactor operating personnel.

2. A significant change in an industry trend, reflecting improvements in training methodology or changes in the content of training materials, as indicated in DOE, NRC, INPO, or ANS literature.

3. A significant change in an operating policy of Martin Marietta Energy Systems, Inc., the Oak Ridge National Laboratory, the Operations Division, or the Reactor Operations Section.

4. A significant change in equipment that would necessitate a major revision to a facility's checklist.

Minor changes to the organization chart or to a facility's checklist will not necessarily constitute a significant change.

A revision to this document may be suggested by any responsible person in the organization who may be knowledgeable of any changes which may subsequently justify revising this training plan and/or appended material. The procedure to effect a revision to this document shall be:

1. The originator of a proposed revision shall discuss the nature of the revision and the justification for it with the Reactor Supervisor of the facility. It shall be the Reactor Supervisor's responsibility to decide if a revision should be effected.

2. If a revision to the document is considered appropriate, the Reactor Supervisor shall inform the Training Coordinator; the Training Coordinator will effect the actual revision to the document after receiving the draft of the proposed changes.

3. After the proposed revision is prepared, the Training Coordinator will issue a draft copy to the Reactor Operations Section Head. If the Section Head approves the revision, copies will be forwarded to the Operations Division Director, ORNL's Office of Operational Safety, and the Oak Ridge Operations (ORO) of the DOE for review and approval.

4. If all the reviews are satisfactory, the revisions will be finalized and issued to all those individuals with controlled copies of the training-plan document, and it will be recorded as a revision in this document. (Refer to the List of Revisions in Appendix D.)

A "controlled" copy is one that will be maintained current by the Training Coordinator and will reflect the most recent changes. An "information" copy will describe the training programs at the time the training-plan document was originally issued and will be maintained in updated form only by the recipient. A "controlled" copy is to be used when seeking current information; "information" copies are primarily for general descriptive purposes. Those individuals on the distribution list with an asterisk adjacent to their name shall be the recipients of the controlled copies.

11.5 DOCUMENTATION FOR AUDIT

To ensure, in part, that all the requirements for training, initial certification, and requalification, as stated in this document, are met, the following documents shall be maintained available for auditing purposes:

1. A controlled copy of this Training-Plan document, including the checklists for each facility
2. Initial Certification Examination for Reactor Operator (these are the graded, written examinations for each operator)
3. Initial Certification Examination for Senior Reactor Operator
4. Recertification Examination for Reactor Operator
5. Recertification Examination for Senior Reactor Operator
6. Oral/Operating Examination Evaluation Form
7. Summary of Requalification Examination Grades*
8. Subject and Study-Time Checklist*
9. Facility Training/Qualification Checklists
10. Reactor Startup Checklist and Related Work*
11. Initial Certification for Reactor Operator (form)
12. Initial Certification for Senior Reactor Operator (form)
13. Renewal of Reactor Operator Certification (form)
14. Renewal of Senior Reactor Operator Certification (form)
15. Medical status report*

Refer to Appendix D for examples of most of the above documents.

With the exception of the original certification and renewal of certification forms (which are filed in the office of the Division Director), all the above-mentioned documents, upon their completion, shall be maintained by the Training Coordinator/Examiner (Bldg. 7910, Room 7). The Subject and Study-Time Checklists and the Training/Qualification Checklists, while they are being used, are to be maintained amenable for audit by the Training Managers at each reactor facility.

*These documents will be maintained in a group folder; the remaining personnel documents will be maintained in the individual's file.

All documents will be maintained in accordance with DOE Order 1324.2, Records Disposition, as applicable.

The Training Coordinator will also maintain a file on the qualifications of those individuals presently having the responsibility for training and examining.

11.6 WAIVER OF REQUIREMENTS

Any waiver of any qualification or training requirement stated in thi document must have the approval of the Reactor Operations Section Head and the Division Director.

Any waiver of any medical requirement shall be in accordance with Sect. A.7.3.

During those months when no examinations are scheduled, periodic safety meetings, lectures on other required subjects, etc., may be scheduled by the Shift Supervisor on each shift or by the Training Manager.

Since operating personnel at the Category-A reactors and one Category-B reactor (the BSR) are required to take written examinations approximately every three months, their training shall be during the in-between months and shall address primarily the subject of the upcoming, scheduled examination. An exception to this would be at a facility where significant changes in instrumentation have been made and the subject of the upcoming test is, for example, Radiation Safety rather than the more appropriate subject of Instrumentation and Controls (which may not be scheduled until six months later). In such cases, the Training Manager shall not only cover the scheduled subject, he/she shall also spend some time on the modifications to the instrumentation. The Examiner, in turn, will include a few questions on the instrument modification on the upcoming test, regardless of the scheduled subject.

12. REFERENCES

A. DOE Literature

1. Order 5480.1A, Chapter VI, "Safety of DOE-Owned Reactors"
2. Order 5481.1B, Safety Analysis and Review System
3. Order 5480.1A, Chapter XI, "Requirements for Radiation Protection"
4. Order 5480.1A, Chapter V, "Safety of Nuclear Facilities"
5. Various appraisals (DOE/US-0013, DOE/US-0018)
6. Order 5484.1, Environmental Protection, Safety, and Health Protection Reporting Requirements
7. Order 5484.2, Unusual Occurrence Reporting System
8. DOE/EP-0095, Guidelines for Job and Task Analysis for DOE Nuclear Facilities
9. Order 5500.2, Emergency Planning, Preparedness, and Response for Operations
10. Order 5500.3, Reactor and Nonreactor Nuclear Facility Emergency Planning, Preparedness, and Response Program for DOE Operation
11. Order 5500.4, Public Affairs Policy and Planning Requirements for Emergencies
12. Order 5700.6A, Quality Assurance
13. Order 1324.2, Records Disposition

B. NRC Literature

1. NRC Action Plan Developed as a Result of TMI-2 Accident (NUREG-0660)
2. Analysis, Conclusions, and Recommendations Concerning Operator Licensing (NUREG/CR-1750)
3. Operator Licensing Examiner Standards (NUREG-1021)
4. Codes of Federal Regulation, 10-CFR-20, -50, -55, and -100
5. "Medical Evaluation of Nuclear Power Plant Personnel Requiring Operator Licenses" (Reg. Guide 1.134)
6. "Personnel Qualification and Training" (Reg. Guide 1.8)
7. Classification of TMI Action Plan Requirements (NUREG-0737)
8. Handbook on Human Reliability Analysis with Emphasis on Nuclear Power Plant Applications (NUREG/CR-1278)
9. "Instructions Concerning Risks from Occupational Radiation Exposure" (Reg. Guide 8.29)
10. Criteria for Preparation of Emergency Operating Procedures (NUREG-0799)
11. Evaluation of Training Programs and Entry Level Qualifications for Nuclear Power Plant Control Room Personnel Based on the Systems Approach to Training (NUREG/CR-3414, ORNL/TM-8848)
12. Operational Decision Making and Action Selection Under Psychological Stress in Nuclear Power Plants (NUREG/CR-4040)
13. Development of a Checklist for Evaluating Maintenance, Test, and Calibration Procedures Used in Nuclear Power Plants (NUREG/CR-1368)
14. Development of a Checklist for Evaluating Energy Procedures in Nuclear Power Plants (NUREG/CR-1970, SAND81-7070)
15. TMI-2 Lessons Learned Task Force. Final Report (NUREG-0585)

C. INPO Literature

1. Guidelines for Qualification Programs (non-license)
2. Guidelines for Mechanical Maintenance Personnel Qualifications
3. Guidelines for Electrical Maintenance Personnel Qualifications
4. Radiological Protection Technician Qualifications
5. Guidelines for Instrument and Control Technician Qualifications
6. General Employee Training (Performance based)
7. Performance Objectives and Criteria for Plant Evaluations
8. Good Practices, Development and Implementation of On-the-Job Training
9. Guidelines for Qualifications Programs at Operational Units (for licensed operators)
10. Recommendations for Shift Technical Advisor
11. Job and Task Analysis User's Manual
12. General Employee Training in Radiological Protection
13. The Accreditation of Training in the Nuclear Power Industry
14. Guidelines for Training to Mitigate the Consequences of Core Damage
15. Guidelines for Heat Transfer, Fluid Flow, and Thermodynamics
16. Guidelines for Qualification Programs: Control Room Operator, Senior Control Room Operator, and Shift Supervisor
17. Nuclear Power Plant Requalification Program for Licensed Personnel
18. Principles of Training Systems Development (INPO 85-006)

D. ANS/ANSI Standards

1. ANSI/ANS-3.1, "American National Standard for Selection, Qualification and Training of Personnel for Nuclear Power Plants"
2. ANSI-N 18.1-1971, "Selection and Training of Nuclear Power Plant Personnel"
3. ANSI/ANS-15.4-1977, "Selection and Training of Personnel for Research Reactors"
4. ANSI, N16.1-1969, "American National Standard for Nuclear Criticality Safety Operations with Fissionable Materials Outside Reactors"
5. ANS-3.2, ANSI N18.7-1976, "Administrative Controls and Quality Assurance for the Operational Phase of Nuclear Power Plants"
6. ANSI/ANS-15.1-1982, "Standard for the Development of Technical Specifications for Research Reactors"
7. ANSI, N18.17-1973, "Industrial Security for Nuclear Power Plants"
8. ANS-Std. 1-1967, "A Code of Good Practices for the Performance of Critical Experiments"
9. ANS-3.4/ANSI N546-1976, "American National Standard Medical Certification and Monitoring of Personnel Requiring Operator Licenses for Nuclear Power Plants"
10. ANSI/ASME NQA-1, "Quality Assurance Program Requirements for Nuclear Facilities"

E. Training Centers/Consultants

1. NUS - Reactor Training Program
2. Texas Educational Research Center - Training Program
3. Analysis and Technology, Inc., Job and Task Analysis for Nuclear Power Plant Personnel (and various studies for NRC)
4. Memphis State (studies for DOE), Guidance for Training Program Evaluation, DOE/EV/10782-T1, January 1984.

F. Other DOE Facilities

1. L. L. Junker, High Flux Beam Reactor Training Plan, Brookhaven National Laboratory, May 19, 1983
2. Training workshops at various DOE reactor facilities
3. EG&G's generic training material (11 manuals)
4. Periodicals, communications, etc., from Training Coordinator's Workshop (semiannual meetings)
5. D. C. French, Reactor Appraisal Criteria
6. Training Programs Manual for the Fast Flux Test Facility

G. ORNL Literature

1. Descriptive and procedure manuals of the HFIR, ORR, BSR, TSR, HPRR, PCA, and CEF
2. Technical Specifications of each ORNL reactor facility
3. Question-and-answer books on generic subjects (reactor physics, heat transfer, radiation)
4. Programmed instruction manuals on generic subjects
5. Unusual Occurrence Reports
6. Industrial Hygiene Manual
7. Quality Assurance Manual
8. ORNL Respirator Program
9. Local Emergency Manual
10. ORNL Emergency Manual
11. Operations Division Special Administrative Requirements Manual
12. Policy Procedures Manual
13. Standard Practice Procedures
14. W. H. Culbert, Qualification Requirements and Training Program for Reactor Operating Personnel at the Oak Ridge National Laboratory, January 29, 1982.
15. W. H. Culbert, Training Material on Core Damage for the High Flux Isotope Reactor
16. Guide for Training Nuclear Power Plant Operators, ORNL/TM-5304
17. Log books
18. Weekly reports

H. Miscellaneous

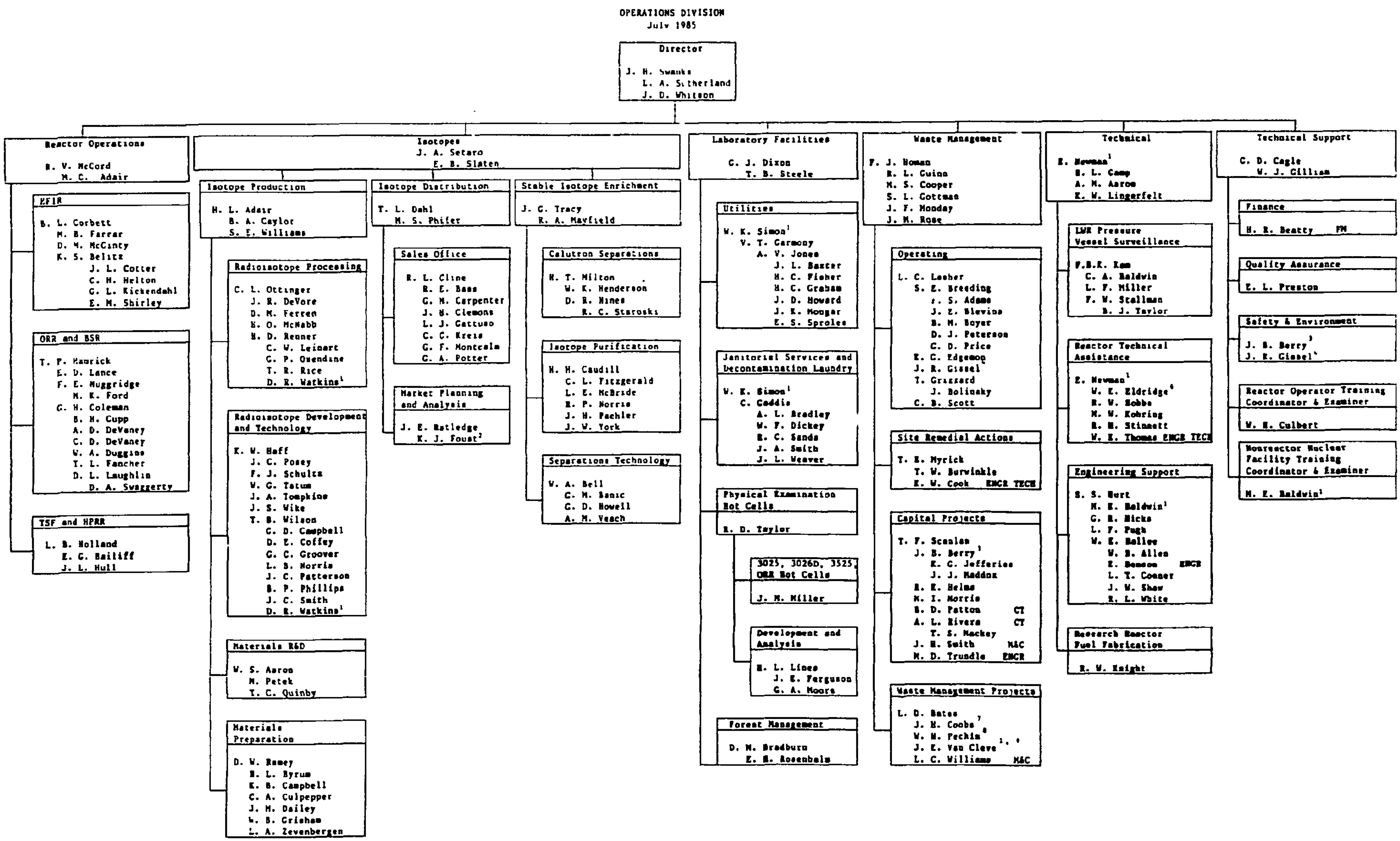
1. The Report of the President's Commission on The Accident at Three Mile Island

2. Criteria for Evaluating DOE Nuclear Facility Training Programs

   a. DOE-sponsored Training-Managers Workshops (coordinated by EG&G)
   b. NRC Examiners' annual workshop
   c. Various appraisals by DOE and ORNL
   d. Instructions from NRC group leaders on subjects to emphasize on NRC licensing examinations

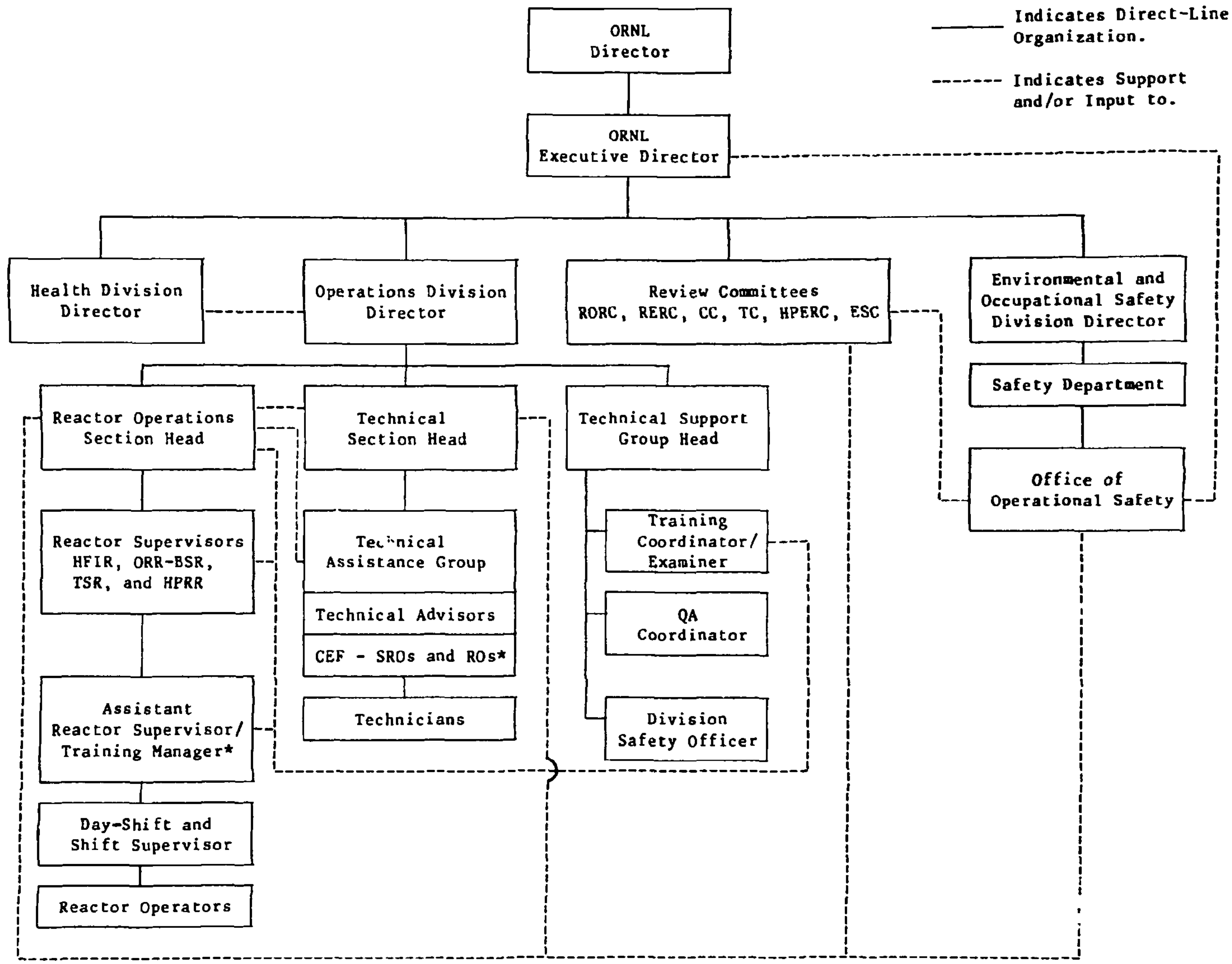
3. Power Reactor Events

A.1. OPERATIONS DIVISION ORGANIZATIONAL CHART



[1] Dual Capacity
[2] Affirmative Action
[3] Environmental Protection Officer (EPO)
[4] Divisional Safety Officer-Radiation Control Officer (DSO-RCO)
[5] Reactor Experiment Coordinator
[6] On IAEA Assignment
[7] On Loan to Central Management Offices
[8] On Loan to Environmental Sciences
[9] Co-op Student

A.2. STAFF ORGANIZATION FOR ORNL REACTOR FACILITIES AND THE CRITICAL EXPERIMENTS FACILITY (CEF)



*Exceptions: 1. At the TSR and HPRR, the Reactor Supervisor is also the Training Coordinator.
2. The CEF is operated by personnel in the Technical Group.

A.3. STAFFING SUMMARY OF ORNL REACTORS*

Category	Reactor	Reactor Operators	Senior Reactor Operators
A	HFIR	12 (union; 42% N.N.)	10 (monthly; 30% N.N.; 50% C.D.)[a]
A-B[b]	ORR-BSR	12 (union; 50% N.N.)	10 (monthly; 20% N.N.; 30% C.D.)
B	TSR	3 (monthly; 100% C.D.)	3 (same individuals; 100% C.D.)
B	HPRR	3 (monthly; 100% C.D.)	3 (same individuals; 100% C.D.)
B	PCA	4 (monthly; 100% C.D.)	4 (same individuals; 100% C.D.)
B	CEF	4 (monthly; 100% C.D.)	4 (same individuals; 100% C.D.)

[a]N.N. - Nuclear Navy training; C.D. - persons having college degrees.
[b]The BSR is a Category-B reactor; however, it is operated by the same individuals who operate the ORR.

Total number of people certified as Reactor Operators:	24 at the Category-A reactor facilities 14 at the Category-B reactor facilities
Total number of people certified as Senior Reactor Operators:	20 at the Category-A reactor facilities 14 at the Category-B reactor facilities
Total number of Reactor Operators in the bargaining group voluntarily taking the Senior Reactor Operator examination:	5

*This indicates the staffing of the ORNL reactor facilities at the time of publication of this training-plan document. The numbers indicated may vary from time to time.

A.4. POSITION TASK ANALYSES

DOE Order 5480.1A, Chapter VI requires that a position task analysis be conducted as necessary for operating personnel to define the tasks performed by the person in each position and to identify the required training, in conjunction with the education and experience, necessary to provide assurance that the tasks can be effectively performed. The position task analysis should include normal and emergency duties and place emphasis on the role played by every member of an operating organization that ensures safe plant operation.

The proper execution of a formal job tasks analyses (JTAs), as performed by INPO, various consultant groups, or a facility's human-factor groups, etc., is a very time-consuming operation. At the large, complex nuclear power plants, the benefits of the formal JTAs are apparent. At the relatively small, far less complex research reactors found at ORNL, where such reactors have been operated for over forty years, the benefits are not readily apparent. A formal job task analysis had been started at one of the Category-A reactors, and it was the opinion of the training staff that the end product would have little or no influence on effecting any significant or meaningful change in the existing training programs. Consequently, informal position task analyses were prepared for several key personnel in the Operations Division who are involved in the training/certification process, who influence the quality of training, or who are required to receive reactor-oriented training for their particular job tasks. Each analysis (or perhaps more appropriately, position description) covers the qualification requirements pertaining to education, experience, and training along with the overall responsibilities and duties of the position. This approach is believed to be more appropriate for the ORNL research-reactor facilities.

From time to time, special cases may arise where it may be within reason to request a waiver or substitution of a qualification requirement stated in this section. Such requests shall be reviewed on a case-by-case basis by the Division Director. Significant deviations from established policy regarding qualification requirements will be prepared as a revision to this document and will be reviewed by the DOE. The Division Director will be the individual to make this type of decision. (Refer to the comments and/or justification for any deviation from DOE Order 5480.1A in Sect. 3.3.)

A.4.1 OPERATIONS DIVISION DIRECTOR

Qualification Requirements

1. Education. The Director of the Operations Division at ORNL should have a minimum of a Bachelor's degree in engineering or one or more of the sciences.

2. Experience. The Operations Division Director should have sufficient technical management experience and education to demonstrate adequate capabilities for the responsibilities listed below.

3. Training. The Operations Division Director should have specialized training, as appropriate, for upper-level (corporate) management personnel in the ORNL organization. Such training should be in Company policies, responsibilities, handling of allocated funds, planning needs (i.e., manpower needs) for future projects, communications with other levels of management, and reporting requirements. In addition, special training should be given (if not already acquired) on regulations imposed on nuclear reactor facilities by DOE and other federal agencies. General employee training is also applicable.

Responsibilities and Duties

With respect to the safe and efficient operations of ORNL research reactors, the Operations Division Director is expected to:

1. Direct the activities of the Reactor Operations Section Head in a manner to achieve the various objectives safely and in accordance with established Martin Marietta Energy Systems, Inc., ORNL, Division, and/or DOE guidelines.

2. Either personally be available to make needed management-level decisions during normal operations or have a designated alternate be available.

3. Provide needed services or advice on matters relative to operations or projects under his/her jurisdiction to various personnel both within and outside the ORNL organization.

4. Maintain effective communication with higher levels of corporate management and prepare certain status reports required by the Laboratory Director and other members of corporate management.

5. Evaluate the existing facilities and operations and effect the necessary plans to ensure that future needs in equipment, manpower, funding, etc., are accomodated and/or executed according to planned schedules.

Responsibilities and Duties (continued)

6. Schedule and/or conduct information-type meetings with Operations Division personnel to establish Division goals and objectives.

7. Investigate, report, and/or provide remedies for deficiencies or failures in operations by monitoring the overall operations of the various facilities and effect improvements needed to ensure safe, reliable, and efficient operations.

8. Maintain a high degree of knowledge of all Company policies and have practical knowledge of industry standards and DOE regulations pertaining to reactor facilities and the qualification of operating personnel.

9. Take the necessary measures to ensure that such policies and regulations are acknowledged and adhered to by all personnel under his/her jurisdiction.

10. Serve in emergency situations in the capacity of an advisor to ORNL's Emergency Director or the Local Emergency Director.

11. Ensure that emergency services and equipment are available, as applicable for nuclear facilities.

12. Ensure that a working environment is provided which allows and encourages effective individual and group efforts toward meeting the organization's objectives through sound decision-making processes, open communication, and proper selection, motivation, and development of people.

13. Investigate and/or review all unusual occurrences reported at any of the reactor facilities, as applicable.

14. Ensure that designated individuals maintain required documentation amenable for audit by ORNL and/or DOE auditors.

15. Implement a quality assurance program for the Operations Division.

16. Review and approve all the Operations Division's training-plan documents required by DOE Orders (e.g., 5480.1A, Chapter VI, for reactor facilities) and provide the necessary upper-management involvement and impetus to effect the initial and continued implementation of all approved training programs.

17. Review and make the final decision on any special cases involving deviations from an established policy pertaining to the selection, training, and/or certification of reactor operating personnel.

18. Become actively involved in the selection and evaluation process of reactor operating personnel. This may be accomplished by conducting interviews and monitoring work performance and other records.

19. Certify all reactor operating personnel for all ORNL reactor facilities and for the Critical Experiments Facility located at the Y-12 Plant. (The Division Director is the highest level of corporate management needed to finalize the operator certification process.)

A.4.2 REACTOR OPERATIONS SECTION HEAD

Qualification Requirements

1. Education. The Reactor Operations Section Head should have a Bachelor's degree in engineering or related science.

2. Experience. The Reactor Operations Section Head should have experience in reactor operations and in Company and federal practice and requirements applicable to reactors. His/her level of experience should be adequate to demonstrate his/her abilities to manage the safe operation of ORNL reactors.

3. Training. The Reactor Operations Section Head should have specialized training for management-level personnel in the ORNL organization. This training should be in Company policies, responsibilities of management personnel, funding and manpower requirements at the various reactor facilities, human relations, etc. He/she should also have training applicable to general employees working at the nuclear facility. Although he/she is not required to be certified as a Senior Reactor Operators, he/she should become thoroughly familiar with the operations of all the reactors and the critical facility which are operated by ORNL. This includes the procurement of fuel, funding, and communications with experimenters and corporate management.

Responsibilities and Duties

The Reactor Operations Section Head is expected to:

1. Assume the responsibility of directing the activities of those individuals within the various groups reporting to him/her so as to accomplish the intended objectives and goals in accordance with established Martin Marietta Energy Systems, Inc., ORNL, Division, and DOE guidelines.

2. Ensure that all the research reactors and the critical facility operated by ORNL for the Department of Energy (DOE) are in compliance with applicable DOE Orders and other standards.

3. Plan, schedule, and/or review operational activities at the reactor facilities under his/her jurisdiction to ensure that each facility is operated in a safe and reliable manner by qualified personnel in accordance with ORNL and federal requirements.

4. Prepare certain periodic status reports generated at the facilities which are required by corporate management and/or DOE.

5. Maintain records and project operational cost estimates for each reactor facility.

6. Review the various experiments, as applicable, to be conducted at each reactor facility.

Responsibilities and Duties (continued)

7. Create and/or serve on various committees which function to ensure safe operation of the reactor facilities and, within the limits of his/her authority, effect changes recommended by the various committees.

8. Attend Division staff meetings and conduct Section meetings to keep abreast of new information, policy changes, etc., and to disseminate pertinent information to his/her staff, respectively.

9. Ensure that radiological and industrial safety standards are acknowledged and adhered to.

10. Investigate the details of all incidents necessitating the writing of an Unusual Occurrence Report at any of the reactor facilities.

11. Evaluate and disseminate safety-oriented literature received from DOE or from outside ORNL so that operating personnel at the ORNL facilities are made aware of changes in industry standards, failures at other facilities, etc.

12. Be actively involved in the selection, hiring, and certification process of reactor operating personnel.

13. Review all certification and requalification examinations prepared by the Examiner for Reactor Operator and Senior Reactor Operator candidates.

14. Review any special cases involving deviations from an established policy pertaining to the selection, training, and/or certification of reactor operating personnel.

15. Monitor periodically the quality of the work performed by individuals in the various groups reporting to him/her and effect changes as needed to ensure that each group is functioning in a safe and reliable manner and is accomplishing intended goals and objectives.

16. Serve, in emergency situations, in the capacity of an advisor to the Laboratory's Emergency Director or to the Local Emergency Director.

17. Implement the division-approved training plan for reactor operating personnel.

18. Implement the quality assurance program established by the Operations Division Director.

A.4.3 REACTOR SUPERVISOR

Qualification Requirements

1. Education. The Reactor Supervisor should have a Bachelor's degree in engineering or related [illegible]

2. Experience. The [illegible] a minimum of two [illegible] operational activities at one or more nuclear reactor [illegible]ities.

3. Training. The Reactor Supervisor shall have successfully completed the Reactor Operator and Senior Reactor Operator Training Programs and be certified at the reactor facility at which he/she will assume the responsibility of Reactor Supervisor. He/she shall maintain Reactor Operator and Senior Reactor Operator certification at the reactor facility during the time he/she holds the position of Reactor Supervisor. He/she should also have training in a management-supervisory course intended for upper-level ORNL management and have some training in handling routine and projected funding and manpower needs. General employee training is also applicable.

Responsibilities and Duties

The Reactor Supervisor is expected to

1. Coordinate and direct all operational activities at the reactor facility at which he/she is in charge and ensure that the facility is operated in a safe and reliable manner and in accordance with Martin Marietta Energy Systems, Inc., ORNL, Division, and DOE guidelines and/or procedures.

2. Review and/or approve all facility and procedural changes.

3. Schedule and approve all experiments at the facility.

4. Prepare certain reports as required by upper-level management.

5. Evaluate manpower and funding needs and take the necessary actions to ensure continued, efficient operation of the facility.

6. Ensure that the required emergency equipment is available at the facility and that personnel at the facility are familiar with emergency procedures.

7. Make certain decisions during normal operations and during emergency situations, as needed.

8. Maintain a practical knowledge of all Martin Marietta Energy Systems, Inc., and DOE regulations addressing nuclear reactors and the qualification requirements of operating personnel.

Responsibilities and Duties (continued)

9. Implement the division-approved training plan for reactor operating personnel.

10. Give technical assistance and advice on matters relative to the facility to individuals both within and outside the ORNL organization.

11. Perform special assignments as originated by the Reactor Operations Section Head and/or the Operations Division Director.

12. Attend meetings to keep abreast of new information, policy changes, etc., and conduct meetings to disseminate certain information to those reporting to him/her.

13. Monitor the quality of work performed by the supervisors and operators at the facility and make those changes needed to ensure efficient and safe operation of the facility.

15. Remain cognizant of the numerous DOE regulations applicable to nuclear reactors and remain abreast of any changes that may effect the facility at which he/she is in charge.

16. Review the qualifications of the individuals requiring certification at the facility and approve them for recertification, as applicable.

17. Review for official approval all procedural changes, all experiment changes, and all changes in the design of the facility.

18. Participate in the continuing requalification program for Senior Reactor Operators and Reactor Operators and maintain Senior Reactor Operator certification.

19. Be cognizant of and abide by the established performance standards.

20. Implement all radiological and industrial safety programs, as applicable.

21. Implement the Division's quality assurance program.

A.4.4 ASSISTANT REACTOR SUPERVISOR

With the exception of requiring one year of experience as a supervising Senior Reactor Operator, the qualification requirements for the Assistant Reactor Supervisor are the same as for the Reactor Supervisor. During the absence of the Reactor Supervisor, the Assistant Reactor Supervisor will have the same responsibilities and duties as the Reactor Supervisor.

The Assistant Reactor Supervisor's position is, in reality, a dual-capacity-type job. That is, the individual assuming this position serves primarily as the Training Manager and/or the Maintenance Manager. Consequently, the individual is also expected to meet the requirements of these other two positions as stated in this document.

There is one Assistant Reactor Supervisor at each Category-A facility.

A.4.5 MAINTENANCE MANAGER*

Qualification Requirements

1. Education. Each Maintenance Manager should have a Bachelor's degree in engineering or related science or the equivalent. (The equivalent should be a minimum of four years of additional experience in his area of responsibility.)

2. Experience. Each candidate for the position of Maintenance Manager should have had a minimum of two years of experience at one or more nuclear reactor facilities.

3. Training. Each Maintenance Manager should have a supervisory training course and should be trained in areas commensurate with his job assignments as applicable to the type of work performed at a reactor facility. General employee training is also applicable.

Responsibilities and Duties

Each Maintenance Manager is expected to:

1. Ensure that the maintenance work performed on the reactor and auxiliary systems is accomplished in a safe and reliable manner in accordance with established Martin Marietta Energy Systems, Inc., and Reactor Operations Section guidelines and procedures.

2. Process work requests and ensure that needed work receives proper attention from Plant and Equipment (P&E) Division and/or Instrumentation and Controls (I&C) Division supervisors.

3. Maintain proper communication between reactor operating personnel, experimenters, maintenance supervisors, and craft personnel, as applicable to maintenance performed on reactor systems.

4. Maintain certain records on maintenance activities which have taken place at the reactor facility.

5. Maintain a list of maintenance personnel qualified to perform work on the reactor facility.

6. Ensure that written procedures are generated for those maintenance activities which are not performed on a routine basis and/or may be new or more complicated than usual.

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*In some cases, this is a dual-capacity job assignment; the Maintenance Manager may also serve as the Assistant Reactor Supervisor or the Training Manager.

Responsibilities and Duties (continued)

7. Supply certain assistance and/or information to persons within or outside of the ORNL organization on maintenance-related subjects applicable to reactor facilities.

8. Maintain equipment inventories and procure needed equipment at the facility.

9. Prepare certain status reports that may be required by the Reactor Supervisor.

10. Monitor the quality of the maintenance work being performed by individuals at the facility and either report or correct deficiencies within his/her authority.

11. Monitor the quality or work performed by craft personnel to ensure that certain safety-related standards and requirements are acknowledged by them in performing their duties.

12. Remain familiar with the importance and need of certain auxiliary and emergency equipment and place priorities on their maintenance to ensure reliability.

13. Remain cognizant of limiting conditions of operation and surveillance requirements when scheduling, planning, or performing certain maintenance or surveillance tests on equipment.

14. Maintain surveillance of equipment performance and certain data to ensure that all equipment is performing as expected and report to the Reactor Supervisor any deficiencies or inadequacies which may compromise the integrity of the reactor or auxiliary systems.

15. Be cognizant of and abide by the established performance standards.

16. Participate in the continuing requalification for Senior Reactor Operators and maintain Senior Reactor Operator certification.

A.4.6 TECHNICAL MANAGER*

Qualification Requirements

1. Education. The Technical Section Head should have a Bachelor's degree in engineering or related science.

2. Experience. The Technical Manager should have a minimum of five years of experience in engineering or a related field. Two years of this required time should include projects relating to work performed at one or more ORNL nuclear facilities.

3. Training. The Technical Manager should have training required of ORNL management personnel and should also be given training in the overall design and operating procedures of the ORNL nuclear facilities commensurate with his/her job assignments. An individual who replaces the Technical Manager on a temporary basis should have comparable qualifications in education and training and have a minimum of three years of experience in a Technical Section. General employee training is also applicable.

Responsibilities and Duties

The Technical Manager is expected to:

1. Assume the responsibility of directing the activities of those individuals within his/her group in a manner so as to accomplish the various technical projects safely, expeditiously, and in accordance with established Martin Marietta Energy Systems, Inc., ORNL, Division, and/or DOE guidelines and procedures.

2. Provide the necessary expertise needed that may be required to during emergency situations at any of the ORNL reactor facilities evaluated and/or mitigate core damage or minimize the possibility of exposure of on-site and off-site personnel to excessive radiation.

3. Supply certain technical assistance and/or information to persons within or outside of the ORNL organization.

4. Establish manpower and funding requirements for his/her group on current and projected schedules.

5. Select personnel with the required educational background and/or technical expertise for his/her group.

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*The responsibilities and duties are written primarily for a Section Head level of manager, as applicable to reactor-related responsibilities; however, it is also largely applicable to all Technical Group Leaders.

<u>Responsibilities and Duties</u> (continued)

6. Prepare, edit, and issue certain routine technical and other reports according to Martin Marietta Energy Systems, Inc., procedures within planned scheduling.

7. Arrange schedules, meetings, projects, etc., so as to maintain a degree of flexibility in accepting special projects or assignments of an emergency nature.

8. Disseminate safety-oriented literature on reactor facilities, as practical, to individuals within his/her group and ensure that those individuals are familiar with reactor and ORNL emergency procedures.

9. Maintain technical surveillance over the progress of projects and report to the Operations Division Director any inadequacies in procedures or equipment that may compromise the integrity of the various reactor systems.

10. Remain cognizant of the limiting conditions of operation and surveillance requirements stipulated in the Technical Specifications of the reactor on which his/her group is assigned a project.

11. Monitor the quality of the work performed by the technical personnel in his/her group and correct any deficiencies.

12. Ensure that the individuals in his/her group are familiar with emergency procedures, as applicable, when such individuals are assigned projects at a specific reactor facility.

13. Ensure proper communications with the Reactor Operations Section Head, other technical groups, experimenters, maintenance personnel, and reactor operating personnel, as applicable.

14. Decide on which of those technical personnel reporting to him/her should be certified as Senior Reactor Operators, as needed for specific job assignments at a reactor facility.

15. Ensure that the Critical Experiments Facility, at the Y-12 Plant, is operated in accordance with established standards, as applicable to his/her authority.

A.4.7. TECHNICAL PERSONNEL*

Qualification Requirements

1. Education. Each technical staff member should have a degree in engineering or related science or the equivalent in experience.

2. Experience. Each technical staff member should have one year of experience at one or more of the ORNL reactor facilities in design work and/or special engineering-type projects.

3. Training. Each technical staff member should have training in accident analysis, and if considered beneficial for specific job assignments by the Technical Manager, the individual may be required to complete the Reactor Operator and Senior Reactor Operator training programs. General employee training is also applicable.

Responsibilities and Duties

Each technical staff member is expected to:

1. Assume the responsibility for special engineering-type projects, as applicable to the conception, design, drafting, fabrication, cost estimates, procedures, data collection, maintenance of records and prints, etc., needed to initiate and complete assigned projects.

2. Conduct, schedule, and/or attend meetings with experimenters, Reactor Operations personnel, etc., to plan new projects, evaluate proposed conceptual designs/modifications of experiments and reactor components from all conceivable safety standpoints, schedule work, analyze data, and resolve overall engineering-type problems.

3. Provide the necessary expertise needed at any of the ORNL reactor facilities that may be required to evaluate and/or mitigate core damage or minimize the possibility of exposure of on-site and off-site personnel to excessive radiation during off-normal or emergency situations.

4. Supply certain technical assistance and/or information to persons within or outside of the ORNL organization, as requested.

5. Prepare and/or edit certain routine technical reports and reports resulting from special investigations and/or research projects.

*This includes the Experiment Coordinator.

Responsibilities and Duties (cont.)

6. Arrange schedules, meetings, projects, etc., so as to maintain a degree of flexibility in accepting special projects or assignments of an emergency nature.

7. Maintain technical surveillance over the progress of fabrication and other phases of work being performed by service/craft personnel and report inadequacies to his/her supervisor.

8. Maintain proper communications with craft personnel, experimenters, Reactor Operations personnel etc., as needed to achieve the intended project goals.

9. Remain cognizant of the facility's special requirements (e.g., Technical Specifications, emergency/evacuation procedures, radiological and industrial safety policies, etc.).

10. If required by the Technical Manager (Section Head), achieve further expertise in reactor systems and complete the Reactor Operator and Senior Reactor Operator training programs.

11. Serve as instructor, on subjects of expertise, to reactor operating personnel, as requested by the facility's Training Manager.

12. Those designated as quality assurance personnel are expected to assume this responsibility and perform QA-type reviews, inspections/audits, etc., in accordance with the Martin Marietta Energy Systems, Inc., Quality Assurance Program, and ANSI/ASME NQA-1 (Quality Assurance Program for Nuclear Reactor Facilities), as applicable to ORNL operations.

A.4.8 TECHNICIANS

Qualification Requirements

1. Education. Each Technician should have an Associate Degree in engineering or the equivalent (e.g., two years of college-level work in drafting and engineering).

2. Experience. Each Technician should have had one year of experience in the application of drafting principles and techniques with specific application to the mechanical aspects of reactor-type components or the equivalent in education.

3. Training. Each Technician shall receive the general employee training for reactor-facility access. Further training will depend on the particular projects assigned by the Technical Group Leader.

Responsibilities and Duties

Each Technician is expected to:

1. Assist the technical staff in the design, planning, and operation of reactor experiments and/or components.

2. Apply conceptual thinking and knowledge of engineering theory to solve certain types of engineering problems.

3. Perform design drafting functions as required by the Technical Group Leader.

4. Perform certain operations using experimental equipment and systems (if any such operations include any handling of fuel, it must be under the supervision of a certified Senior Reactor Operator).

5. Assist the technical personnel in developing equipment modifications and new operational techniques.

6. Assist in the preparation of procedures for the operation or assembly of various kinds of equipment or experiments.

7. Assist in the analysis of certain data recorded during the evaluation of experiments, etc. (which may require the use of elementary computer programs).

8. Assist in coordinating and monitoring of the various jobs being performed to help ensure that schedules, tolerances, and quality standards are met and report inadequacies to his/her supervisor.

Responsibilities and Duties (cont.)

9. Be available to accommodate special projects or projects of an emergency nature.

10. Be cognizant of and abide by established performance standards.

A.4.9 TRAINING MANAGER*

Qualification Requirements

1. Education. Each Training Manager should have a Bachelor's degree in engineering or related science. Although not absolutely necessary, some college-level course work in educational techniques is preferred.

2. Experience. Each Training Manager shall have a minimum of two years of experience as a Reactor Operator and/or Senior Reactor Operator. (If the individual has had assignments in reactor-support groups, it may be substituted for one year of this requirement.)

3. Training. Each Training Manager shall have completed the certification requirements for Reactor Operator and Senior Reactor Operator at the particular reactor facility at which he/she is assigned and performs training, and he/she shall maintain his certification at that facility during the time he/she serves in the capacity of Training Manager. General employee training is also applicable.

Responsibilities and Duties

Each Training Manager is expected to:

1. Supervise the training of new operating personnel assigned to his/her facility in order to prepare them for the initial written and oral certification examinations to be administered by the Examiner for the Reactor Operations Section.

2. Oversee the training activities and ensure the safety of all trainees during the initial training period.

3. Give lectures and/or schedule lectures by guest speakers on required subjects during the initial training program and the requalification program.

4. Monitor the progress of trainees during the initial training program by giving written and oral examinations, as needed, and report the results to the Reactor Supervisor and Reactor Operations Section Head. Recommendations regarding the need for continued training or transfer from the Reactor Operations Section shall be given to the Reactor Supervisor and Reactor Operations Section Head.

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*In some cases, this is a dual-capacity job assignment; for instance, the Training Manager may also serve as the Assistant Reactor Supervisor.

Responsibilities and Duties (continued)

5. Arrange a schedule with the Examiner to administer the certification examinations after the trainee has completed the initial training programs and complete the necessary documentation indicating the completion.

6. Participate in the Reactor Operator and Senior Reactor Operator Recertification Programs at the facility at which he/she performs training.

7. Remain knowledgeable of all design and procedural changes at his/her facility and incorporate them, as needed, into the training material.

8. Keep all the shift supervisors informed of any changes in design or procedures at the facility and distribute to the operating crew any safety-oriented literature of interest that may enhance the efficiency or safety of operations at the facility.

9. Maintain a liaison with the Training Coordinator to ensure a proper flow of information regarding the status of training and retraining of personnel.

10. Be cognizant of the radiological and industrial safety programs and policies.

11. Be cognizant of and abide by the established performance standards.

12. Participate in the continuing requalification program for Senior Reactor Operators and maintain Senior Reactor Operator certification.

13. Be cognizant of quality assurance requirements.

14. Administer training, as needed, to those general employees requesting access to the reactor building for job-related assignments.

A.4.10 TRAINING COORDINATOR*

Qualification Requirements

1. Education. The Training Coordinator should have a Bachelor's degree in engineering or related science and have a practical working knowledge of federal (DOE and NRC) and ORNL requirements applicable to the qualifications of reactor operating personnel.

2. Experience. The Training Coordinator should have a minimum of five years of experience in reactor operations, perferably as a Senior Reactor Operator at at least two ORNL reactor facilities or the equivalent, and have a practical knowledge of all ORNL reactor facilities and the Critical Experiments Facility at the Y-12 Plant.

3. Training. The Training Coordinator shall become familiar with the operation and literature (descriptive material, operations manuals, emergency manuals, technical specifications, etc.) for each ORNL reactor facility and the Critical Experiments Facility. Although not absolutely necessary, it is preferable that he/she complete the Reactor Operator and Senior Reactor Operator certification at at least two reactor facilities at ORNL. Maintaining certification at a reactor facility is desirable but is not mandatory. General employee training is also applicable.

Responsibilities and Duties

The Training Coordinator is expected to:

1. Assume the responsibility of keeping the Training Managers at each of the ORNL reactor facilities informed of the current DOE requirements applicable to the qualification and training of reactor operating personnel and also keep them informed of any pertinent changes in policy as they become known; however, he/she shall not be involved in the actual training of any personnel for the purpose of certification.

2. Review certain DOE, NRC, INPO, and ANS documents in order to remain knowledgeable of current industry standards, requirements, and trends.

3. Monitor the various training programs and report deficiencies to the Reactor Operations Section Head and other concerned individuals.

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*This is a dual-capacity job assignment; normally, the Training Coordinator will also serve as the Examiner.

Responsibilities and Duties (continued)

4. Suggest or originate improvements to the training programs as industry standards change. (Approval from the Reactor Operations Section Head and the Operations Division Director shall be required prior to effecting any significant changes to the training plan.)

5. Answer certain questions presented by Reactor Operations Review Committee members regarding reactor-operator training on an informal basis or for routine committee meetings.

6. Prepare certain reports and/or generate other literature on the ORNL reactor facilities as requested by the Operations Division Director and/or Reactor Operations Section Head.

7. Attend periodic meetings, as required, to address the status of operator training and/or learn new training methodologies and requirements.

8. Assist in the preparation of certain written material regarding operator training (e.g., the training programs, scenarios for various types of emergency drills, control manipulation, etc.).

9. Be cognizant of the radiological and industrial safety programs and policies.

10. Be cognizant of the quality assurance requirements.

11. Be cognizant of and abide by the established performance standards.

A.4.11 EXAMINER*

Qualification Requirements

1. Education. The Examiner for the Reactor Operations Section should have a Bachelor's degree in engineering or related science. He/she shall have a practical working knowledge of federal (DOE and NRC) and ORNL requirements applicable to the qualifications of reactor operating personnel.

2. Experience. The Examiner should have a minimum of three years of experience in reactor operations, perferably as a Senior Reactor Operator at at least two ORNL reactor facilities, and have a practical knowledge of all ORNL reactor facilities and the Critical Experiments Facility at the Y-12 Plant. The Examiner shall have had some experience or training in preparing, administering, and grading examinations. (Although not absolutely necessary as a prerequisite, experience as an Examiner for the Licensing Branch of the NRC is preferable.)

3. Training. The Examiner shall become familiar with the literature (descriptive material, operations manual, emergency manuals, technical specifications, etc.) used at each ORNL reactor facility and the Critical Experiments Facility. Although not absolutely necessary, it is preferable that he/she complete the Reactor Operator and Senior Reactor Operator certification requirements at at least two ORNL reactor facilities. If he/she does not have the experience in preparing, administering, and grading examinations, he/she shall be given this training in order to achieve the required level of expertise prior to assuming the responsibilities of an Examiner. General employee training is also applicable.

4. Certification. The Examiner should be initially certified, in accordance with the requirements of this document, at one or more ORNL reactor facilities for which he/she will prepare examinations. Maintaining certification at any one facility, for special assignments, is not mandatory but perferred practice.

Responsibilities and Duties

The Examiner is expected to:

1. Schedule, prepare, administer, and evaluate examinations required for the initial certification and for the requalification of Reactor Operators and Senior Reactor Operators at all ORNL reactor facilities and the critical facility at the Y-12 Plant in accordance with the policies and procedures stipulated in this document.

*This is a dual-capacity position; normally, the Examiner will also serve as the Training Coordinator.

<u>Responsibilities and Duties</u> (continued)

2. Recommend for certification those candidates who have successfully completed the required training programs to the Operations Division Director.

3. Maintain a high degree of knowledge of DOE, NRC, INPO, ANS, ORNL, and other nuclear industry standards and requirements applicable to the qualification of personnel at reactor facilities.

4. Arrange with the Training Manager at each facility, the schedule for all written, oral, and operating examinations required for initial certification and for requalification.

5. Prepare, administer, and grade all examinations for initial certification and for requalification in accordance with the requirements stipulated in this training-plan document.

6. Remain cognizant of all significant changes in design or procedures at each facility for the purpose of preparing meaningful examinations.

7. Report overall grades, results of oral and operating examinations, any deficiencies, etc., to the Reactor Operations Section Head in order to effect, in part, changes needed to maintain high-quality training programs and have a staff of personnel who meet the qualification requirements.

8. Maintain all required documentation on file and amenable for internal and/or external audit.

9. Prepare training-related literature, give talks to describe the practices regarding the training and qualifications of reactor operating personnel at ORNL, and/or perform special projects, as needed.

10. Be cognizant of and abide by the established performance standards.

A.4.12 SENIOR REACTOR OPERATORS

Qualification Requirements

1. Education. Each Senior Reactor Operator should have a Bachelor's degree in engineering or related science or the equivalent. (One year of experience as a Reactor Operator at one or more of the ORNL reactor facilities, during which time the individual has indicated competence in technical subjects covered in the training program and has displayed supervisory potential, may substitute for the formal educational requirements. This must be evaluated on a case-by-case basis by the Reactor Operations Section Head.)

2. Experience. Each Senior Reactor Operator shall have a minimum of one year of experience as a Reactor Operator at ORNL, shall have had a similar experience at another reactor facility, or shall meet the advanced educational requirements (i.e., having a college degree in engineering or related science).

3. Training. Each Senior Reactor Operator shall complete the training program for this position and be certified by the Operations Division Director prior to directing the activities of Reactor Operators. Training in leadership and other supervisory-type subjects may be given after certification, since classes are scheduled by another ORNL training group. A portion of the technical material required in the Senior Reactor Operator Training Program may be considered applicable in meeting the educational requirements for this position if the candidate does not have a college degree. General employee training is also applicable.

4. Certification. The competency of an individual to perform in the capacity of a Senior Reactor Operator (i.e., usually in a supervisory position) at an ORNL reactor facility, in a safe and reliable manner, shall be certified by the Operations Division Director. This certification shall include consideration of successful completion of training and testing, demonstrated abilities, interviews, satisfactory health, dependability, stability, trustworthiness, and other positive attributes as enumerated in the Performance Standards. (The ORNL medical requirements are based on various standards and guidelines, as applicable to the nuclear industry, and the position task analysis. It is intended to ensure that the physical condition and mental stability of a candidate are such as to allow him/her to perform his/her job in a safe and reliable manner under possibly stressful situations.) Certification automatically expires at the end of a two-year period of time. If the individual is to continue to serve in the capacity of Senior Reactor Operator, he/she must be recertified biennially.

Responsibilities and Duties

Each Senior Reactor Operator shall:

1. Be responsible for directing the activities of the operators on his/her shift in a safe and reliable manner in accordance with established Martin Marietta Energy Systems, Inc., ORNL, Division, and DOE policies and procedures when he/she is the acting supervisor.

2. Maintain a practical familiarity with Company and DOE regulations applicable to the operation of a nuclear reactor and the qualification requirements for personnel operating these facilities.

3. Conduct safety meetings, drills, and other required training sessions for the Reactor Operators on his/her shift.

4. Prepare certain written material such as operating procedures, weekly reports, safety meeting reports, etc.

5. Ensure that maintenance work performed on his/her shift by various craft personnel is performed within acceptable industrial-safety and radiological-safety guidelines, as applicable to his/her authority.

6. Perform reactor startups, shutdowns, refueling, and other operational activities in a safe and reliable manner, commensurate with his/her responsibility as a Reactor Operations supervisor.

7. Perform routine surveillance of equipment, operating parameters, and data recorded by the operators on his shift.

8. Perform special assignments as originated by the Reactor Supervisor (e.g., maintaining records on fuel inventory, surveillance items, etc.).

9. Ensure that the individuals whom he/she supervises execute their assigned tasks in accordance with established standards of performance as established in this document.

10. Have a working knowledge of quality assurance and monitor the quality of the work performed by the operators and other personnel on his/her shift, as applicable. Reporting and/or correcting poor quality in performance will be of primary importance.

11. Report to the Reactor Supervisor any inadequacies in procedures and equipment that may compromise the integrity of the various reactor systems.

12. Remain cognizant of the limiting conditions of operation, surveillance, and reporting requirements stipulated in the Technical Specifications for the reactor at which he/she is assigned.

Responsibilities and Duties (continued)

13. Remain familiar with emergency procedures and the use of emergency equipment and ensure that the operators on his/her shift can perform as a team during various postulated emergency situations by conducting periodic emergency drills.

14. Review with his/her operators all safety-oriented literature received from the Reactor Supervisor on such things as design or procedural changes applicable to his/her facility, failure of equipment, or operational errors which have occurred at other ORNL facilities or at reactors outside ORNL.

15. Be cognizant of potential violations in plant security and be observant of and report any unpredictable or aberrant behavior of personnel at the facility which may jeopardize plant security or present any situation which may lead to unsafe operation of the reactor facility.

16. Be cognizant of and abide by the established performance standards.

17. Participate in the Senior Reactor Operator and Reactor Operator continuing training programs and maintain Senior Reactor Operator and Reactor Operator certification.

A.4.13 REACTOR OPERATORS

Qualification Requirements

1. Education. Each Reactor Operator shall have a high school diploma or the equivalent. (The equivalent shall be a minimum of four years additional experience in a related area of responsibility or a GED.)

2. Experience. At the time an individual is selected to become a Reactor Operator trainee, he/she should have had experience as a Reactor Operator in the Nuclear Navy or as a Reactor Operator at another nuclear facility. If no candidate having the preferred experience requirement is available, applicants from within the ORNL organization having a high school diploma may be accepted for training as a Reactor Operator on a probationary basis, pending approval by the Reactor Operations Section Head.

3. Training. Each candidate for the position of Reactor Operator shall have satisfactorily completed the ORNL Reactor Operator Training Program prior to certification. General employee training is also applicable.

4. Certification. The competency of an individual to operate an ORNL reactor in a safe and reliable manner shall be certified by the Operations Division Director. This certification shall include consideration of successful completion of training, demonstrated abilities, interviews, satisfactory health, dependability, stability, trustworthiness, and other positive attributes as enumerated in the Performance Standards. (The medical requirements are based on various standards and guidelines, as applicable to the nuclear industry, and the position task analysis. It is intended to ensure that the physical condition and mental stability of a candidate are such as to allow him/her to perform his/her job in a safe and reliable manner under possibly stressful situations.) Certification automatically expires at the end of a two-year period of time. If the individual is to continue to serve in the capacity of a Reactor Operator, he/she must be recertified biennially.

5. Medical and/or Mental. An individual certified as a Reactor Operator shall meet the physical and mental requirements covered in Sect. A.7 of Appendix A. In addition, a Reactor Operator shall:

    a. Have the manual dexterity to manipulate control-room instrumentation and auxiliary-system instrumentation (this includes valves, switches, knobs, keyboards, etc.).

    b. Have the physical ability and coordination to manipulate 35-ft-long tools that are used for refueling and other core and underwater work.

Qualification Requirements (continued)

c. Have the physical ability to handle objects that may weigh up to 50 lbs, without undue stress or fatigue.

d. Have the physical endurance to perform in a safe and reliable manner on rotating shifts (i.e., 4-12, 12-8, and 8-4 shifts).

e. Have the visual ability and manual dexterity to perform work through approximately 30 ft of water with or on objects as small as 1/2 in. in diameter.

f. Have the mental capacity to understand basic mathematics and solve high-school-level written problems in reactor physics, radiation safety, and heat transfer.

g. Have the mental capacity, perception, concentration, and endurance to observe, interpret, evaluate, and use control and other information displayed on or by various instrument readouts.

h. Have the mental capacity, to participate in the initial certification training program and the continuing requalification program; this includes considerable reading about reactor systems and about some technical material on a high-school-graduate level.

i. Have the mental capacity to memorize the "Immediate Operator Response" to abnormal/emergency situations.

j. Have the mental capacity, physical ability, and personality to perceive the progression of potentially unsafe or dangerous situations, establish priorities during emergency situations, and perform satisfactorily under stress.

Responsibilities and Duties

Reactor Operators shall:

1. Be responsible for performing the various job assignments associated with the operation of an ORNL reactor. This shall include refueling and other core changeouts, manipulations of the reactor controls, operations of auxiliary systems, servicing demineralizers, performing routine surveillance checks, working with radioactive materials, and performing work on components which are under 35 ft of water. It shall also include monitoring and processing of liquid, gaseous, and solid wastes.

2. Participate in all required training and retraining programs, safety meetings, drills, etc.

Responsibilities and Duties (continued)

3. Report to his immediate supervisor any unsafe condition and/or practice that may compromise the safety of personnel or equipment at the facility.

4. Perform his/her assigned tasks in accordance with established procedures and not deviate from such procedures without authorization from line supervision.

5. Maintain a high degree of familiarity with emergency equipment and emergency procedures.

6. Perform his/her job assignment in accordance with the established performance standards specified in this document.

7. Maintain a practical knowledge of all immediate responses to all emergency procedures.

8. Maintain a practical knowledge of operating limits and other requirements stipulated in the facility's Technical Specifications.

9. Keep abreast of procedural changes, facility changes, unusual occurrences which happen at this and other reactor facilities, new requirements, etc., applicable to the reactor facility.

10. Read safety-related literature routinely circulated by the Reactor Supervisor.

11. Participate in the continuing training program for Reactor Operator and maintain Reactor Operator certification.

A.4.14 INSTRUCTORS

The Training Manager will normally perform most of the required training and he/she shall meet the qualification requirements stated for that title. From time to time, however, the Training Manager will select various individuals to teach trainees certain required subjects. Such individuals, selected as Instructors by the Training Manager, shall:

1. be certified as Senior Reactor Operators or Reactor Operators, or have a college degrees, if teaching academic-type subjects or subjects such as instrumentation and controls and/or electrical systems that may be beyond the scope of the supervising Senior Reactor Operators,

2. have expertise in the subject being taught, and

3. have communication/teaching skills.

Training in teaching skills shall be administered as needed.

Individuals designated as Instructors by other ORNL training groups (e.g., instructor in the use of fire-fighting equipment and respirators, for defensive driving, quality assurance, etc.) are excluded from all but the general employee training of the Reactor Operations' requirements; however, they must meet the training requirements of their respective organizations.

A.4.15 QUALITY ASSURANCE PERSONNEL*

Individuals performing quality-assurance-type tasks at the reactor facilities are, in essence, from three separate groups. These individuals are (1) the Reactor Operations Section's Assistant Quality Assurance Coordinators, (2) the Operations Division QA Coordinator, and (3) the auditors and inspectors from ORNL's Quality Department. Only those in the Operations Division are addressed in this document; however, all QA personnel requiring access to a reactor facility must have the general employee training.

Qualification Requirements

1. Education. The Division QA Coordinator should have a college degree. The Reactor Operations Section Coordinators should have a college degree in engineering or a related science or the equivalent in engineering-type experience.

2. Experience. All QA coordinators should have one year of experimence in QA practices and procedures.

3. Training. All personnel involved in QA should take the ORNL course on quality assurance practices and procedures. General employee training is also applicable.

Responsibilities and Duties

Each Operations Division QA person is expected to:

1. Assume the responsibility of performing inspections and audits in accordance with Martin Marietta Energy Systems, Inc., Quality Assurance Program and ANSI/ASME NQA-1 (Quality Assurance Program for Nuclear Reactor Facilities), as applicable to the research reactors.

2. Meet the requirements for the Technical Personnel, as enumerated in Sect. A.4.8, when a technical person is selected to perform QA tasks on a part-time basis (i.e., the Assistant QA Coordinators are technical staff people).

3. Coordinate and assist in the preparation of Division quality-assurance-related documents, as required, and arrange for review and approval, when appropriate, by the Division Director and the Laboratory's Quality Department personnel.

4. Keep the Division Director and/or the Division's Quality Assurance Coordinator informed of QA activities in the Reactor Operations Section.

*For the Assistant QA personnel, this is a dual-capacity-type job task.

<u>Responsibilities and Duties</u> (continued)

5. Be responsible to the Laboratory's Quality Department auditors for quality assurance activities within the Division and/or the Reactor Operations Section, as applicable.

6. Cooperate with other QA Coordinators in coordinating mutual activities.

7. Implement Laboratory quality assurance objectives within the Division and/or Section.

8. Perform Division audits, practices, record keeping, training, etc., and assist the Quality Department auditors, as requested.

9. Interpret quality assurance procedures and requirements for the Division and/or Section, as needed.

10. Review and approve QA requirements applicable to engineering documents.

A.4.16 HOT CELLS/CHEMICAL OPERATORS

Certain tasks are performed at the reactor facilities by bargaining unit operators who are in the Operations Division but who are not in the Reactor Operations Section. These individuals are the hot cell/chemical operators who, on occasion, use the hot cells at the ORR, monitor stack effluents at a remote station, and/or perform certain surveillance checks on liquid-waste systems at the various facilities.

These operators are required to have the general employee training for reactor-facility access; however, they are not included in any further detail in this document since their training/qualification requirements have been addressed in detail in a training-plan document that is in accordance with the requirements of Chapter V of DOE Order 5480.1A.

A.5 LIST OF ORNL REVIEW/ADVISORY COMMITTEES

The following committees perform some review and/or advisory function at the reactor facilities.

1. Reactor Operations Review Committee (RORC)
2. Reactor Experiments Review Committee (RERC)
3. Radioactive Operation Committee (ROC)
4. Criticality Committee (CC)
5. Transportation Committee (TC)
6. Division Safety Committee or Division Safety Officer (DSO)
7. Laboratory Emergency Review and Advisory Committee (LERAC)
8. High-Pressure Equipment Review Committee (HPERC)

APPENDIX A. ORGANIZATION AND REQUIREMENTS

A.6. COMMENTS AND/OR JUSTIFICATION FOR ANY DEVIATION FROM DOE ORDER 5480.1A, CHAPTER VI

A.6.1 INTRODUCTION

It is the intent of the Oak Ridge National Laboratory (ORNL) to comply with the Department of Energy (DOE) Orders addressing requirements for the safe operation of its nuclear reactors. A document of primary importance is DOE Order 5480.1A, Chapter VI, "Safety of Department of Energy Owned Reactors" (8-13-81).

This Order contains the requirements for the selection, qualification, and training of personnel employed at Category-A, DOE-owned reactors. The majority of the requirements are actually from the American National Standard ANSI/ANS-3.1, "Selection, Qualification, and Training of Personnel for Nuclear Power Plants" (Draft, October 1980). Since there is considerable difference between the relatively small research reactors and the nuclear power plants, the DOE Order states that "the requirements of ANS 3.1 are to be followed to the extent that they are appropriate for the facility or operation being considered"; and "in order to facilitate the application of a power reactor standard to a Department-owned reactor, requirements of ANS 3.1 shall be selectively applied as appropriate to each site or reactor" (p. V.1-11, Item 6.e.1.a.).

Training plans, which define and describe the selective application of ANS 3.1 requirements have been prepared for the reactors at ORNL as applicable to qualification and training of personnel in the Reactor Operations Section. By far, the majority of all Chapter VI requirements are incorporated in this training-program document. The following material identifies the provisions of Chapter VI and ANS 3.1 which are <u>not</u> applied and/or which are believed to be inappropriate for ORNL research reactors. The requirements are referenced and comments and/or justifications for any deviations are given.

It should be noted that the terminology in the ANS 3.1 document is that of the Nuclear Regulatory Commission (NRC) and is intended for the nuclear power plants. The term "licensed" operator is equivalent to "certified" operator at the DOE-owned reactor facilities. The term "power" plant is used quite frequently; there is no electrical power generated at any of the ORNL research reactors. It should also be noted that there is a finalized, non-draft version of ANS 3.1 (ANSI/ANS-3.1, 1981); however, we have been instructed to follow the 1980 (draft) version.

A. Comments on Chapter VI

Item 1, Technicians, Personnel Qualification Requirements
P. 12, 6.e.1.c.4 (Chapter VI)

Comments and/or Justification for Any Deviations

There are a few individuals in the Reactor Operations Section who are classified as technicians. They are given training commensurate with their job duties and the general employee training; we believe this should suffice for the training requirements. In regard to the three-years experience requirements, we believe that one year of experience should suffice if the individual does not have the college-level work indicated in the position task analysis.

Item 2, Medical Certification
P. 13, 6.e.1.c.5 (Chapter VI)

Comments and/or Justification for Any Deviations

The ORNL Health Division has evaluated all the standards pertaining to health requirements for nuclear-facility personnel and established its own criteria. Since the DOE Order has allowed for an alternate form for NRC-396 "Certification of Medical Examination" to be used, the Medical Department has elected to do so.

Item 3, Position Task Analysis
P. 13, 6.e.1.d.1 (Chapter VI)

Comments and/or Justification for Any Deviations

Formal job task analyses (JTAs) are very time consuming and costly. A partial JTA was performed by Analysis and Technology, Inc., of Connecticut at one of our Category-A reactors. It was the opinion of those ORNL personnel concerned with this project that the JTAs would be of little value in our type of operation; hence, the project was terminated. The DOE Order does allow for some flexibility in the matter by stating that, "a position task analysis shall be conducted as necessary ..." We believe the informal position task analysis that we have included in our training program document is adequate.

Item 4, Simulator Training - Requirements
P. 13, 6.e.1.d.2 (Chapter VI)

Comments and/or Justification for Any Deviations

Since we do not have simulators at any of our reactor facilities, we cannot comply with simulator-training requirements. The DOE Order recognizes this fact and has allowed some flexibility in this matter. The reactors are used where practical; where impractical, abnormal/emergency scenarios are conducted as talk-through exercises.

Item 5, Retraining and Reexamination Program - Requirements
P. 14, 6.e.1.d.3 (Chapter VI)

Comments and/or Justification for Any Deviations

Training on the use of plant systems to control or mitigate accidents in which the core may be severely damaged is covered, as needed. A training document addressing this subject has been developed at one of our Category A reactors.

Item 6, Control Manipulations - Requirements
P. 14, 6.e.1.d.4 (Chapter VI)

Comments and/or Justification for Any Deviations

Specific control manipulations are: reactor startups, shutdowns, power changes, dropped control-element recoveries, scram recoveries, setback recoveries, and reverse recoveries.

Item 7, Certification - Requirements
P. 14, 6.e.1.d.5 (Chapter VI)

Comments and/or Justification for Any Deviations

In regard to the documentation of qualifications of "all" personnel, other than Reactor Operators (ROs), Senior Reactor Operators (SROs), etc., many personnel in reactor support groups are in other ORNL divisions and have their own training programs. Hence, maintenance groups and Health Physics personnel, etc., are addressed in the appropriate following sections.

Item 8, On-The-Job Training
P. 15, 6.e.1.d.6 (Chapter VI)

Comments and/or Justification for Any Deviations

In regard to the requirement of three months of training on shift, we feel that this may be appropriate at a power plant, where a candidate is in training for approximately two years before taking the NRC licensing examination; however, it is not practical for our type of operation. Some training must be, and is, accomplished on the off-shifts. The majority of the training, however, is performed on the day shift because a considerable portion of the training is studying manuals and covering diagrams with the Training Manager. The off-shifts are not as productive as the day shift in regard to study and availability of training personnel. We believe that one month is more than adequate for RO trainees on shift.

The three months of training on shift for the SROs is also not practical since most SROs are from the ranks of ROs; hence, the requirement would not be applicable. In the case of an "instant senior," one month of training on shift should suffice.

Item 9, Fuel Handling - Requirements
P. 20, 6.e.2.j (Chapter VI)

Comments and/or Justification for Any Deviations

The DOE Order specifies that "all fuel-handling operations shall be performed by or under the direction of certified personnel." The loading of new fuel into the core, the removal of depleted fuel from the core, and the preparation of fuel-shipping casks are all performed by certified operators. In the case where fuel is handled by non-certified trainees, it is always under the supervision of certified individuals.

B. Comments on ANS 3.1 (draft 1980)

Item 1, "Collective" Qualifications - Requirements
P. 4, 3.1 (ANS 3.1)

Comments and/or Justification for Any Deviations

On the day shifts, when there is a full complement of operating and technical personnel at the facility, the "collective" qualifications of the plant staff are greater than the sum of the minimum individual requirements. On the off-shifts, however, there is a minimum crew. To ensure availability of additional technical/supervisory support, a technical advisor is on-call on a 24-hour basis, via radio.

Item 2, Plant Manager, Qualifications - Requirements
P. 8, 4.2.1.b (ANS 3.1)

Comments and/or Justification for Any Deviations

In the ORNL organization scheme, the "Plant Manager" (identified in ANS 3.1) is equivalent to our "Reactor Supervisor." The ANS requirement is six-years experience in a power plant, of which three shall be nuclear-power-plant experience. Excluding the term "power," our present staff would meet the major part of these requirements; however, we do not believe the requirement should actually apply to a research reactor. The time elements for power plants are valid due to the complexity of the plants. For the relatively simple research reactor, we believe that two years as an SRO should suffice as a minimum requirement.

Item 3, Operations Manager, Qualifications - Requirements
P. 8, 4.2.2.b (ANS 3.1)

Comments and/or Justification for Any Deviations

In the ORNL organizational scheme, the "Operations Manager" (identified in ANS 3.1) is the equivalent of our "Assistant Reactor Supervisor." The ANS requirement is four-years experience in a power plant, of which three shall be nuclear-power-plant experience. Due to the relative lack of complexity of our research reactors, we believe that one year of experience as a Senior Reactor (SRO) is adequate.

Item 4, Maintenance Manager, Qualifications - Requirements
P. 9, 4.2.3 (ANS 3.1)

Comments and/or Justification for Any Deviations

The Reactor Operations Section Maintenance Manager performs more as a coordinator between the Reactor Operations Section and the Plant and Equipment (P&E) Division's Maintenance Manager and/or Maintenance Foreman. In the Reactor Operations Section, we require an engineering degree or the equivalent of four-years experience in the area of responsibility. It is believed that all our supervisors have the ability to function responsibly in this position after two years of experience as an SRO supervisor.

Item 5, Technical Manager, Qualifications - Requirement
P. 10, 4.2.4 (ANS 3.1)

Comments and/or Justification for Any Deviations

The requirement for having a Technical Manager be certified at a reactor facility is not practical in the overall organizational scheme. The Technical Manager serves as the group leader of various technical personnel, who serve as technical support for all the reactor facilities. At ORNL, certain technical-support people will be required to be certified as SROs at the various reactor facilities at which they work; however, we do not believe that the certifying of the Group Leader (Technical Manager) would add to the overall expertise of the group as a whole.

In regard to the three-years-experience requirement at the nuclear plant, we believe that two years should be more than adequate due to the relative lack of complexity of our research reactors.

Item 6, Training Manager Qualification - Requirements
P. 10, 4.2.5 (ANS 3.1)

Comments and/or Justification for Any Deviations

The Training Managers at the reactor facilities serve in a dual capacity; they are also the Assistant Reactor Supervisors and/or the Maintenance Managers at the facility at which they are stationed. The need for having courses in education is not believed to be important enough to make it a requirement. Since it is very seldom that the Training Manager is teaching more than one individual at a time, communication and teaching skills would appear to be less important than having expertise in the various systems. In addition, certain subjects are taught by individuals from outside the Reactor Operations Section having expertise in specific subjects. Again, we consider the expertise essential and do not believe formal classes in education are either important enough to make it mandatory or that it would accomplish more than what is presently being achieved. (Courses in "training the trainer" are also given at ORNL.)

In regard to the requirements for having four years of professional-level experience, two of which shall be at the nuclear (power) plant, we believe that two years overall should be adequate due to the relative lack of complexity of the ORNL research reactors.

Item 7, Shift Supervisor Qualifications - Requirements
P. 11, 4.3.1.1 (ANS 3.1)

Comments and/or Justification for Any Deviations

The requirement for 60 semester hours of college-level education in mathematics, chemistry, thermodynamics, etc., is not believed to be essential to the safe and efficient operation of our relatively small research reactors. Many of these new, more stringent requirements resulted from the TMI incident of March 28, 1979, and were directed at the nuclear power plants.

Originally, it was the Laboratory's policy, since the first reactor was placed in operation here in 1943, to have all supervisors be college graduates. This policy remained in effect for over thirty years until some of the more promising individuals with a great deal of operating experience, but without college backgrounds, were promoted to Shift Supervisors. This policy has been quite satisfactory.

Our educational requirement for the supervisory SRO is that he/she have a college degree in engineering or one of the sciences that he/she have a high-school education and a minimum of one year of experience as a Reactor Operator (RO) at an ORNL facility, during which time the individual has achieved a high grade average in the requalification written examinations and has displayed a high degree of supervisory potential, technical ability, decision-making ability, and responsibility in reactor operations, or that he/she has had similar experience at another reactor facility.

Technical material is covered in our training programs; however, the need for such technical material to be covered in greater depth, as on a college level, is questionable at our facilities. Many years of operation have indicated that, on the level of first-line supervisor, it is preferable to have the expertise in the various systems, refueling techniques, and overall operations. Technical expertise and surveillance is supplied by the technical-support groups.

The requirement of having four years of power plant experience of which two years shall be nuclear-power-plant experience is again intended to allow the nuclear power plants to take experienced workers from their fossil-fuel plants and enter their nuclear training programs. The nuclear power plants are far more complex than our low-power research reactors. The need for more time at the power plants is a valid requirement; however, we believe that one year of experience as an RO, followed by the SRO training program, is adequate to qualify an individual for the position of supervisor. In certain cases, however, when a college-level SRO candidate is to perform principally in a capacity other than day-to-day operational duties, he will be allowed to be certified as an "instant" SRO. This would also apply to technical-support personnel who are required to take RO and SRO training to enhance their level of expertise at a reactor facility, but who will perform only in a technical group and not in the routine operations of the reactor.

Item 8, Senior Reactor Operator, Qualifications - Requirements
P. 13, 4.3.1.2 (ANS 3.1)

Comments and/or Justification for Any Deviations

Our functional SROs are not only the first-line supervisors in charge of reactor operators on shift; they are also the shift supervisors; hence, since the shift supervisors were addressed in the previous section, the same comments and/or justifications for any deviation still apply. The major difference in the ANS 3.1 requirement is that the SRO is required to have 30 semester hours of college-level education instead of the 60 hours required for the shift supervisor.

A number of our ROs and SROs are taking college courses; however, this is not mandatory.

Item 9, Supervisors Not Requiring Certification - Requirements
P. 14, 4.3.2; P. 15, 4.4 (ANS 3.1)

Comments and/or Justification for Any Deviations

Supervisors in the Operations Division's Technical Section, who are not required to be certified, are in the category of design engineers, physicists, electrical engineers, or nuclear engineers. Although their need for any specific training was not identified by a job task analysis, they are well qualified and/or trained in the subjects listed in 5.2.1.8 and 5.4. Since such individuals have many years of experience at the reactors, they have not been given any written examinations as required under General Employee Training. Any new individuals chosen as replacements for those presently holding the supervisory positions will be given the necessary general and technical training, as required.

Other supervisors not requiring certification are in other ORNL Divisions and are not addressed in this document.

Item 10, Instrumentation and Control Personnel, Qualifications - Requirements
P. 16, 4.4.2 (ANS 3.1)

Comments and/or Justification for Any Deviations

These individuals are under the I&C Division's training-program requirements. Their training program addresses the ANS 3.1 document, and it is believed that they meet the intent of the standard.

Item 11, Chemistry and Radiochemistry Personnel, Qualifications - Requirements
P. 17, 4.4.3 (ANS 3.1)

Comments and/or Justification for Any Deviations

All routine water analyses are performed by the reactor operators, who are certified. Any special analyses, performed by an analytical laboratory at ORNL, would be performed by a professionally trained staff in another division.

Item 12, Radiation Protection, Personnel Qualifications - Requirements
P. 18, 4.4.4 (ANS 3.1)

Comments and/or Justification for Any Deviations

The radiation protection staff currently provides surveillance to meet the qualifications specified in section 4.4.4 of ANS 3.1. They are all considered, and have been rated, as competent (superior in some cases) individuals and have in each case more than 25 years experience in applied radiation protection. They all periodically receive training in radiation protection. Their proficiency, however, has not been evaluated through a structural series of examinations. The current radiation protection training staff is involved in developing a systematic training/examination protocol. Limitations in staffing and resources have delayed implementation of a job-specific radiation-protection training program.

Item 13, Quality Assurance, Personnel Qualifications - Requirements
P. 18, 4.4.5 (ANS 3.1)

Comments and/or Justification for Any Deviations

The QA Program at ORNL is administered by the ORNL Quality Department. The Division QA Coordinator is required to successfully complete courses in general QA practices, QA auditing, and statistical methods for quality and productivity improvement. There are also assistant QACs in each Section of the Operations Division. All Quality Department inspectors are required to be officially certified in their areas of expertise such as radiography, non-destructive testing, and boiler and pressure-vessel standards.

In regard to experience, the only point of exception would be the four years required. At this time, we believe one year of experience in QA practices and procedures should be adequate.

In regard to training, although no formal job task analysis has been performed, personnel involved in QA take a course in the subject at ORNL; and a written examination is administered. Examinations in the other subjects covered in Section 5.4 are not given, since those subjects are generally covered on a somewhat informal basis.

In regard to the degree in engineering or related science, we believe that this is necessary on some levels for QA responsibility, but should not be a requirement for all (e.g., for Assistant QA Coordinators, where expertise in systems is far more valuable).

Item 14, Preoperational-Startup Testing - Requirement
P. 19, 4.4.6 (ANS 3.1)

Comments and/or Justification for Any Deviations

Our reactors have been in operation for a number of years; hence, this requirement does not apply.

Item 15, Training Coordinator, Qualifications - Requirements
P. 21, 4.4.7.1 (ANS 3.1)

Comments and/or Justification for Any Deviations

Although no formal job task analysis was performed to identify specific training needs, we feel that the requirements we have stipulated in our training-program document exceeds those in ANS 3.1.

Item 16, Training Instructor, Personnel Qualifications - Requirements
P. 22, 4.4.7.2 (ANS 3.1)

Comments and/or Justification for Any Deviations

The majority of the training is performed by the Training Manager at each facility. This individual is also the Assistant Reactor Supervisor; hence, he/she is certified as an SRO and meets the requirements.

On occasion, guest lecturers having expertise in certain fields give talks (e.g., on I&C, electrical systems, core components, etc.). These individuals, who are not certified, provide a great deal of expertise; however, they may be in other ORNL good certification program. Some of our instructors have been involved in training for many years; new ones are observed by the Reactor Supervisor as part of a checkout procedure. For our type of operation, the expertise in a specific field is of primary importance; and the small number of candidates being taught at any one time would appear to facilitate communication on the part of the instructor and comprehension on the part of the student. (Courses in "training the trainer" are also available at ORNL.)

Item 17, Shift Technical Advisor, Qualifications - Requirements
P. 22, 4.4.8 (ANS 3.1)

Comments and/or Justification for Any Deviations

On the day shifts, there is much technical expertise available at our reactor facilities. On the off-shifts and weekends, an individual, with considerable expertise on our reactors, is available on a 24-hour basis via radio.

Although a formal task analysis has not been performed, the technical staff has many years of experience and some are certified SROs. In actuality, we believe that the qualifications of our technical advisors far exceed the requirements listed.

Item 18, Non-Licensed Operators, Personnel Qualifications - Requirements
P. 23, 4.5.1.1 (ANS 3.1)

Comments and/or Justification for Any Deviations

Non-certified (non-licensed) operators that have any responsibility at our reactor facilities, although in the Operations Division, are not in the Reactor Operations Section. These are the Chemical Operators, and the two job tasks of significance are: (1) monitoring of stack effluents and (2) handling and/or processing of liquid radwaste. The Chemical Operators are in another section, and they will have their own training program (which will address the training requirements of DOE Order 5480.1A, Chapter V and 4.5.1.1. of Chapter VI).

Item 19, Licensed Operators, Personnel Qualifications - Requirements
P. 24, 4.5.1.2 (ANS 3.1)

Comments and/or Justification for Any Deviations

The experience requirements are primarily for the nuclear-power-plant personnel. The year of experience required at these far more complex facilities is a most valid requirement; however, at our relatively simple research reactors, where no steam generation or power production is included, we believe that the experience requirement specified in our training-program document is more than adequate.

Item 20, Technicians, Personnel Qualifications - Requirements
P. 25, 4.5.2 (ANS 3.1)

Comments and/or Justification for Any Deviations

Although there was not a formal job task analysis performed for this position, training is given commensurate with job duties. Efforts are underway to structure training to conform more to the general outline given in ANS Sections 5.3.4 and 5.4 and in Chapter VI, 6.e.1.c.4.

Since we require either an Associate Degree, two years of college, or the equivalent, we believe that the three years of experience requirement is unnecessary for our type of operations; one year should be sufficient.

Item 21, Maintenance Personnel, Qualifications/Training - Requirements
P. 25, 4.5.3 (ANS 3.1)

Comments and/or Justification for Any Deviations

Maintenance personnel are in either the Plant and Equipment (P&E) Division or the Instrumentation and Controls (I&C) Division. Both of these divisions have their own training programs to meet the ANS 3.1 requirements, and it is believed that they meet the intent of the standard.

Item 22, Engineering and Technical Support Personnel - Requirements
P. 25, 4.6 (ANS 3.1)

Comments and/or Justification for Any Deviations

Technical-support personnel under the jurisdiction of the Reactor Operations Section have already been addressed in a previous section. Certain engineering work is performed by personnel from another division. These people normally do not work at the reactor sites, and they are specially trained in their fields of expertise. In addition, engineering and other technical-support personnel work under the direct surveillance of reactor personnel; therefore, we do not believe that they need additional training other than as required by the general employee training.

Item 23, Independent Review Personnel, Qualifications - Requirements
P. 26, 4.7 (ANS 3.1)

Comments and/or Justification for Any Deviations

There are several independent groups that review the operations at the reactor facilities. The committees are generally comprised of individuals from a number of different divisions, and they report findings to corporate management. These people normally do not work at the reactor sites, and they are specially trained in their fields of expertise. Therefore, we do not believe that they need additional training other than as required by the general employee training. (A list of review personnel is given in A.5.)

<u>Item 24, Training, General Aspects - Requirements</u>
<u>P. 28, 5.1 and 5.2 (ANS 3.1)</u>

<u>Comments and/or Justification for Any Deviations</u>

It is required that a training program and schedule be established for <u>each</u> nuclear (power) plant. The intent of the requirement is understood. In our case, however, where we have six research-type reactors (only two of which are Category A reactors) and one critical facility, we believe that one training-program document addressing the programs at all the facilities should be adequate. It would contribute little, if anything, by having seven separate, repetitious documents.

In regard to job task analyses, for our type of facilities and operations, we do not believe that performing formal job task analyses would either be cost effective or would improve the overall efficiency in training or safety in operations. This was the opinion of many after a partial JTA was performed by the Analysis and Technology Corporation. We chose not to pursue formal JTAs, and the DOE Order has allowed for some practical flexibility in this matter.

<u>Item 25, Training Programs for RO and SRO Eligibility - Requirements</u>
<u>P. 29, 5.2.1.1 (ANS 3.1)</u>

<u>Comments and/or Justification for Any Deviations</u>

Since we have always followed the NRC guidelines for the nuclear power plants in regard to subject material and depth, we have been in compliance with the majority of these requirements. However, we do not emphasize electrical theory, since we do not have any turbines or generators, and our electrical systems are serviced by personnel from the P&E Division under the supervision of electrical engineeers. Chemistry is also not a major necessity. The need at the nuclear power plants is a valid one; at our research reactors, it is questionable. The majority of the theoretical material emphasized for our operating personnel is in the fields of reactor physics, heat transfer, and fluid flow.

In regard to simulator training, we unfortunately do not have simulators; hence, we can not comply with this requirement. In cases where we cannot use the reactors for training, abnormal and emergency situations are covered as talk-through exercises.

In regard to the supervisory training for SRO candidates, as identified in 5.2.1.8, the fundamentals of the required subjects (i.e., leadership, problem analysis, etc.) are covered. However, some supervisory-type training is given after certification because it is scheduled and given by another ORNL training group at various times throughout the year.

Item 26, Training of Personnel Not Requiring NRC Licenses - Requirement
P. 35, 5.3 (ANS 3.1)

Comments and/or Justification for Any Deviations

Training of managers and supervisors not requiring certification has, in essence, been addressed in the previous sections. Reiterating, no formal job task analysis has been performed. Supervisors in the Reactor Operations Section are primarily in the technical-support groups and they have been discussed previously. Certain managers are given courses identified in 5.2.1.8.

The shift-technical-advisor training has also been addressed in a previous item. Control manipulations on a simulator were also addressed previously.

Training of technicians in the Reactor Operations Section is primarily intended to be in accordance with the requirements for "General Employee Training." Technicians may assist in removing fuel elements from the delivery truck at the critical facility; however, they have not been categorically identified as "fuel handlers," since the uncrated fuel is handled only by certified Reactor Operators.

In regard to non-licensed operators, the chemical operators who monitor stack effluents and/or process radioactive wastes are in another section and have their own training program. At this time, efforts are underway to structure their programs to comply more fully with the items identified in 5.3.5.

Item 27, General Employee Training - Requirements
P. 37, 5.4 (ANS 3.1)

Comments and/or Justification for Any Deviations

Many of the subjects identified in this section are covered in orientation classes; however, they are generally not covered on a formal basis, and written examinations are given only to reactor operating personnel. In essence, the basics are taught to general employees needing access to a reactor building to ensure safety, and recipients of such training are required to sign a "Dos and Don'ts"-type checklist before their names are entered on the computer access list. At present, efforts are also underway to implement a Laboratory-Wide General Employee Training Program which will further emphasize the required subjects. Due to the diversity of disciplines, groups, divisions, etc., at the reactor facilities, it is not considered practical to give written examinations to secretaries, foreign scientists, and/or janitors. We believe that reactor operating personnel and maintenance personnel should be the main recipients of such testing since greater training is needed and written examinations can be more meaningful.

Item 28, Retraining - Requirements
P. 38, 5.5 (ANS 3.1)

Comments and/or Justification for Any Deviations

Annual retraining programs identified in 5.1.1 of ANS 3.1 are not applicable, except in emergency procedures (refer to 6.e.1.d.3, of Chapter VI). Training in all other subjects is to be on a biennial basis.

Simulators are not available; hence, training cannot be performed as required in 5.5.1. The abnormal and/or emergency operating situations in which training is required is, of course, intended for power plants. We have identified appropriately similar situations as they apply to our Category-A reactors. Where it is not practical to use the reactor for training purposes, talk-through training is given on the various abnormal/emergency situations.

In regard to "annual" examinations, the ANS 3.1 document requires annual exams; but Chapter VI specifies giving annual exams only in abnormal/emergency procedures; all other subjects are to be covered biennially. This policy is followed.

In regard to "conditioned licenses," chemical operators who monitor stack effluents and/or process radioactive wastes would be in this category. As previously stated, they have their own training program.

Item 29, Retraining of Personnel Not Requiring NRC License - Requirements
P. 47, 5.5.2 (ANS 3.1)

Comments and/or Justification for Any Deviations

Although training is given as needed, the retraining of non-licensed personnel at the reactor facilities is not presently structured in accordance with the ANS 3.1 requirements. Efforts are underway to correct this situation.

A.7. REQUIREMENTS FOR MEDICAL CERTIFICATION OF NUCLEAR REACTOR OPERATING PERSONNEL AT OAK RIDGE NATIONAL LABORATORY

A.7.1 GENERAL GUIDELINES

1. These criteria shall apply to all Nuclear Reactor Operators and Shift Supervisors. Medical evaluation shall be done by the Health Division prior to initial certification, every two years as required for recertification, and following any significant interim illness.

2. Normal operations may involve shift work and duties ranging from data taking and control manipulations to maintenance activities which may require moderate physical activity for a lengthy period.

3. Emergency operations cover the same range as normal activities with the added requirement for strenuous activity, prolonged time requirements, and/or the possible use of emergency breathing equipment.

4. Prior to periodic re-examination by the Health Division, it shall be the responsibility of the examinee's immediate supervisor to communicate to the Health Division any information deemed to be pertinent, including but not limited to work performance, attendance, behavioral changes, incidents of ineptness or poor coordination, poor judgment, lack of physical stamina, or emotional instability.

A.7.2 MEDICAL REQUIREMENTS

1. General Requirements

   a. The examinee shall demonstrate mental alertness and emotional stability.

   b. Acuity of senses and ability of expression must allow rapid and accurate appraisal of normal and emergency situations and rapid and accurate ability to communicate by spoken, written, and other audible, visible, or tactile signals.

   c. Muscle strength, range of motion, and dexterity shall be sufficient to allow ready access to duty sites and safe execution of assigned duties.

   d. Examinee shall be capable of shift work without detriment to his physical or emotional well-being.

   e. Examinee must be able to wear personal protective equipment, including respirators, air supply hoods or suits, self-contained breathing apparatus, and other protective clothing and devices.

f. In order to qualify for solo operator duty, the examinee shall be free of any condition which might result in sudden or unexpected incapacitation. In some instances, with such a condition, the examinee could be qualified for multiperson operator duty with the approval of the examining physician.

g. In situations where a medical condition exists which would justify a specific limitation (such as "No lifting above 50 lb") which would not interfere with the performance of routine duties, such a limitation could be imposed by the examining physician in the usual manner, without disqualifying the examinee for certification.

2. Specific Requirements

a. Mouth and throat. Capacity for clear speech.

b. Ears. Puretone audiometric threshold better than 30 dB (American National Standard Specification for Audiometers, 1969) for speech frequencies 500, 1000, and 2000 Hz in better ear. Neither drum may be perforated.

If audiometric scores are unacceptable, qualification may be based upon a practical demonstration to the satisfaction of the Operations Division of the examinee's ability to safely detect, interpret, and respond to speech and other auditory signals.

c. Eyes

(1) Near and distant visual acuity must be 20/40 or better in better eye, corrected or uncorrected.

(2) Depth perception must be adequate, either by stereopsis or as demonstrated by practical test.

(3) Peripheral visual fields by confrontation must extend to 120° or greater.

(4) Color vision must be adequate to distinguish among red, green, and orange-yellow signal lights, and any other coding required for safety in examinee's work place.

d. Nose. Examinee must be able to detect odor of products of combustion and of tracer or marker gases.

e. Respiratory. Examinee must have the capacity and reserve to perform strenuous physical exertion in emergencies and ability to use respiratory protective devices.

f. Cardiovascular. Examinee must have a resting pulse rate between 50 and 100. He/she must have no significant arrhythmia. He/she must have a resting blood pressure of 160/100 or less and be able to tolerate rapid postural changes. He/she must have a normal electrocardiogram and normal cardiac contour on chest X-ray. He/she must have no organic heart murmurs. He/she must have no evidence of heart failure. He/she must not have a prosthetic heart valve. He/she must not have angina pectoris or other evidence of coronary artery disease. He/she must have full symmetrical pulses in the neck and extremities. In some instances, the examinee may be disqualified for solo operator duty with cardiovascular abnormalities, but qualified for multiperson operator duty with the approval of the examining physician.

g. Abdomen and viscera. If an external hernia is present, it must not be of such a nature as to interfere with the performance of assigned duty or present a significant potential for incapacity.

h. Musculoskeletal. Normal symmetrical structure, range of motion and power.

i. Skin. Capability to tolerate use of personal protective devices, covering, and decontamination procedures.

j. Endocrine/nutrition/metabolic. Normal. Must be able to change schedule or delay meals without potential incapacity. Diabetes mellitus, if present, should be well controlled. Insulin-dependent diabetics will not be approved for solo operator duty but may be qualified for multiperson operator duty with the approval of the examining physician.

k. Hematopoietic/lymphatic. No significant abnormalities.

l. Neurological. Normal central and peripheral nervous system function. Examinee must have normal equilibrium, coordination, and tactile discrimination sufficient to distinguish among various shapes of control knobs and handles by touch. He/she must not have epilepsy or any other condition in which loss of consciousness or impaired coordination is a possibility.

m. Psychiatric. Examinee must have normal mental status, including orientation and ability to function in emergencies and unusual environments, such as in confined or crowded spaces, alone in darkness, in elevators, or on open metal grids and ladders. He/she must be free of suicidal tendencies. Use of medications that may impair alertness or judgment should be evaluated on an individual basis.

n. Laboratory studies. Examinee should have no significant abnormalities of complete blood count, urinalysis, pulmonary function studies, routine blood chemistries, electrocardiogram, or chest X-ray.

A.7.3 WAIVER OF STANDARDS

If an examinee fails to meet any of the specified minimum requirements of Sect. A.7.2 but can demonstrate to the satisfaction of the Operations Division supervisor that he/she has adequate capacity to perform the required operational duties, the examining physician may recommend a waiver of any portion of the medical requirements listed above. Final approval of the waiver must be contingent upon agreement to the waiver by the examinee, the examining physician, the Director of the Health Division, the Operations Division Director, and the Management of the Laboratory.

A.8. PERFORMANCE STANDARDS

The following standards and/or guidelines for the performance of Reactor Operators and Senior Reactor Operators have been established to further ensure that the nuclear reactors at ORNL are operated in a safe and reliable manner.

Those individuals certified to operate a nuclear reactor at ORNL are expected to:

1. Perform their assigned duties in a safe and reliable manner and in accordance with established and approved operating procedures.

2. Abide by Company rules and regulations, as applicable to all Martin Marietta Energy Systems, Inc., employees.

3. Abide by all health physics rules and regulations and be familiar with the available radiological health manuals, other safety-oriented literature, and the ALARA concept.

4. Remain alert in performing their duties, and request permission from their first-line supervisor to be relieved from manipulating the controls of the reactor or from performing any other responsible job assignment, should their physical condition at the time be such as to present a potential problem to the safe operation of the reactor or facility.

5. Inform the Reactor Supervisor of any medical problem (or of the use of any medication) that might arise between required physical examinations which could conceivable interfere with the safe performance of his/her duties.

6. Conscientiously participate in all training and retraining programs required of reactor operating personnel by the Reactor Operations Section and meet the requirements to maintain certification, as applicable.

7. Participate in Company-required training programs (e.g., on fire fighting, CPR, security, safety, supervisory training, etc.).

8. Call attention to any unsafe conditions, procedural deficiency, and/or practice that may present a potential hazard to the safety of personnel or equipment.

9. Remain cognizant of the potential hazards of working with radioactive materials and not assume the responsibility to deviate from accepted and/or approved procedures without prior approval from line supervision.

10. Assume a degree of responsibility for the safety of visitors during their tour of the reactor facility, as applicable to the situation.

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11. Assume a degree of responsibility for the safety of personnel and/or equipment during abnormal or emergency situations, as applicable to the situation.

12. Neither participate in nor encourage any activity considered to be distracting in the control room or at any other areas where critical work is being performed (e.g., no radios, television, alcohol use or drug abuse, games, horseplay, hobbies, or reading that is not job related).

13. Be knowledgeable of all emergency equipment available for use by reactor operating personnel at the reactor facility (including fire-fighting and respiratory equipment).

14. Be knowledgeable of the emergency-oriented literature available at the facility (e.g., the Health Physics Manual, the ORNL Environmental Protection Manual, the Respirator Program Manual, the Local Emergency Manual, the ORNL Emergency Manual, etc.).

15. Be knowledgeable of all normal and emergency procedures and maintain a high degree of proficiency in control manipulations and/or responses to various abnormal or emergency situations. (Reactor Operators should commit to memory the "Immediate Operator Response" to all emergency situations.)

16. Be prepared to demonstrate proficiency in responding to emergency situations on both an individual or team-effort basis during unannounced emergency drills.

17. Be aware of all facility design changes and/or procedural changes.

18. Perform in the capacity of the position for which the individual has been hired and not engage in any extracurricular activities which might interfere with the proper and responsible performance of his/her duties.

19. Remain cognizant of the operating limitations and reporting requirements as specified in the facility's Technical Specifications.

20. Be cognizant of Company policy pertaining to the dissemination of information on operational activities to individuals outside the ORNL organization.

21. Demonstrate such qualities as integrity, trustworthiness, stability, dependability, perceptiveness, and good judgment.

22. Display a high degree of maturity, professionalism, and pride in being a Reactor Operator and/or Senior Reactor Operator.

B.1. THE HIGH FLUX ISOTOPE REACTOR (HFIR)

Category A; 100 MW; coolant flow rate: ~1.01 m^3/s (~16,000 gpm); pressure: 5.17 x 10^6 Pa (750 psig)

The High Flux Isotope Reactor (HFIR), which was completed and brought critical in August 1965, is a beryllium-reflected, light-water-cooled and -moderated, aluminum-clad fuel plate, flux-trap-type reactor which uses highly enriched ^{235}U fuel. The design power level is 100 MW.

The HFIR was designed primarily as a part of the overall program to produce transuranium isotopes for use in the heavy-element research program of the United States. The fuel region consists of two concentric fuel elements, each approximately 60.96 cm (2 ft) high. The inner element contains 171 curved fuel plates; the outer element contains 369 fuel plates. All fuel plates are 0.127 cm (50 mills) thick and are spaced 0.127 cm (50 mills) from each other to provide cooling. A typical core loading is 9.4 kg of ^{235}U. The average core lifetime is approximately 23 days at 100 MW.

The fuel region is surrounded by a concentric ring of beryllium reflector approximately 30.48 cm (1 ft) thick. This, in turn, is backed up by a water reflector of effectively infinite thickness. In the axial direction the reactor is reflected by water.

The control plates, in the form of two thin poison-bearing concentric cylinders, are located in an annular region between the outer fuel element and the beryllium reflector. These cylinders are driven in opposite directions by drive mechanisms located beneath the reactor. The inner control cylinder has its poison arranged so that reactivity is increased by downward motion. This cylinder is used for shimming and regulation; it has no fast safety function. The outer control cylinder consists of four separate quadrants, each having an independent drive and safety release mechanism. Reactivity is increased as the outer plates are raised. All control plates have three regions of different poison content designed to minimize the axial peak-to-average power density ratio throughout the core lifetime.

The HFIR is unique in the sense that it provides the highest neutron fluxes available in any of the world's reactors, and neutron currents from the four horizontal beam tubes are among the highest in the world. With an onstream time typically greater than 90%, continuity of operation of the HFIR is probably unsurpassed by any other reactor.

The HFIR and its auxiliary facilities (electrical building, cooling tower/chemical-treatment building, filter/stack area, and office complex) are located on the DOE reservation at Oak Ridge, Tennessee, at a point in Melton Valley approximately one mile south of the main ORNL site.

B.2. THE OAK RIDGE RESEARCH REACTOR (ORR)

Category A; 30 MW; coolant flow rate: ~1.17 m^3/s (18,500 gpm)

The Oak Ridge Research Reactor (ORR) first achieved criticality in March 1958. At that time, air-cooled heat exchangers were used and the power level of the reactor was 20 MW. In 1960, the air-cooled units were replaced with water-to-water heat exchangers and an induced-draft cooling tower, and the power level was raised to 30 MW.

The reactor core is a heterogeneous type which uses enriched uranium fuel in the form of aluminum-clad, aluminum-uranium alloy fuel plates. A fuel element consists of an assembly of 19 fuel plates. Demineralized water serves as the reactor coolant and moderator. The reflector is composed of an arrangement of beryllium elements which are physically interchangeable with each other and with the fuel elements. The thickness of the reflector, therefore, varies according to the particular fuel and experiment arrangement in the core. About 121.92 cm (4 ft) of ordinary water surrounds the reflector.

A rectangular aluminum box surrounds the core and beryllium reflector, and a grid plate is located below it to provide for the spacing and support of the fuel and beryllium elements. Fuel elements, control rods, experiments, and reflector elements are positioned in a 9 by 7 array by the grid plate.

The reactor is controlled by vertically positioning control rods which are located in the fuel and reflector regions of the reactor core. The control rods are driven from below the reactor core. Facilities for up to 12 control rods are provided, but only six of these positions are used. The poison section of each control rod is approximately as long as the reactor core height and consists of an aluminum-jacketed cadmium sheet formed into a rectangular box. The lower half of the rod consists of a fuel section of the same composition and general type as the fuel elements, except that only 14 fuel plates are included in the assembly. The control rods may be used as combination shim-safety-regulating rods, and the follower sections may be chosen according to the amount of fuel or reflector material desired.

B.3. THE BULK SHIELDING REACTOR (BSR)

Category B; 2 MW; coolant flow rate: ~0.07 m^3/s (~1,100 gpm)

The Bulk Shielding Reactor (BSR) is a small research reactor located in a building near the ORR. It first was brought critical in 1950. It is water-cooled, water-moderated, and water-shielded. Originally, the maximum power level was 1 MW, and there was no forced-flow cooling system. In the mid-1960s, the cooling system was modified for forced-flow cooling and the maximum power level has since been 2 MW.

The core of the BSR consists of an assembly of MTR-type fuel elements. The core is located in a pool of water 12.19 m (40 ft) long, 6.10 m (20 ft) wide, and 6.71 m (22 ft) deep. Each control-rod element consists of a partial fuel element containing MTR fuel plates similiar to those used in the fuel assembly with a central aluminum housing and guide for boron and steel control rods. The support structure for the core is attached to a movable bridge; this bridge is supported on steel rails located along the walls of the pool. An additional movable bridge, called the instrument bridge, is used for a working platform and to provide space for special equipment. This bridge is supported by the same poolside rails used to support the reactor bridge.

The BSR is used frequently for training purposes, but is used primarily for the irradiation of experiments. This reactor can be operated remotely by use of a closed-circuit television-monitoring system by personnel on duty in the ORR control room. All startups, however, are performed locally.

B.4. THE TOWER SHIELDING REACTOR (TSR)

Category B; 2 W to 1 MW; coolant flow rate: ~0.05 m^3/s (800 gpm)

The Tower Shielding Reactor (TSR) was built in 1954 to meet the requirement by the Aircraft Nuclear Propulsion (ANP) Project for a reactor radiation source which could be located in a region free from ground or structure scattering. Although the ANP Project has long since been terminated, the versatility for the TSR continues to make it a valuable tool in shielding research. In 1960, the TSR-I was replaced by a spherically symmetric reactor, the TSR-II, which may be operated up to a power level of 1 MW, and which more closely simulates the idealized spherical reactor used as a basis for machine calculations.

The facility consists of four 96-m-high (315-ft-high) towers erected on the corners of a 30.5 (100.1 ft) by 61.0 m (200.1) rectangle located on a knoll with an elevation of 325.8 meters (1068.9 ft) 3.78 km south-southwest of the Oak Ridge National Laboratory. Two of the towers are used for suspending the reactor; the other two, as well as the bridges which connect the pair of towers, are used for supporting other equipment, such as secondary shields and detectors. The reactor may be positioned anywhere between ground level and an altitude of 61 m (200.1 ft) or in a ground-based shield.

There are three regions of the TSR-II core; the internal reflector, the fuel annulus, and the outer reflector. The core is water-cooled and consists of a spherical fuel annulus, 14 cm (5.51 in.) thick and 73.7 cm (29.02 in.) OD, containing 21 aluminum-uranium alloy-type fuel elements. The fuel plates at a given radius in each element form concentric cylinders. Each fuel plate is 0.152 cm (0.06 in.) thick and consists of a sandwich of uranium-aluminum alloy clad in aluminum. The reactor is contained in a cylindrical aluminum vessel with a hemispherical bottom. This aluminum vessel has a 1.9-cm-thick (0.73-in.-thick) wall and is 243.8 cm (95.98 in.) long; its ID at the hemispherical end is 94 cm (37.01 in.). The top of the tank can be opened to facilitate removal of fuel elements and shielding from the vessel.

The internal reflector region is almost completely filled by a 43.2-cm-diam (17.01-in.-diam) aluminum sphere which houses in water-filled pockets, five or six neutron-absorbing control plates and the mechanisms for positioning them. Four fuel-loaded, lune-shaped cover plates are mounted outside the control-mechanism housing to form a complete spherical shell, which is positioned 0.635 cm (0.25 in.) inside the elements in the fuel annulus.

The TSR core consists of 0.15-cm-thick (60-mills-thick) curved aluminum-clad uranium-aluminum alloy plates cooled and moderated with light water. The plates are shaped and arranged so that the assembled core is a spherical fuel annulus.

Five plates, designated as shim-safety plates, are moved simultaneously relative to the fuel to operate the reactor, but each plate is independently driven toward the fuel, four outward and, in some cases, one downward, to shut down the reactor when the protection system initiates the action. The sixth plate, which is designated as the regulating plate, moves vertically in the upper region of the sphere and can be servo-operated to maintain the reactor power at a constant level. All cavities within the spherical control mechanism housing are filled with water. The reactor is thus controlled by varying the thickness of water between the control plates and the inner surface of the fuel annulus.

In each control mechanism, a throttling action develops a hydraulic pressure differential across a piston to balance a spring force so that a small motor can simultaneously position the shim-safety plates connected to four or five separate control mechanisms to operate the reactor. The interruption of the water flow producing the pressure differential permits the spring on each mechanism to independently drive its associated plate toward the fuel to shut down the reactor.

Two reinforced concrete underground buildings adjacent to and north of the towers provide shielded working areas for personnel during reactor operation. The buildings are shielded against radiation by a 0.46-m-thick (18-in.-thick) concrete roof covered with 1.07 m (3 1/2 ft) of earth.

B.5. THE HEALTH PHYSICS RESEARCH REACTOR (HPRR)

Category B; variable power [0.1 W to 10 kW steady state, pulsed to 50×10^3 MW]; natural convection cooling in air

The Health Physics Research Reactor is a small, unshielded and unmoderated, fast-pulse reactor suitable for research in health physics, radiobiology, biomedicine, and related fields. The reactor core is a right circular cylinder [0.20 m (0.66 ft) diam, 0.23 m (0.75 ft) high] of enriched uranium (93.14 wt% ^{235}U) alloyed with 10% molybdenum. Its fuel plates are coated with nickel and held together by fuel bolts. It has one large scrammable fuel element (the safety block) and three control rods, one of which can be inserted rapidly to produce a pulse of radiation. The HPRR has an 0.008-m-diam (0.03-ft-diam) hole that extends vertically through the fuel core. This cavity has been used to obtain extremely high exposures for small specimens.

Functional Characteristics: The HPRR can be operated in a pulse or steady-state mode. The nominal maximum yield in the pulse mode is 10^{17} fissions and the halfwidth of the pulse is <50 μs. The HPRR can be operated at steady-state power levels ranging from about 0.1 W to 10 kW. At high power levels, the operating time may be limited by the maximum permissible temperature of 316°C (600°F). The HPRR is capable of routinely producing neutron doses ranging from a few millirads to thousands of rads depending on the power level, duration of the exposure, and the location of the experiment relative to the core. Flux in the center cavity reaches 10^{12} n/(cm^2·s). The unshielded reactor or the reactor used with one of four shields provides five different neutron and gamma-ray spectra.

The primary use of the HPRR is for biological research, training, dosimetry development, and dosimetry intercomparison studies.

B.6. POOL CRITICAL ASSEMBLY (PCA)

Category B; 10 kW; coolant flow rate: natural circulation

The Pool Critical Assembly (PCA) is a versatile research tool intended to augment the Bulk Shielding Reactor (BSR) and the Oak Ridge Research Reactor programs by handling most of the low-power (up to 10 kW) experiments for these reactors. It is used for trainees and experiments and for the Reactor Controls Department for field testing proposed modifications in control instrumentation.

The PCA is located near the northwest corner of the pool of the Bulk Shielding Facility. The support structure for the core and control chamber guides is mounted on a plate anchored to the floor of the pool. The support structure for the tops of the rod drives, the chamber lift tubes, and the control-power and signal-cable trough is attached to the pool wall at the surface of the pool. The loading platform is located above the pool wall over the cable trough and the core. The control system console is in the PCA control room which is located at the northwest side of the reactor bay.

The PCA was designed to accommodate fuel elements with either round (BSR-type) or square (ORR-type) end boxes. This is accomplished by means of "stacked" grid plates; the BSR-type grid plate (round holes) rests on top of the ORR-type grid plate (square holes). The BSR-type grid plate is secured by dowel pins inserted into properly located holes in the top of the ORR-type grid. When a core consisting of ORR-type fuel elements is to be installed, the BSR-type grid plate is lifted off (with a special handling tool) permitting direct access to, and use of, the ORR-type grid plate.

Control of a core consisting of either BSR-type or ORR-type fuel elements is normally accomplished by means of four BSR-type control rods and associated drive mechanisms. The rods are moved within special control-rod fuel elements. Three of the control rods contain boron carbide as the neutron-absorbing material and are designated as shim-safety rods. The fourth rod is normally a shell of type 347 stainless steel and is called the regulating rod. The three shim-safety rods are supported by electromagnets; the extension tubes on the magnets are, in turn, directly attached to the individual drive motor shafts. The regulating rod is attached directly to its drive mechanism and may be positioned either by manual operation or by the servo mechanism. The special fuel elements through which rods travel are identical, each containing about 70 g of ^{235}U in nine fuel-bearing plates. The special control rod elements are positioned in the ORR-type grid plate by the use of adapters which support the rod elements at the correct height for the ORR-type fuel elements; these same rod elements are used without adapters in the BSR-type grid plate.

B.7. THE CRITICAL EXPERIMENTS FACILITY (CEF)*

Category B; zero power level

The Critical Experiments Facility (CEF) is located at the Y-12 plant and is used by certified personnel from the Operations Division's Technical Section to determine the shutdown margin of new HFIR fuel elements. The facility provides a special test area, control room, control and safety instrumentation, and other equipment needed for the tests. Each test consists of adding water reflector/moderator, under controlled conditions, to a test tank in which the two-piece HFIR element has been positioned. Additional reactivity or poison may be added as needed for the test.

*In some literature on the Critical Experiments Facility, the title "CEF-West" is used to indicate that the west experiment room is the (only) area of the facility used by Reactor Operations personnel. This terminology is not used in this training-plan document.

Rev. ________
Date ________

APPENDIX B. A BRIEF DESCRIPTION OF EACH ORNL REACTOR FACILITY

APPENDIX C. FACILITY TRAINING/QUALIFICATION CHECKLISTS

FACILITY TRAINING/QUALIFICATION CHECKLIST(S)

Trainee: ______________________ Badge No.: ______________

Facility: High Flux Isotope Reactor (HFIR) Buildings: 7900, 7910, 7912

Instructions

This composite checklist is comprised of four sections; these are (1) the Generic Subjects Checklist (i.e., reactor physics, heat transfer/fluid flow, radiation safety, and industrial safety); (2) the Facility-Specific Checklist; (3) the Emergency Preparedness Checklist; and (4) the Supervisor's Checklist. (Refer to the individual checklists for any special instructions.)

The topics herein are to be taught to the above-mentioned trainee by the Training Manager, or his designated instructors, to the extent that the trainee will be prepared for (1) the written, oral, and/or operating examinations required for certification or requalification and (2) solo operation at the above-mentioned facility. All items on each checklist are to be covered for the initial qualification; selected items, with emphasis on abnormal/emergency procedures, are to be covered for requalification training.

The training personnel shall be responsible for establishing learning objectives, as applicable. That is, they shall cover each subject with the primary objective of leaving the trainee with that essential information and/or knowledge needed to operate the reactor or auxiliary equipment in a safe, efficient, and reliable manner during normal, abnormal, and emergency conditions.

The Training Manager at this facility shall coordinate all training and shall sign the cover page of this and each individual checklist after all the required sections have been covered, as applicable. He/she shall also ensure that all required signatures are affixed prior to sending the composite checklist to the Examiner for filing. All sections should be completed prior to taking the written examination required for initial certification.

The composite checklist is intended to be used for the initial qualification and for one requalification; however, it may be used for an additional requalification (two-year period) by using a color code, or some similar scheme, to indicate continued use of the same checklist.

This material has been taught to the trainee.

______________________, ______________
Training Manager Completion Date

This material has been taught to me by the training personnel.

______________________, ______________
Trainee Completion Date

SECTION 1. GENERIC SUBJECTS CHECKLIST

Trainee: ____________________________ Badge No.: ____________

Facility: High Flux Isotope Reactor (HFIR) Buildings: 7900, 7910, 7912

Instructions

The generic subjects may be covered by self study, viewing videotapes, and/or classroom work. Many of the subjects are academic in nature and serve as background material. Where possible, however, the practical applications should be emphasized.

Trainers should establish learning objectives to ensure that the trainee is left with the knowledge required to reliably operate the equipment or execute a procedure.

Each subject should be taught to the extent that the trainee will be prepared to take the certification examinations and be able to perform the required work, without direct supervision, in a safe and reliable manner.

When the Trainer initials an item (and signs the bottom of each page), it should indicate that he/she has not only been assured that the material has been covered with the Trainee, it should also indicate that the Trainee knows the material well enough to be qualified in that subject area.

Upon completion, this checklist should be returned to the Training Manager; he/she shall submit it to the Examiner.

This material has been taught to the trainee. ______________________, ____________

Training Manager Completion Date

This material has been taught to me by the training personnel. ______________________, ____________

Trainee Completion Date

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1.1.3. Prompt and delayed neutrons				
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1.2.2. Reactivity and criticality				
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1.4.2. Fuel loading				
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Trainer(s) Date Trainee Date

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2.4.1. Fission-produced heating				
2.4.2. Temperature and heat transfer in reactors				
2.4.3. Heat transfer rates				
2.4.4. Determination of operating parameters				
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Trainer(s) Date Trainee Date

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
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3.6.5. Radioactive decay				
3.6.6. Shielding with distance				
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3.7.3. Contamination, surface and airborne				
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4.1.1. Safety organization and Safety Officer				
4.1.2. Protective equipment (use, location)				
4.1.3. Safety practices				
1. Pre-job planning				
2. Electrical safety				
3. Permits and tags				
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Trainer(s) Date Trainee Date

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
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1. Standard Practice Procedure				
2. Policy Procedure Manual				
3. Safety Manual				
4. Environmental Protection Manual				
5. ORNL Respiratory Program				
4.2. Industrial Hygiene				
4.2.1. Hearing/sight conservation				
4.2.2. Use and availability of respiratory equipment				
4.2.3. Control of toxic chemicals/acid spills				
4.2.4. Incompatible chemicals				
4.2.5. Reporting requirements				
4.3. Environmental Protection				
4.3.1. Organization (function, contact)				
4.3.2. General requirements for discharging of effluents to the environs				
4.3.3. Handling and disposing of hazardous materials				
4.3.4. Reporting				
4.4. Fire Protection				
4.4.1. Organization				
4.4.2. Location of alarm boxes and equipment				
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Trainer(s) Date Trainee Date

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1.1.1. Responsibilities, precautions				
1.1.2. Personnel hazards during startup				
1.1.3. Preparation for startup				
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1.1.6. Startup following a shutdown due to the dropping of one or more shim-safety plates				
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Trainer(s) Date Trainee Date

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
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1.2.2. Heat power calculations				
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1.3.2. Refueling shutdowns				
1.3.3. Accidental scrams, rod drops, setbacks, and reverses				
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1.4. Annunciator Procedures				
1.4.1. Set points				
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Trainer(s)	Date	Trainee	Date

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
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2.1. Control System				
2.1.1. Relaying and switching equipment				
1. Operator requests				
2. Automatic requests				
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4. Mode 1, run				
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8. Rod selector switch				
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11. Start request pushbutton				
12. Run pushbutton				
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15. Raise test switch				
16. Auto process start pushbutton				
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18. Annunciator acknowledge and reset pushbuttons				
19. Evacuation horn stop pushbutton				
20. Evacuation horn pushbutton				
21. Mode selector switch				
22. Shim cylinder inhibit pushbutton				
23. Shim cylinder inhibit reset pushbuttons				
24. Safety test pushbuttons				
2.1.2. Shim plates, drives, and drive motor				
1. Shim plate couplings				
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Trainer(s) Date Trainee Date

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
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4. Seat switches				
5. Scram latch mechanism				
6. Drive rods				
7. Snubber assembly				
8. Coincidence magnet				
9. Clutch switch				
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11. Push-rod release spring				
12. Acceleration spring assembly				
13. Reclutch spring				
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17. Insert and withdraw limit switches				
18. Insert air motor				
19. Position transmitters and asymmetry pot				
2.1.3. Shim and regulating cylinder				
1. Shim cylinder lock nut and screw				
2. Shim cylinder drive rod				
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4. Shim motor				
5. Servo motors and differential velocity adder				
6. Shim drive limit switches				
7. Servo limit switches				
8. Position transmitters and asymmetry pot				
9. Drive rod seal housing				
2.1.4. Normal, abnormal, and emergency procedures related to above items				

Trainer(s) Date Trainee Date

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
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2.2. Servo System				
2.2.1. System description				
1. Ionization chamber				
2. Flux amplifier and reset mechanism				
3. Afterheat computer				
4. Heat power computer and sensors				
5. Flux rate network				
6. Power demand signals				
7. Flow demand clamp				
8. Servo motors				
9. Differential velocity adder				
10. Regulating drive mechanism				
11. Limit switches				
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2. Group shim withdraw inhibit matrix				
3. 2/3 servo error				
4. Withdraw error in start permit				
2.2.3. System readouts and manual control				
1. Reset flux and heat power				
2. Differential temperature				
3. PDP 11/60 computer data collection and computations				
4. Heat power meter module				
5. Reset flux indication, flux amplifier, and chamber voltage module				
6. Servo motor speed indications				
7. Servo demand drive module				
8. Fast trip comparators				
9. Regulating rod position indications				

Trainer(s)	Date	Trainee	Date

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
2. INSTRUMENTATION AND CONTROL (cont.)				
10. Group demand control switch (S-11)				
11. Individual channel demand pushbuttons				
12. Servo demand indications				
13. Demand limit lights				
14. Ionization chamber position adjustment controls				
15. Servo "ON" indication				
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2.3. Wide-Range Counting Channels				
2.3.1. System description				
1. Fission chamber and drive system				
2. Pulse amplifier, discriminator and count rate meters				
3. Servo demand and error output amplifier				
4. Drive motor, tachometer, linear potentiometer, position indicator and function generator				
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8. Period trip comparators				
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1. Count rate confidence				
2. "Sag" trip comparator				
3. Period inhibit				
4. Period reverse				
5. Infinite period run permit				

Trainer(s) ______ Date ______ Trainee ______ Date ______

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
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2.3.3. System readouts and manual controls				
1. Power recorder				
2. Period recorder				
3. Power indicator				
4. Log count-rate indicator				
5. Chamber position indicators				
6. Period indicator				
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2.4. Safety System				
2.4.1. System description				
1. Auxiliary control action				
2. Mode selection				
3. Slow scram				
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b. Flux rate				
c. Flux/flow ratio				
d. Inlet temperature				
e. Low-low flow				
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g. FFED				

Trainer(s) Date Trainee Date

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
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Trainer(s) ____________ Date   Trainee ____________ Date

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
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1. Portable radiation detecting equipment				
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1. Fuel cladding failure detector				
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4. Pool cleanup system radiation monitor				
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3. FCV-377 controller				
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7. ApHC-331				
8. LCT-454				
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10. ApHC-1200				

Trainer(s)	Date	Trainee	Date

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
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4. Removal of the target bundle and tower structure assembly				
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7. Remove the inner shroud				
8. Remove the outer fuel element				
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Trainer(s) ____________ Date ____________ Trainee ____________ Date

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
3. STORAGE, REACTOR, AND POOL WORK (cont.)				
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12. Replace the target bundle and tower structure				
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Trainer(s)	Date	Trainee	Date

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
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Trainer(s) Date Trainee Date

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Trainer(s) Date Trainee Date

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
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d. Reactor inlet header				
e. Flow measurement (FE-216)				
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Trainer(s) ____________ Date ____________ Trainee ____________ Date

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
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4. Remote stop feature				
5. Type of pump				
6. Power source				
5.1.9. I&C				
1. Temperature monitoring				
a. Vessel outlet temperature				
b. Vessel inlet temperature				
c. Heat exchanger outlet temperature				
d. Hot water injection system				
2. Pressure monitoring				
a. Vessel inlet pressure				
b. Vessel ΔP				
c. Pump discharge pressure				
d. Pump suction pressure				

Trainer(s) Date Trainee Date

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
5. COOLING SYSTEMS (cont.)				
3. Flow monitoring				
1. Venturi				
4. Radiation monitoring				
1. Cladding failure detector				
2. Gross gamma monitor				
3. Faulty fuel element detector				
5. pH control system				
5.1.10. Procedures				
1. Precautions				
2. Pressurize the system				
3. Establish primary coolant flow				
4. Shut down the primary coolant system				
5. Depressurize the system				
6. Switch primary pump during operation				
5.1.11. Routine checks				
5.1.12. Normal, abnormal, and emergency procedures related to above items				
5.2. Primary Cleanup System				
5.2.1. Flow paths				
1. Normal				
2. Alternates				
5.2.2. Letdown valves				
1. Purpose				
2. Controller				

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Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
5. COOLING SYSTEMS (cont.)				
5.2.3. Block valves				
1. Purpose				
2. Controller				
5.2.4. 90-second holdup tank				
5.2.5. Deaerator				
1. Purpose				
2. Water level controller				
3. Condenser				
4. Steam-operated vacuum ejectors				
5. I&C				
a. High water level alarm				
b. Very high water level alarm and control action (overflow)				
c. Low water level alarm and control action				
d. High pressure alarm				
e. Water level indicator				
f. Primary cleanup pumps (PU-2A and PU-2B)				
(1) Pumping capacity				
g. Prefilters				
h. Demineralizers				
i. After filters				
j. Head tank				
(1) Level controller				
(2) Low water level alarms and control actions				
(3) Makeup water				
(4) Level indicator				
k. pH control system				
l. Resin disposal system				

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Trainee Date

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
5. COOLING SYSTEMS (cont.)				
m. Procedures				
(1) Precautions				
(2) Place the system in normal service				
(3) Shut down the primary cleanup system				
(4) Bypassing equipment in the cleanup room				
(5) Regeneration of primary cleanup demineralizers				
(6) Filter cleaning				
(7) Backwash cation while system is in operation				
n. Routine checks				
5.2.6. Normal, abnormal, and emergency procedures related to above items				
5.3. Pool Coolant System				
5.3.1. Flow paths				
5.3.2. Scrubbers				
1. High and low pool level alarms and control actions				
5.3.3. Pool surge tank				
1. Level controller				
2. Low level alarm and control action				
3. Makeup water				
4. Overflow				
5. Level indicator				
5.3.4. Pool coolant pumps				
1. Capacity				
5.3.5. Pool filter				

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Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
5. COOLING SYSTEMS (cont.)				
5.3.6. Heat exchangers				
1. Heat removal capacity				
2. Temperature control system				
5.3.7. Conductivity and pH measurement				
5.3.8. Flow control valves				
5.3.9. Procedures				
1. Precautions				
2. Place the system in normal service				
3. Shutdown of the pool coolant loop				
4. Filter cleaning				
5.3.10. Radiation monitoring				
5.3.11. Routine checks				
5.3.12. Normal, abnormal, and emergency procedures related to above items				
5.4. Pool Cleanup System				
5.4.1. Flow paths				
1. Normal				
2. Alternates				
5.4.2. Defective element storage racks				
5.4.3. Deaerator				
1. Purpose				
2. Water level controller				
3. Condensers				
4. Steam-operated vacuum ejectors				

Trainer(s)	Date	Trainee	Date

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
5. COOLING SYSTEMS (cont.)				
5. I&C				
a. High water level alarm				
b. Very high water level alarm and control actions				
c. Low water level alarm and control actions				
d. High pressure alarm				
e. Water level indicator				
5.4.4. Pool cleanup pumps (PU-7A and -7B)				
1. Pumping capacity				
5.4.5. Prefilter				
5.4.6. Demineralizer/filter				
1. Regeneration				
2. Cleaning				
5.4.7. Recycle pump				
5.4.8. After filter				
5.4.9. Normal, abnormal, and emergency procedures related to above items				
5.5. Secondary Water System				
5.5.1. Purpose				
5.5.2. Flow paths				
5.5.3. Flow rates				
5.5.4. Cooling				
1. Heat dissipation capacity				
2. Basin capacity				
3. Fans				
4. Tower bypass				

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Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
5. COOLING SYSTEMS (cont.)				
5.5.5. Secondary water pumps				
1. Main pumps (PU-6A, -6B, -6C)				
a. Capacity				
b. Power source				
2. Auxiliary power (PU-14)				
a. Low speed winding				
b. High speed winding				
c. Power source				
5.5.6. Water distribution				
1. TRU				
2. O&M building				
3. Chiller				
4. Pool heat exchangers				
5. Deaerators condensers				
6. Primary heat exchangers				
7. Heat exchanger cell unit coolers				
8. Pump seal coolant heat exchangers				
9. Blowdown				
5.5.7. Potable water makeup				
5.5.8. I&C				
1. Flow elements (FE-310)				
2. Blowdown control				
3. Flow control valves (FCV-377 and FCV-377A)				
4. pH control system				
a. Sulfuric acid storage tank				
b. Acid metering pumps				
c. Acid mixer				
d. pH meter ApHE-331				
e. pH meter ApHE-334				
f. High and low pH alarms				

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Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
5. COOLING SYSTEMS (cont.)				
5. Corrosion inhibitor				
6. Water temperature control system				
7. Water temperature alarms				
8. Radiation monitor				
9. Flow element (FE-300)				
10. Auxiliary pump switch off alarm				
11. Basin level controller and alarm				
5.5.9. Procedures				
1. Precautions				
2. Circulate secondary water				
3. Adjust blowdown flow				
4. Chemical treatment				
5. De-icing the cooling tower				
6. Cleaning screens				
7. Filling and draining of basin bays				
5.5.10. Normal, abnormal, and emergency procedures related to above items				
5.6. Fill and Drain System				
5.6.1. Purpose				
5.6.2. Flow paths				
5.6.3. Underground pool water storage tank				
5.6.4. Underground primary water storage tank				
5.6.5. Storage tank level indicators				
5.6.6. Procedures				
1. Precautions				
2. Drain water from pools to the storage tank				
3. Fill pools from the storage tank				
4. Drain primary system to storag tank				
5. Fill primary system from storage tank				

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Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
5. **COOLING SYSTEMS (cont.)**				
5.6.7. Routine checks				
5.6.8. Normal, abnormal, and emergency procedures related to above items				
5.7. Miscellaneous Procedures				
5.7.1. Drain and fill primary side of primary heat exchangers				
5.7.2. Drain and fill secondary side of primary heat exchangers				
5.7.3. Venting of air from water/instrument lines				
5.7.4. Normal, abnormal, and emergency procedures related to above items				
5.8. Hot-Water Injection System				
5.8.1. Purpose				
5.8.2. Flow path				
5.8.3. Expected response of readouts				
5.8.4. Normal, abnormal, and emergency procedures related to above items				

Trainer(s) Date Trainee Date

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
6. CONTAINMENT: HEATING, VENTILATING, AND AIR CONDITIONING				
6.1. SBHE System				
6.1.6. Purpose of the system				
6.1.2. Technical specification limitations				
6.1.3. Air flow paths				
6.1.4. Stack fans				
1. Standby-start feature				
2. Fan controls and lights				
6.1.5. Filter pits and ducts				
1. Type of filters and purpose of each type				
2. Filter ΔP - normal and abnormal				
3. Shielding				
4. Valving				
6.1.6. I&C				
1. Low flow alarms and automatic actions				
2. Building ΔPs				
3. Fresh air intake dampers				
4. Radiation monitoring				
6.1.7. Procedures				
1. Precautions				
2. Place the system in service				
3. Annunciator procedures				
4. Action on normal power outages				
5. Action on loss of flow in the ducts				
6. Filter replacement				
7. Routine checks				
6.1.8. Normal, abnormal, and emergency procedures related to above items				

Trainer(s) Date Trainee Date

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
7. EMERGENCY SYSTEMS				
7.1. Emergency Equipment				
7.1.1. Diesel electric generation and distribution system				
1. Purpose of systems				
2. Normal-emergency system No. 1				
a. Diesel engine				
b. Starting battery				
c. Battery charger				
d. Generator				
e. Controls & instrumentation				
f. Fuel oil supply system				
g. Switchgear tripping sequence				
h. Loads on generator				
i. Building lighting system test load				
3. Normal-emergency system No. 2				
a. Diesel engine				
b. Air-operated starting motor				
c. Air compressor and receiver				
d. Generator				
e. Controls & instrumentation				
f. Fuel oil supply system				
g. Switchgear tripping sequence				
h. Loads on generator				
i. Building lighting system test load				
4. I&C				
a. Operating mode selector switch				

Trainer(s) Date Trainee Date

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
7. **EMERGENCY SYSTEMS (cont.)**				
b. Abnormal operating condi- [illegible]				
[illegible] water temperature				
(2) Low lubricating oil pressure				
(3) Engine overspeed				
(4) Very low lubricating oil pressure				
(5) Overcranking				
5. Procedures				
a. Precautions				
b. Testing the normal-emergency systems				
c. Load testing the diesel generators				
d. Return to normal operation after a normal power outage				
7.1.2. Battery-powered pony motors				
1. Purpose				
2. Operational limitations				
3. Motors				
4. Batteries				
5. Battery chargers				
6. I&C				
a. High and low current annunciators				
b. Pony motor metering cabinet				
c. Shunt load test circuit				
d. Floating charge rate				
e. Freshening charge rate				
f. Charge failure and dc ground annunciators				
g. Spare battery charger				

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Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
7. EMERGENCY SYSTEMS (cont.)				
7. Procedures				
a. Precautions				
b. Pony motor performance test				
8. Routine checks				
7.1.3. Instrument batteries				
1. Purpose				
2. Operational limitations				
3. Batteries				
4. Battery chargers				
5. Power distribution				
6. 120-V noninterruptive power				
7. 125-V dc power				
8. I&C				
a. Charger failure and dc ground annunciators				
b. Floating charge rate				
d. Freshening charge rate				
9. Procedures				
a. Precautions				
b. Recharging the batteries after a normal power outage				
7.1.4. Auxiliary pressurizer pump				
1. Purpose				
2. Operational limitations				
3. Pumping capacity				
4. I&C				
a. Pump control				
b. Automatic start feature				
c. "Control Switch Off" annunciator				
5. Procedures				
a. Precautions				

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Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
7. **EMERGENCY SYSTEMS** (cont.)				
b. Testing the operation of the pump				
6. Routine checks				
7.1.5. Auxiliary secondary coolant pump				
1. Purpose				
2. Operational limitations				
3. Two-speed motor windings				
4. Pumping capacity				
5. I&C				
a. Pump control				
b. "Control Switch Off" annunciator				
c. Automatic start feature				
d. Cooling tower bypass valve				
6. Procedures				
a. Precautions				
b. Testing the operation of the pump				
7. Routine checks				
7.1.6. Normal, abnormal, and emergency procedures related to above items				
7.2. Fire Protection Systems				
7.2.1. Cooling tower, cooling tower equipment building, and electrical building fire alarms (Master Box No. 1, Code 843)				
1. Dry-pipe sprinkler system				
2. Fire alarm detectors				
a. Water flow switch				
b. Heat detectors				

Trainer(s) Date Trainee Date

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
7. **EMERGENCY SYSTEMS** (cont.)				
3. Cooling tower fan shutdown				
4. Relay R-60 and R-61 manual reset and bypass				
5. Trouble bell				
7.2.2. Reactor building fire alarm (Master Box No. 2, Code 842)				
1. Pre-action sprinkler system				
Fire alarm detectors				
a Water flow switch				
b. Heat detectors				
3. FN-5 and UV-1 (Room G-12) shutdown				
4. Hose cabinets				
5. Portable extinguishers				
6. Trouble bell				
7.2.3. Office and maintenance building fire alarm (Master Box No. 3, Code 841)				
1. Wet-pipe sprinkler system				
2. Water flow switch actuated fire alarm				
3. Trouble bell				
7.2.4. Master Box No. 4, trouble alarm (Code 8422)				
7.2.5. Power supply				
1. Battery				
2. Battery charger				
7.2.6. Normal, abnormal, and emergency procedures related to above items				

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Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
7. EMERGENCY SYSTEMS (cont.)				
7.3. Evacuation Procedures				
7.3.1. Emergency director and alternates				
7.3.2. Laboratory emergency instructions				
7.3.3. Laboratory evacuation - emergency outside the HFIR area				
7.3.4. Local area evacuation - emergency in the HFIR building				
7.3.5. Building evacuation - emergency in the HFIR building				
7.3.6. Normal, abnormal, and emergency procedures related to above items				
7.4. Radiation - Contamination Emergencies				
7.4.1. Fission product release - direct indication				
7.4.2. Fission product release - indirect indication				
7.4.3. Immediate steps to take upon a fission product release				
7.4.4. Defective element movement				
7.4.5. Defective element disposal				
7.4.6. Decontamination				
7.4.7. Normal, abnormal, and emergency procedures related to above items				

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Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
7. **EMERGENCY SYSTEMS (cont.)**				
7.5. Radiation Warning and Communication System				
7.5.1. Monitrons				
7.5.2. CAMs				
7.5.3. Control room readout				
7.5.4. Normal, abnormal, and emergency procedures related to above items				
7.6. Poison Injection System				
7.6.1. Precautions				
7.6.2. Injection of poison				
7.6.3. System test				
7.6.4. Normal, abnormal, and emergency procedures related to above items				
7.7. Emergency Secondary Cooling				
7.7.1. Source of water				
7.7.2. Testing the system				
7.7.3. Normal, abnormal, and emergency procedures related to above items				

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Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
8. WASTE SYSTEMS				
8.1. Process Waste System				
8.1.1. Purpose				
8.1.2. Activity ranges				
8.1.3. Flow paths				
8.1.4. Collection system				
1. Floor drains				
2. Experiment drains				
8.1.5. Process waste drainage sump				
1. Steam ejectors				
2. Level controller				
3. Level alarm				
8.1.6. Valve box No. 3				
1. FCV-700 and FCV-701				
2. Monitor box No. 2				
a. Flow element				
b. Proportional sampler				
c. Radiation monitor				
d. Radiation alarms				
8.1.7. Valve box No. 2				
1. FCV-703A and FCV-703B				
8.1.8. Valve box No. 1				
1. FCV-702A and FCV-702B				
2. Monitor box No. 1				
a. Flow element				
b. Proportional sample				
c. Radiation monitor				
d. Radiation alarms				

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Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
8. **WASTE SYSTEMS (cont.)**				
8.1.9. Retension ponds				
8.1.10. Pumping station				
8.1.11. Procedures				
1. Precautions				
2. Place the system in service				
3. Normal operation				
8.1.12. Routine checks				
8.1.13. Normal, abnormal, and emergency procedures related to above items				
8.2. Intermediate-Level Waste System				
8.2.1. Purpose of the system				
8.2.2. Activity levels				
8.2.3. Flow paths				
8.2.4. Collection system				
1. Experiment drains				
2. Equipment drains				
3. HOG drains				
4. FCV-700				
8.2.5. Waste storage and accessory equipment				
1. ILW storage tank				
a. Capacity				
b. Level element				
c. Level switch				
d. Level recorder				
2. Transfer pumps				
a. Purpose				
3. Sampling station				

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Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
8. WASTE SYSTEMS (cont.)				
8.2.6. Procedures				
1. Precautions				
2. Normal operation				
3. Pumping procedures				
4. Neutralize the waste with NaOH				
8.2.7. Routine checks				
8.2.8. Normal, abnormal, and emergency procedures related to above items				
8.3. Hot Off-Gas Systems (CHOG and OHOG)				
8.3.1. Purpose of system				
8.3.2. Flow paths				
8.3.3. Collection system				
1. Experiment vents				
2. Equipment vents				
8.3.4. Stack fans				
1. Fan controls and lights				
2. Standby-start feature				
8.3.5. Filter pit and ducts				
1. Type of filters and purpose of each				
2. Filter ΔP - clean and dirty				
3. Shielding				
4. Standby compartment				
8.3.6. I&C				
1. HOG vacuum low alarms				
2. Standby fan start alarms				
3. Radiation monitoring				
4. Vacuum indicators in the control room				
5. Vacuum indicators in the fan shed				

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Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
8. WASTE SYSTEMS (cont.)				
8.3.7. Procedures				
1. Operational limitations				
2. Place the system in service				
3. Switch fans from standby to run				
4. Switch the center filter compartment into service				
5. Removal of systems from service				
8.3.8. Action on an outage of normal power				
8.3.9. Action on loss of vacuum in HOG ducts				
8.3.10. Routine checks				
8.3.11. Normal, abnormal, and emergency procedures related to above items				
9. ON-SITE UTILITIES				
9.1. Process Water System				
9.1.1. Source of water				
9.1.2. Flow path				
9.1.3. Separation from potable water				
9.1.4. I&C				
1. Pressure indicators				
9.1.5. Procedures				
1. Place the system in service				
2. Normal operation				
3. Remove the system from service				
9.1.6. Normal, abnormal, and emergency procedures related to above items				

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Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
9. ON-SITE UTILITIES (cont.)				
9.2. Potable Water System				
9.2.1. Source of water				
9.2.2. Fire water loop				
9.2.3. Metering				
1. O&M building				
2. Electrical building				
3. Cooling tower area				
9.2.4. Uses of potable water				
9.2.5. I&C				
1. Pressure monitoring				
9.2.6. Normal, abnormal, and emergency procedures related to above items				
9.3. Plant Demineralized-Water System				
9.3.1. Purpose of system				
9.3.2. Flow path				
9.3.3. Plant demineralizer				
1. Capacity				
2. Automatic regeneration				
9.3.4. Demineralized water storage tank				
1. Capacity				
2. Level controller				
3. Level indicator				
4. Level alarms				
9.3.5. Demineralized water pumps				
9.3.6. I&C				
1. Conductivity sensor				

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Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
9. ON-SITE UTILITIES (cont.)				
9.3.7. Procedures				
1. Precautions				
2. Place the system in service				
3. Regeneration of the demineralizer				
4. Placing the demineralizer in service after standing idle				
5. Removing the system from service				
9.3.8. Routine checks				
9.3.9. Normal, abnormal, and emergency procedures related to above items				
9.4. Chilled Water System				
9.4.1. Purpose of system				
9.4.2. Flow path				
9.4.3. Chiller unit				
1. Motor-compressor assembly				
2. Condenser				
3. Economizer				
4. Cooler				
5. Control system				
a. Automatic shutdown features				
9.4.4. Chilled water pumps				
9.4.5. Chemical feeder				
9.4.6. Expansion tank				
9.4.7. Normal, abnormal, and emergency procedures related to above items				

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Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
9. ON-SITE UTILITIES (cont.)				
9.5. Acid and Caustic Systems				
9.5.1. Nitric acid				
1. Uses				
2. Storage tank				
3. Day tank				
4. Nitric acid pump				
5. Procedures				
a. Precautions				
b. Fill the nitric acid storage tank				
c. Fill the nitric acid day tank				
6. Routine checks				
9.5.2. Caustic				
1. Uses				
2. Storage tank				
3. Day tank				
4. Steam tracing				
5. Procedures				
a. Precautions				
b. Fill the caustic storage tank				
c. Fill the caustic day tank				
6. Routine checks				
9.5.3. Sulfuric acid				
1. Uses				
2. Storage tank				
3. Acid mixer				
4. Metering pumps				

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Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
9. ON-SITE UTILITIES (cont.)				
5. Procedures				
a. Precautions				
b. Fill the sulfuric acid storage tank				
6. Routine checks				
9.5.4. Normal, abnormal, and emergency procedures related to above items				
9.6. Steam				
9.6.1. Uses				
9.6.2. Scurce				
9.6.3. Pressure reducers				
9.6.4. 125 psi				
9.6.5. 15 psi				
9.6.6. Procedures				
1. Precautions				
2. Eject water from the elevator sump				
3. Place process water waste sump ejectors in service 4. Place caustic tank steam heating in service				
5. Place cooling tower area tracings in service				
9.6.7. Routing checks				
9.6.8. Normal, abnormal, and emergency procedures related to above items				

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Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
9. ON-SITE UTILITIES (cont.)				
9.7. Instrument Air System				
9.7.1. Purpose of system				
9.7.2. Flow path				
9.7.3. Normal air compressors				
1. Dual compressors				
2. Standby-start features				
3. After coolers				
4. Filters				
5. Air receiver				
6. Dryers				
7. Moisture detector				
8. Capacity of compressors				
9. Capacity of dryers				
10. Cooling water supply				
9.7.4. Emergency air compressor				
1. Purpose				
2. Capacity				
3. Automatic start feature				
4. After cooler				
5. Filter				
6. Surge air receivers				
7. Cooling water supply				
8. Check valve				
9.7.5. Loading and unloading valves				
9.7.6. Air dryer regeneration				
9.7.7. I&C				
1. Standby compressor start alarm				
2. Selector switch				

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Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
9. ON-SITE UTILITIES (cont.)				
3. Running lights				
4. High temperature alarm				
5. Emergency air compressor start alarm				
6. Instrument air pressure low alarms (Panels A, B, and C)				
9.7.8. Procedures				
1. Precautions				
2. Place the system in service				
3. Remove a compressor from service				
9.7.9. Routine checks				
9.7.10. Normal, abnormal, and emergency procedures related to above items				
9.8. Electrical Systems				
9.8.1. Normal power system				
1. 13.8-kV switching station				
a. Preferred feeder				
b. Alternate feeder				
c. Automatic switching from preferred to alternate				
d. Capacity of alternate feeder				
e. Six fused interrupter switches				
2. 13-8-kV distribution				
a. One 2.4-kV transformer				
b. Four 480-V transformers				
c. Two 120/240-V instrument power transformers				

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Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
9. ON-SITE UTILITIES (cont.)				
3. 2.4-kV system				
a. Zig-zag grounding transformer				
b. Chiller compressor				
c. Pressurizer pumps				
d. Secondary coolant pumps				
e. Primary coolant pumps				
4. Substation No. 1 (480 V)				
a. Motor control center "A"				
b. Motor control center "B"				
c. Motor control center "O"				
5. Substation No. 2 (480 V)				
a. Beam hole power panels (120/240 V)				
b. Reactor bay power panels (120/240 V)				
c. Beam room bus duct (480 V)				
d. Experiment area bus duct (480 V)				
e. Motor control center "C" (480 V)				
6. Substation No. 3 (480 V)				
a. Bus tie				
b. Motor control center "N"				
7. Substation No. 4 (480 V)				
a. Bus tie				
b. Motor control center "L"				
c. Motor control center "K"				

Trainer(s) Date Trainee Date

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
9. ON-SITE UTILITIES (cont.)				
9.8.2. Normal emergency system No. 1				
1. TRU feeder (10-second delay)				
2. Motor control center "G" (0-second delay)				
3. Motor control center "J" (20-second delay)				
a. P-1A				
b. P-1B				
c. P-18				
d. Beam room bus duct				
e. Experiment area bus duct				
4. Motor control center "D" (20-second delay)				
5. Motor control center "E" (30-second delay)				
6. 226-amp south experiment area bus duct (40-second delay)				
9.8.3. Normal emergency system No. 2				
1. Motor control center "H" (0-second delay)				
2. TRU feeder (10-second delay)				
3. Motor control center "F" (20-second delay)				
4. 225-amp west experiment area bus (30-second delay)				

Trainer(s) Date Trainee Date

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
9. ON-SITE UTILITIES (cont.)				
9.8.4. Failure-free systems				
1. Pony motor drive system				
a. Batteries				
b. Battery chargers				
c. Charger failure alarms				
2. Instrument dc power				
a. Batteries				
b. Battery chargers				
c. Charger failure alarms				
3. Switchgear dc power				
a. Batteries				
b. Battery chargers				
c. Charger failure alarms				
9.8.5. Instrument power station				
1. 13.8-kV - 120/240-V transformers				
2. Automatic transfer switches				
9.8.6. Procedures				
1. Precautions				
2. 13.8-kV systems				
3. 2.4-kV systems				
4. 480-V systems				
5. Normal emergency systems				
6. Failure-free system				
7. Instrument power				
9.8.7. Routine checks				
9.8.8. Normal, abnormal, and emergency procedures related to above items				

Trainer(s) ____________ Date ____________ Trainee ____________ Date ____________

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
9. ON-SITE UTILITIES (cont.)				
9.9. Communcations Systems				
9.9.1. Intercom systems				
1. Master stations				
2. Staff stations				
9.9.2. Sound-powered telephone system				
9.9.3. Dial telephones				
9.9.4. Public address system				
9.9.5. Normal, abnormal, and emergency procedures related to above items				
10. RECORDS AND DATA ACCUMULATION				
10.1. Daily Report Forms				
10.1.1. Hourly readings				
10.1.2. Accumulated instrument power				
10.1.3. Shift check sheets				
10.1.4. Water system check sheets				
10.1.5. Daily summary				
10.1.6. SBHE and HOG systems check sheet				
10.1.7. Diesel generator and dc power check sheet				
10.1.8. Normal, abnormal, and emergency procedures related to above items				

Trainer(s) Date Trainee Date

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
10. RECORDS AND DATA ACCUMULATION (cont.)				
10.2. Cyclic Report Forms				
10.2.1. Startup checklist				
10.2.2. Weekly checklist				
10.2.3. Radiation background survey				
10.2.4. Shutdown checklist				
10.2.5. Normal, abnormal, and emergency procedures related to above items				
10.3. Data Summation				
10.3.1. Weekly report				
10.3.2. Quarterly report				
10.3.3. Normal, abnormal, and emergency procedures related to above items				
11. AUXILIARY EQUIPMENT				
11.1. Reactor Bay Crane				
11.1.1. Capacity of large hook				
11.1.2. Capacity of small hook				
11.1.3. Vertical travel length				
11.1.4. Operating restrictions				
11.1.5. Normal, abnormal, and emergency procedures related to above items				

Trainer(s) Date Trainee Date

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
11. **AUXILIARY EQUIPMENT** (cont.)				
11.2. Freight Elevator				
11.2.1. Load capacity				
11.2.2. Normal, abnormal, and emergency procedures related to above items				
11.3. Reactor Bay Air Locks				
11.3.1. Precautions				
11.3.2. Procedures				
11.3.3. Normal, abnormal, and emergency procedures related to above items				
12. **MISCELLANEOUS**				
12.1. Job Performance Standards				
12.2. Quality Assurance				
12.2.1. Organization				
12.2.2. Application				
12.2.3. Reporting (audits, hotline)				
13. **OPERATING EXPERIENCE**				
13.1. Has performed a reactor startup (console operation or in a supervisory capacity)				

Trainer(s) Date Trainee Date

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
13. **OPERATING EXPERIENCE** (cont.)				
13.2. Has participated in reactor startups, other than console work				
13.3. Has participated in reactor refueling and/or core disassembly work				
13.4. Has participated in reactor shutdown work (other than refueling)				
13.5. Has participated in power changes of greater than 10%				
13.6. Has participated in control room work during normal operations				
13.7. Other ______________________				

Trainer(s) Date Trainee Date

SECTION 2. FACILITY-SPECIFIC CHECKLIST

Trainee: ______________________ Badge No.: ______________

Facility: High Flux Isotope Reactor (HFIR) Buildings: 7900, 7910, 7912

Instructions

This is a most important checklist. Each subject should be taught to the extent that the trainee will be capable of confidently operating equipment and/or executing a procedure without the need for direct supervision. Trainers should establish learning objectives to ensure that the trainee is left with that knowledge required to perform his/her job duties in a safe and reliable manner.

At the end of each section is an item entitled "normal, abnormal, and emergency procedures related to above items." This should serve, in part, as a review for the subjects in that section. Areas in which weaknesses are indicated should be repeated as needed.

When the Trainer initials an item (and signs the bottom of each page), it should indicate that he/she has not only been assured that the material has been covered with the Trainee, it should also indicate that the Trainee knows the material well enough to be qualified in that subject area.

Upon completion, this checklist should be returned first to the Training Manager. The Training Manager shall submit it to the Examiner at the time the request is made to administer the certification examination.

This material has been taught to the trainee. ______________________, ______________
Training Manager   Completion Date

This material has been taught to me by the training personnel. ______________________, ______________
Trainee   Completion Date

SECTION 3. EMERGENCY PREPAREDNESS CHECKLIST

Trainee: ______________________ Badge No.: ____________

Facility: High Flux Isotope Reactor (HFIR) Buildings: 7900, 7910, 7912

Instructions

This checklist, on abnormal/emergency operating instructions (A/EOIs), is intended to ensure, in part, that an individual has received training in emergency procedures, as required by DOE Orders 5480.1A, Chapter VI (Safety of DOE-Owned Reactors) and 5500.3 (Reactor and Nonreactor Nuclear Facility Emergency Planning, Preparedness, and Response Program for DOE Operations).

This checklist is to be used for initial certification and for requalification training. It is required that all emergency procedures be reviewed on an annual basis.

(Recommendation: The shift supervisor should periodically cover with his or her crew a few A/EOIs and postulated emergency scenarios in the generic categories as talk-through exercises, as time allows. Toward the end of a certification period, return all checklists for auditing purposes.)

With the exception of Section 3, all items must be completed prior to the administering of the initial certification examination. Some of the subjects in this section are taught by training personnel in other ORNL organizations at different times throughout the year. These subjects (only) may be signed off after the initial certification examination but shall be acknowledged during requalification periods.

When the Trainer initials an item (and signs the bottom of each page), it should indicate that he/she has not only been assured that the material has been covered with the Trainee, it should also indicate that the Trainee knows the material well enough to be qualified in that subject area.

Upon completion, this checklist should be returned to the Training Manager; he/she shall submit it to the Examiner.

This material has been taught to the trainee. ______________________, ____________

Training Manager Completion Date

This material has been taught to me by the training personnel. ______________________, ____________

Trainee Completion Date

SECTION 3. EMERGENCY PREPAREDNESS CHECKLIST

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
1. FACILITY-SPECIFIC ABNORMAL/EMERGENCY OPERATING INSTRUCTION (A/EOIs)				
1.1. Inadvertent criticality during refueling				
1.2. Loss of shutdown cooling during power outage				
1.3. Handling of a dropped, irradiated fuel element				
1.4. Loss of coolant accident (LOCA)				
1.5. High radiation level in reactor building				
1.6. Rapid loss of pool water				
1.7. Stuck control rod				
1.8. Loss of primary containment				
1.9. Loss of one primary coolant pump				
1.10. Loss of two or more primary coolant pumps				
1.11. Loss of primary coolant - small leaks				
1.12. Loss of primary coolant - large leaks (but no LOCA)				
1.13. Loss of steam				
1.14. Loss of instrument air				

Trainer(s)	Date	Trainee	Date

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
1. **FACILITY-SPECIFIC ABNORMAL/EMERGENCY OPERATING INSTRUCTION (A/EOIs)** (cont.)				
1.15. Significant changes in differential pressure across the reactor vessel and inlet strainer - an increase in pressure across the reactor vessel				
1.16. Loss of flow to experiment facility (EF-2, etc.)				
1.17. Control-rod drive system failure				
1.18. Loss of secondary cooling system				
1.19. An unexpected change in reactivity while at full power				
1.20. Uncoupled control rod				
1.21. Loss of control rod position indication				
1.22. Fuel damage during power operation				
1.23. An increase in the radiation level in the primary coolant system				
1.24. High radiation level in the secondary water system				
1.25. High radiation in the off-gas system				
1.26. Failure of a primary pressure-relief valve				
1.27. Failure of a primary pump check valve				
1.28. Operation during tornado watches and/or warnings				

Trainer(s) ______ Date ______ Trainee ______ Date ______

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
1. **FACILITY-SPECIFIC ABNORMAL/EMERGENCY OPERATING INSTRUCTION (A/EOIs)** (cont.)				
1.29. Operation during earthquake conditions				
1.30. Loss of electrical power				
1.31. Loss of 2.4-kV electrical power				
1.32. Normal, abnormal, and emergency procedures related to above items				
1.33. Transfer of damaged, irradiated fuel				
1.34. Operation during severe weather conditions (high temperature and humidity, freezing rain, ice, etc.)				
2. **GENERIC EMERGENCY PROCEDURES** (as identified in DOE Order 5500.3)				
If any of the items below have been covered in the previous section, write NA in the space.				
2.1. Operational (On-site and off-site)				
2.1.1. Fires				
2.1.2. Explosion				
2.1.3. Industrial accidents				
2.1.4. Personnel injury or fatality				
2.1.5. Release of radioactive or toxic materials				
2.1.6. Personnel exposure				

Trainer(s) Date Trainee Date

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
2. GENERIC EMERGENCY PROCEDURES (cont.)				
2.1.7. Oil and hazardous material pollution				
2.1.8. Air and water pollution				
2.1.9. Transportation accident involving hazardous materials				
2.2. Natural phenomena				
2.2.1. Earthquake				
2.2.2. Tornado				
2.2.3. Flood				
2.2.4. Wind, snow, ice				
2.3. Special nuclear materials (SNM)				
2.3.1. Accidents or malevolent acts involving fuel				
2.4. Terrorists threats or acts				
2.4.1. Bomb threat				
2.4.2. Overt or covert actions, including sabotage				
2.4.3. Nuclear threats				
2.4.4. Extortion or kidnapping				
2.4.5. International threats				

Trainer(s) Date Trainee Date

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
3. OTHER SAFETY-RELATED SUBJECTS				
3.1. Has periodically participated in building and/or plant evacuation drills. (Required at least annually.)				
3.2. Has had fire-fighting training				
3.3. Has had training in the use of respiratory safety equipment				
3.4. Has had training in first aid and/or CPR				
3.5. Has had periodic safety meetings				
3.6. Has read all scenarios and/or reports on accident-type drills at this facility				
3.7. Has read all reactor-related Unusual Occurrence Reports generated at ORNL				
3.8. Has read the summaries of the Unusual Occurrence Reports generated by other DOE facilities				
3.9. Has read selected and/or significant unusual occurrence reports generated by the NRC				
3.10. Has reviewed all Mechanical and Instrumentation and Controls Design Change Memos applicable to this facility				

Trainer(s)	Date	Trainee	Date

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
3. **OTHER SAFETY-RELATED SUBJECTS** (cont.)				
3.11. Has been made aware of all significant changes in equipment and/or procedures at this facility				
3.12. Has periodically reviewed the following ORNL safety literature:				
1. Local Emergency Manual				
2. Laboratory Emergency Manual				
3. Safety Manual				
4. Health Physics Procedures Manual				
3.13. Knows the building evacuation procedure				
3.14. Knows the plant-wide evacuation procedure				
3.15. Knows the type and location of emergency equipment at the facility				

Trainer(s)	Date	Trainee	Date

SECTION 4. SUPERVISOR'S CHECKLIST

Trainee: ______________________________ Badge No.: ______________

Facility: High Flux Isotope Reactor (HFIR) Buildings: 7900, 7910, 7912

Instructions

Some of the material on supervisor training is covered by special courses given by ORNL instructors (other than Reactor Operations personnel) at various times throughout the year. To allow the candidate to take the Senior Reactor Operator examination and assume the duties of a Supervisor prior to attending these courses, the instructor shall cover the fundamentals of the various subjects to ensure that the individual is prepared to assume his/her supervisory responsibilities.

When the Trainer initials an item (and signs the bottom of each page), it should indicate that he/she has not only been assured that the material has been covered with the Trainee, it should also indicate that the Trainee knows the material well enough to be qualified in that subject area.

Upon completion, this checklist should be returned to the Training Manager; he/she shall submit it to the Examiner.

This material has been taught to the trainee. ______________________, ______________

Training Manager Completion Date

This material has been taught to me by the training personnel. ______________________, ______________

Trainee Completion Date

SECTION 4. SUPERVISOR'S CHECKLIST

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
1. LEADERSHIP				
1.1. Fundamentals				
1.2. Protocol				
1.3. Command responsibilities and limits				
1.4. Interpersonal communication				
1.5. Motivation of personnel and handling complaints				
1.6. Labor relations				
1.7. Problem/decisional analysis				
1.8. Job performance standards				
1.9. Organizing and planning				
2. ADMINISTRATIVE REQUIREMENTS				
2.1. Responsibilities during reactor-type operation				
2.2. Technical Specifications				
2.3. Reporting requirements				
2.4. Special forms to fill out and/or reports to write (RWP, work requests, etc.)				
2.5. Disseminating pertinent information to shift personnel				
2.6. Special projects				

Trainer(s) Date Trainee Date

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FACILITY TRAINING/QUALIFICATION CHECKLIST(S)

Trainee: ______________________ Badge No.: ____________

Facility: Oak Ridge Research Reactor (ORR) Buildings: 3042, 3001, 3004

Instructions

This composite checklist is comprised of four sections; these are: (1) the Generic Subjects Checklist (i.e., reactor physics, heat transfer/fluid flow, radiation safety, and industrial safety); (2) the Facility-Specific Checklist; (3) the Emergency Preparedness Checklist; and (4) the Supervisor's Checklist. (Refer to the individual checklists for any special instructions.)

The topics herein are to be taught to the above-mentioned trainee by the Training Manager, or his/her designated instructors, to the extent that the trainee will be prepared for (1) the written, oral, and/or operating examinations required for certification or requalification and (2) solo operation at the above-mentioned facility. All items on each checklist are to be covered for the initial qualification; selected items, with emphasis on abnormal/emergency procedures, are to be covered for requalification training.

The training personnel shall be responsible for establishing learning objectives, as applicable. That is, they shall cover each subject with the primary objective of leaving the trainee with that essential information and/or knowledge needed to operate the reactor or auxiliary equipment in a safe, efficient, and reliable manner during normal, abnormal, and emergency conditions.

The Training Manager at this facility shall coordinate all training and shall sign the cover page of this and each individual checklist after all the required sections have been covered, as applicable. He/she shall also ensure that all required signatures are affixed prior to sending the composite checklist to the Examiner for filing. All sections should be completed prior to taking the written examination required for initial certification.

The composite checklist is intended to be used for the initial qualification and for one requalification; however, it may be used for an additional requalification (two-year period) by using a color code, or some similar scheme, to indicate continued use of the same checklist.

This material has been taught to the trainee. ______________________, ____________

Training Manager — Completion Date

This material has been taught to me by the training personnel. ______________________, ____________

Trainee — Completion Date

SECTION 1. GENERIC SUBJECTS CHECKLIST

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
1. REACTOR PHYSICS				
1.1. Neutron Reactions				
1.1.1. Type of reactions				
1.1.2. Fast and thermal neutrons				
1.1.3. Prompt and delayed neutrons				
1.1.4. Multiplication factor				
1.1.5. Cross section				
1.1.6. Neutron spectrum				
1.2. Nuclear Reactors				
1.2.1. Description of reactor components				
1.2.2. Reactivity and criticality				
1.2.3. The four-factor formula				
1.3. Reactivity and Reactor Period				
1.3.1. Reactivity calculations				
1.3.2. Reactor period				
1.3.3. Prompt criticality				
1.4. Fuel Burnup				
1.4.1. Fuel requirements for critical mass				
1.4.2. Fuel loading				
1.5. Xenon and Samarium Poisoning Effects				
1.5.1. Fission-product poisons				
1.5.2. Buildup and removal				

Trainer(s)	Date	Trainee	Date

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
1. REACTOR PHYSICS (cont.)				
1.5.3. Effect of shutdown on poison equilibrium				
1.6. Temperature Effects				
1.6.1. Reactivity and temperature				
1.6.2. Temperature coefficients				
1.6.3. Reactor control				
1.6.4. Doppler effect				
1.7. Neutron Flux Distribution				
1.7.1. Basic information				
1.7.2. Reflector effects				
1.7.3. Temperature effects				
1.7.4. Fuel burnup effects				
1.7.5. Control-rod effects				
1.7.6. Control-rod worth				
2. HEAT TRANSFER/FLUID FLOW				
2.1. Heat (Units, Definitions)				
2.1.1. Introduction				
2.1.2. Temperature units				
2.1.3. Heat units				
2.1.4. Thermal energy and power				
2.1.5. Thermal stress				
2.2. Heat Transfer				
2.2.1. Sources of heat				

Trainer(s)	Date	Trainee	Date

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
2. HEAT TRANSFER/FLUID FLOW (cont.)				
2.2.2. Heat conduction				
2.2.3. Heat transfer by convection				
2.2.4. Nucleate, transition, and filler boiling				
2.3. Fluid Mechanics				
2.3.1. Hydraulic and pneumatic pressure				
2.3.2. Static pressure and force				
2.3.3. Dynamic pressures and forces				
2.3.4. Water hammer				
2.4. Heat Production and Control in Nuclear Reactors				
2.4.1. Fission-produced heating				
2.4.2. Temperature and heat transfer in reactors				
2.4.3. Heat transfer rates				
2.4.4. Determination of operating parameters				
2.4.5. Afterheat				
3. RADIATION SAFETY AND CONTROL				
3.1. Atoms				
3.1.1. Parts defined				
3.1.2. Characteristics of protons, neutrons, and electrons				
3.2. Radioactive Material and Radiation				
3.2.1. Unstable atoms				
3.2.2. Types of radioactive decay				

Trainer(s) Date Trainee Date

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
3. RADIATION SAFETY AND CONTROL (cont.)				
3.2.3. Radioactive contamination				
3.3. Ionization				
3.3.1. Ions				
3.3.2. Radiation and ionization				
3.3.3. Range				
3.3.4. Shielding				
3.4. Radiation Units				
3.4.1. The curie				
3.4.2. The roentgen				
3.4.3. The rad				
3.4.4. The relative biological effectiveness of radiation (RBE)				
3.4.5. The roentgen equivalent man (REM)				
3.5. Health Hazards of Radiation				
3.5.1. Radiation review				
3.5.2. Penetration effects				
3.5.3. Effects from ingested sources				
3.5.4. Radiation sensitivity of body organs				
3.5.5. Radiation dose rate				
3.6. Radiation Protection Methods				
3.6.1. Review				
3.6.2. Planning, to reduce exposure				
3.6.3. Reducing the dose rate				

Trainer(s) Date Trainee Date

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
3. RADIATION SAFETY AND CONTROL (cont.)				
3.6.4. Shielding--tenth-value and half-value layers				
3.6.5. Radioactive decay				
3.6.6. Shielding with distance				
3.7. Radioactive Contamination - Protective Measures				
3.7.1. Review				
3.7.2. Radioactive contamination (solid, liquid, and gaseous)				
3.7.3. Contamination, surface and airborne				
3.7.4. Contamination zones				
3.7.5. Contamination clothing				
3.7.6. Regulated zones				
3.7.7. Continuous air monitors				
3.7.8. Maximum permissible body burden				
3.7.9. Maximum permissible concentration				
4. INDUSTRIAL SAFETY				
4.1. Operational Safety				
4.1.1. Safety organization and Safety Officer				
4.1.2. Protective equipment (use, location)				
4.1.3. Safety practices				
1. Pre-job planning				
2. Electrical safety				
3. Permits and tags				
4. Company vehicles				
4.1.4. Reporting of accidents •				

Trainer(s) Date Trainee Date

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
4. INDUSTRIAL SAFETY (cont.)				
4.1.5. Source of information (reference)				
1. Standard Practice Procedure				
2. Policy Procedure Manual				
3. Safety Manual				
4. Environmental Protection Manual				
5. ORNL Respiratory Program				
4.2. Industrial Hygiene				
4.2.1. Hearing/sight conservation				
4.2.2. Use and availability of respiratory equipment				
4.2.3. Control of toxic chemicals/acid spills				
4.2.4. Incompatible chemicals				
4.2.5. Reporting requirements				
4.3. Environmental Protection				
4.3.1. Organization (function, contact)				
4.3.2. General requirements for discharging of effluents to the environs				
4.3.3. Handling and disposing of hazardous materials				
4.3.4. Reporting				
4.4. Fire Protection				
4.4.1. Organization				
4.4.2. Location of alarm boxes and equipment				
4.4.3. Effects of smoke and hot, toxic gases				
4.4.4. Combating fires alone				

Trainer(s) Date Trainee Date

SECTION 2. FACILITY-SPECIFIC CHECKLIST

Trainee: ______________________________ Badge No.: ____________

Facility: Oak Ridge Research Reactor (ORR) Buildings: 3042, 3001, 3004

Instructions

This is a most important checklist. Each subject should be taught to the extent that the trainee will be capable of confidently operating equipment and/or executing a procedure without the need for direct supervision. Trainers should establish learning objectives to ensure that the trainee is left with that knowledge required to perform his/her job duties in a safe and reliable manner.

At the end of each section is an item entitled "normal, abnormal, and emergency procedures related to above items." This should serve, in part, as a review for the subjects in that section. Areas in which weaknesses are indicated should be repeated as needed.

When the Trainer initials an item (and signs the bottom of each page), it should indicate that he/she has not only been assured that the material has been covered with the Trainee, it should also indicate that the Trainee knows the material well enough to be qualified in that subject area.

Upon completion, this checklist should be returned first to the Training Manager. The Training Manager shall submit it to the Examiner at the time the request is made to administer the certification examination.

This material has been taught to the trainee. ______________________, ____________
Training Manager Completion Date

This material has been taught to me by the training personnel. ______________________, ____________
Trainee Completion Date

SECTION 1. GENERIC SUBJECTS CHECKLIST

Trainee: ______________________________ Badge No.: ______________

Facility: Oak Ridge Research Reactor (ORR) Buildings: 3042, 3001, 3004

Instructions

The generic subjects may be covered by self study, viewing videotapes, and/or classroom work. Many of the subjects are academic in nature and serve as background material. Where possible, however, the practical applications should be emphasized.

Trainers should establish learning objectives to ensure that the trainee is left with the knowledge required to reliably operate the equipment or execute a procedure.

Each subject should be taught to the extent that the trainee will be prepared to take the certification examinations and be able to perform the required work, without direct supervision, in a safe and reliable manner.

When the Trainer initials an item (and signs the bottom of each page), it should indicate that he/she has not only been assured that the material has been covered with the Trainee, it should also indicate that the Trainee knows the material well enough to be qualified in that subject area.

Upon completion, this checklist should be returned to the Training Manager; he/she shall submit it to the Examiner.

This material has been taught to the trainee. ______________________, ______________
Training Manager — Completion Date

This material has been taught to me by the training personnel. ______________________, ______________
Trainee — Completion Date

SECTION 2. FACILITY SPECIFIC CHECKLIST

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
1. DESIGN AND DESCRIPTION OF FACILITY				
1.1. Reactor Core Components				
1.1.1. Fuel elements				
1. One-half fuel element (presently not in use)	______	______	______	______
2. Whole element	______	______	______	______
1.1.2. Shim rods	______	______	______	______
1. Al-Cd (presently not in use)	______	______	______	______
2. Be-Cd (presently not in use)	______	______	______	______
3. Fuel-Cd	______	______	______	______
1.1.3. Beryllium core pieces				
1. Hollow and inserts	______	______	______	______
2. Solid pieces	______	______	______	______
1.1.4. N_F tray (presently not in use)	______	______	______	______
1.1.5. Isotope stringers (presently not in use)	______	______	______	______
1.1.6. Neutron source insert (presently not in use)	______	______	______	______
1.1.7. Aluminum core pieces	______	______	______	______
1.1.8. Iodine stringer	______	______	______	______
1.1.9. End-box adapters	______	______	______	______
1.1.10. Hydraulic tubes (presently not in use)	______	______	______	______
1.1.11. In-core experiments (see Irradiation Facilities)	______	______	______	______

______________________________ ______________________________

Trainer(s) Date Trainee Date

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
1. DESIGN AND DESCRIPTION OF FACILITY (cont.)				
1.2. Reactor Vessel				
1.2.1. Access cover and closure				
1.2.2. Upper bearing supports				
1.2.3. Lower grid				
1.2.4. Lower bearing support plate				
1.2.5. Inlet water line expansion joints				
1.2.6. Large facility seals (leak detectors)				
1.2.7. H_2O holes and plugs				
1.2.8. Thermal shields				
1. Facilities				
2. Inside vessel				
3. Pool floor				
4. Poolside facility				
1.2.9. Ion chamber shield				
1.2.10. Access cover				
1.2.11. Access cover flange				
1.2.12. Reactor tank head V-1 through V-10				
1.2.13. Slant access tubes				
1.2.14. Bottom tank (subassembly B-2)				
1.2.15. D_2O system				

Trainer(s) ________ Date ________ Trainee ________ Date ________

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
1. DESIGN AND DESCRIPTION OF FACILITY (cont.)				
1.2.16. Large facility cooling water flow (primary water)				
1.2.17. Poolside facility (see Irradiation Facilities)				
1.2.18. Ion-chamber racks				
1.2.19. Bottom plug				
1. Shock absorber				
2. Drive tubes				
1.2.20. Spray nozzles				
1.2.21. ^{16}N dispersion				
1.2.22. Beam-hole cooling				
1.2.23. Tubes for gamma chambers				
1.2.24. Normal, abnormal, and emergency procedures related to above items				
1.3. Control-Rod-Drive Mechanisms				
1.3.1. Ball engagement mechanism assembly				
1. Guide tube				
2. Push rod				
3. Stellite balls				
4. Plunger				
1.3.2. Operator assembly				
1. Upper housing				
a. Snubber assembly				
b. Lock-unlock mechanism				

Trainer(s) Date Trainee Date

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
1. DESIGN AND DESCRIPTION OF FACILITY (cont.)				
2. Lower housing				
a. Magnet				
b. Magnet armature				
c. Release spring				
1.3.3. Recocking mechanism assembly				
1. Recocking springs				
2. Recocking pins				
1.3.4. Drive gear box				
1. Drive screw (worm gear)				
1.3.5. Worm gear housing				
1. Coarse selsyn				
2. Fine selsyn				
1.3.6. Mounting plate				
1.3.7. Drive electrical motors				
1.3.8. Tachometer generator (servo rod only)				
1.3.9. Upper limit switch				
1.3.10. Clutch switch				
1.3.11. Push-rod response switch				
1.3.12. Seat switch				
1.3.13. Lower limit switch				
1.3.14. Magnet amplifiers				

Trainer(s)	Date	Trainee	Date

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
1. **DESIGN AND DESCRIPTION OF FACILITY** (cont.)				
1.3.15. Timers				
1.3.16. Selsyns (coarse and fine)				
1.3.17. Normal, abnormal, and emergency procedures related to above items				
1.4. Nuclear Instrumentation and Control System				
1.4.1. Counting-rate-meter channels				
1. Fission chamber				
2. Pulse preamplifier				
3. Pulse amplifier				
4. Counting-rate meter				
5. Counting-rate-meter recorder (set points)				
6. Scaler				
7. Audible amplifier and speakers				
8. Counting-rate-meter period recorder (set points)				
1.4.2. Log-N channels				
1. Ion chamber (compensated)				
2. High-voltage supply				
3. Negative voltage				
4. Log-N amplifier				
5. Period amplifier				
6. Log-N recorder				
7. Log-N period recorder				
1.4.3. Safety channels				
1. Ion chamber (uncompensated)				
2. Sigma amplifier				
3. Safety recorder				
4. Sigma bus				
5. Magnet amplifiers				
6. Safety preamplifier				

Trainer(s) Date Trainee Date

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
1. DESIGN AND DESCRIPTION OF FACILITY (cont.)				
1.4.4. Gamma channels				
1. Ion chamber				
2. Gamma recorder				
1.4.5. ^{16}N channel				
1. Ion chamber				
2. Electrometer				
3. Voltage supply				
4. ^{16}N recorder				
1.4.6. Micromicroammeter channel				
1. Chamber				
2. Noise monitor				
3. Recorders				
1.4.7. Servo channel				
1. Introduction				
2. Functional description				
a. Demand control				
(1) Operator demand control				
(2) 30-s period				
(3) Oscillation mode				
(4) Demand indicator				
(5) Lower limit logic diagram				
(6) Permissives to increase demand				
(7) Raise-test-norm switch				
(a) Ranger (3 kW, 300 kW, 30 kW)				
(b) 1% - 105%				
(c) Lamps on operator's control panel				
(d) Demand automatic set				

Trainer(s) Date Trainee Date

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
1. DESIGN AND DESCRIPTION OF FACILITY (cont.)				
(8) No primary cooling flow				
(a) 3 kW and 300 kW				
(b) Test				
(c) Bypass of setback features				
(9) Demand oscillator				
(a) Purpose				
(b) Key switch				
b. Flow and temperature calculations				
(1) Sampling time				
(2) Running average				
(3) RTDs				
(a) Calculations				
c. Heat power calculations				
(1) $HP = F \cdot \Delta T \cdot K$				
(a) Primary water and pool heat power				
(2) Displayed (MW)				
(3) Experiments power level transmission system				
d. Flux calibration				
(1) Purpose				
(2) Calibrated flux ($\phi_R = C_1 \cdot \phi$)				
(3) Calibration parameter ($C_2 = HP/\phi$)				
(4) Sampling time				
(5) Flux calibration gain				
(a) 30 MW mode				
(b) 3 kW and 300 kW mode				

Trainer(s) ____________ Date ____________ Trainee ____________ Date ____________

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
1. DESIGN AND DESCRIPTION OF FACILITY (cont.)				
e. Flux error and rod control				
(1) Deadbank				
(2) Servo sensitivity				
3. Servo amplifier				
a. Servo NIM bin				
b. Ionization chamber*				
(1) 8 μA at 30 MW				
c. Keithley amplifier				
(1) 4 to 20 ma				
(2) Gain change				
(3) Analog panel meter				
(4) Range selector switch				
(4) Operator control and displays				
(a) Servo NIM bin contents				
(b) Operator's control panel contents				
1.4.8. Reactor water activity				
1.4.9. Pool water activity				
1.4.10. Reactor secondary water activity				
1.4.11. Degasifier activity				
1.4.12. POG radiation				
1.4.13. NOG radiation				
1.4.14. Containment gamma monitors				

*The non-gamma compensated chamber will be used initially. A gamma compensated chamber will be installed when available.

Trainer(s)	Date	Trainee	Date

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
1. DESIGN AND DESCRIPTION OF FACILITY (cont.)				
1.4.15. Radiation warning and communication system				
1. Monitrons				
2. Continuous air monitors (old and new)				
1.4.16. β-γ background survey meters				
1.4.17. Normal, abnormal, and emergency procedures related to above items				
1.5. Process Instrumentation and Control Systems				
1.5.1. Reactor primary water inlet temperature (readout and alarms)				
1.5.2. Reactor primary water outlet temperature channels				
1.5.3. ΔT channels				
1.5.4. Reactor secondary basin water temperature				
1.5.5. Reactor secondary heat-exchanger average temperature				
1.5.6. Pool primary coolant temperature channel				
1.5.7. Pool secondary coolant temperature				
1.5.8. POG filter-pit temperature				
1.5.9. NOG filter-pit temperature				
1.5.10. Cell-ventilation filter-pit temperature				

Trainer(s) Date Trainee Date

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
1. DESIGN AND DESCRIPTION OF FACILITY (cont.)				
1.5.11. Main pump bearing temperature				
1.5.12. Reactor primary coolant flow				
1.5.13. Reactor primary facility cooling flow				
1.5.14. Reactor primary demineralizer flow				
1.5.15. Pool primary demineralizer flow				
1.5.16. Pool primary coolant flow				
1.5.17. Pool secondary coolant flow				
1.5.18. Reactor primary tank pressure limitations				
1.5.19. Reactor primary pressure near strainer pit				
1.5.20. Reactor primary tank ΔP				
1.5.21. Reactor secondary system pressure				
1.5.22. NOG system pressure, ΔP across filters				
1.5.23. POG system pressure, ΔP across filters				
1.5.24. Cell-ventilation system pressure, ΔP across filters				
1.5.25. Total solids indicator				
1.5.26. Reactor water resistivity				

Trainer(s) Date Trainee Date

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
1. **DESIGN AND DESCRIPTION OF FACILITY** (cont.)				
1.5.27. Pool water resistivity				
1.5.28. Reactor demineralizer effluent resistivity				
1.5.29. Reactor tower pH				
1.5.30. Pool tower pH				
1.5.31. Normal, abnormal, and emergency procedures related to above items				
1.6. Cooling Water Systems				
1.6.1. Reactor primary water system				
1. Exit lines from reactor vessel				
2. 36-in. section of exit water line				
3. Decay tank with screens				
4. Manual pump inlet valves				
5. Main primary pumps				
6. Shutdown pump				
7. Gasoline pump (standby)				
8. dc motors				
9. Mission-type check valves				
10. 24-in. butterfly bypass valve				
11. Heat exchangers				
12. Bypass filters				
13. Venturi				
14. Strainer				
15. 24-in. manual valve				
16. Expansion joints (inlet and exit lines)				
17. Degasifier				
18. Facility pumps				
19. Facility cooling flows				

Trainer(s) Date Trainee Date

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
1. DESIGN AND DESCRIPTION OF FACILITY (cont.)				
20. Ball-float traps				
21. Demineralizers (cation and anion) north, south, and degasifier				
22. Pipe-chase grinnel valve				
23. Equalizer leg				
a. orifice				
b. alarm				
c. scram				
d. primary pumps shutdown				
e. degasifier line				
24. Syphon break				
a. tank negative pressure relief				
b. reactor tank swing check valves				
c. exit line syphon break				
d. gas removal pressure equalization valve				
e. reactor-center pool dam check valve				
f. pool level				
g. process water, reactor pool				
25. Inlet lines to pool vessel				
a. spools				
b. strainers				
c. ΔP (spools)				
1.6.2. Reactor secondary water system				
1. 16-in. bypass valve				
2. 350-hp pumps				
3. 250-hp pumps				
4. Manual pump inlet and exit valves				

Trainer(s) Date Trainee Date

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
1. DESIGN AND DESCRIPTION OF FACILITY (cont.)				
5. Check valves				
6. Risers (north and south)				
7. Tower fans (north and south)				
8. Make-up water line				
a. Automatic valve				
b. Manual valve				
9. Drain line				
10. Blowdown lines				
11. Acid addition system				
a. Tank				
b. Pumps				
c. Controls				
1.6.3. Pool primary system				
1. Reactor pool inlet(s)				
2. Center and west pool inlets				
3. Reactor pool exit				
4. Scum gutter exits				
5. Make-up tank				
6. 100-gpm pool demineralizer pump				
7. Pool demineralizer cation unit				
8. Pool demineralizer anion unit				
9. Christmas tree				
10. Fill and drain pump				
11. Storage tanks				
12. 900-gpm pool primary pump				
13. Strainer				
14. Filters for pool				
15. Heat exchanger				

Trainer(s) ____________________ Date ____ Trainee ____________________ Date ____

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
1. DESIGN AND DESCRIPTION OF FACILITY (cont.)				
1.6.4. Pool secondary water system				
1. Automatic throttling valve				
2. Tower bypass manual valve				
3. Pool basin				
a. Make-up manual valve				
b. Make-up float valve				
c. Drain line				
4. Pool tower fan				
a. Motor, breaker, start and stop switches, etc.				
5. 900-gpm pump				
6. Blowdown line				
7. Acid-addition system				
a. Tank				
b. Schematic of acid flow and controls				
1.6.5. Normal, abnormal, and emergency procedures related to above items				
1.7. Buildings				
1.7.1. Building 3042				
1. Construction				
2. Layout				
a. Pipe chase, pipe tunnel, subpile room, and hot cells				
b. Reactor pools				

Trainer(s) ____________ Date ____________ Trainee ____________ Date ____________

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
1. DESIGN AND DESCRIPTION OF FACILITY (cont.)				
3. Equipment				
a. Truck doors, H&V units, and elevator				
b. Overhead crane and motorized bridge				
c. Overhead fans				
4. Communications				
a. Phone, Teletalk system, and public-address system				
b. Radiation and contamination alarm system				
1.7.2. Building 3085 - primary pump house				
1.7.3. Building 3102 - heat-exchanger pit				
1.7.4. Building 3103 - reactor tower				
1.7.5. Building 3086 - pool tower				
1.7.6. Building 3109 - POG filter pit				
1.7.7. Building 3125 - NOG filter pit				
1.7.8. Building 3106 - cell-ventilation filter pit				
1.7.9. Building 3039 - stack area				
1.7.10. Buliding 3095 - warehouse				
1.7.11. Building 3087 - Trane coolers				
1.7.12. Building 3089 - A/C tower				
1.7.13. Normal, abnormal, and emergency procedures related to above items				

Trainer(s) Date Trainee Date

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
1. **DESIGN AND DESCRIPTION OF FACILITY** (cont.)				
1.8. Irradiation Facilities (In-Core and Additional Systems)				
1.8.1. Hydraulic tubes (presently not in use)				
1. In-core pieces				
2. Loading stations				
3. Rabbits				
1.8.2. In-core experiments (current list)				
1.8.3. Isotope and iodine stringers (see core components)				
1.8.4. Horizontal beam holes (HB-1, -2, -3, -4, -5, and -6)				
1.8.5. Slant access tubes				
1.8.6. North and south facilities				
1. HN-1, -2, -3, and -4				
2. HS				
1.8.7. Pool-side facility				
1.8.8. Gamma grid (presently not in use)				
1.8.9. Normal, abnormal, and emergency procedures related to above items				
1.9. Pool Area				
1.9.1. Motorized bridge				
1.9.2. Isotope bridge				

Trainer(s) ____________ Date   Trainee ____________ Date

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
1. DESIGN AND DESCRIPTION OF FACILITY (cont.)				
1.9.3. Isotope platform				
1.9.4. Isotope tools				
1.9.5. Fuel element tools				
1.9.6. Core tools				
1.9.7. Dam				
1.9.8. Underwater saw				
1.9.9. Chokers				
1.9.10. East bridge				
1.9.11. Underwater lights				
1.9.12. Fuel (spent) carriers				
1.9.13. Isotope carriers				
a. Sugarman				
b. Iodine				
c. Others				
1.9.14. Gamma grid (presently not in use)				
1.9.15. Fuel racks				
1.9.16. Beryllium rack				
1.9.17. Utility rack				
1.9.18. Neutron radiography (presently not in use)				
1.9.19. Normal, abnormal, and emergency procedures related to above items				

Trainer(s) Date Trainee Date

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
1. **DESIGN AND DESCRIPTION OF FACILITY** (cont.)				
1.10. Utilities for Building 3042 and Area				
1.10.1. Electrical (D-54474)				
1. Substations				
2. Voltages and phases				
1.10.2. Process water (D-51981)				
1.10.3. Demineralized water (D-51980)				
1.10.4. Potable water				
1.10.5. Steam supply (D-51983)				
1.10.6. Compressed-air supply (D-51982)				
1.10.7. Helium supply				
1.10.8. Caustic and acid				
1.10.9. Normal, abnormal, and emergency procedures related to above items				
1.11. Waste Disposal Systems				
1.11.1. Solids				
1. Hot cans and hot dumpster				
2. Lead-lined dumpster				
3. Scrap carrier and burial ground				
1.11.2. Gases				
1. NOG system				
a. Plant service and 3039 stack area				
b. ORR project system				

Trainer(s) ____ Date ____ Trainee ____ Date ____

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
1. **DESIGN AND DESCRIPTION OF FACILITY** (cont.)				
(1) Purpose				
(2) Description, including seal tank, catch tank, and filter pit				
(3) Instrumentation				
(4) Maintenance, if any				
2. POG system (presently on standby)				
a. Tie-in to 3039 stack				
b. ORR project system (1-4)				
c. Components including filter pit and blower				
3. Cell ventilation				
a. Routine of building duct work				
(1) High-bay area and around pool				
(2) PWL, PWL battery room, B-9 cubicle, pipe chase, and Loop 2 cell, lab hood, and pipe tunnel				
(3) Hot cells				

Trainer(s) Date Trainee Date

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
1. DESIGN AND DESCRIPTION OF FACILITY (cont.)				
b. Location of auxiliary control panels				
(1) Seal tank				
(a) Overflow to WC-19				
(b) Inlet lines to seal tank from filter pit and future filter pit				
(c) Level alarms				
(2) Water supply to seal tank				
(a) LCV123A and LCV123B (solenoid-operated) level control valves				
(b) LS123A and LS123B "lo" level and "hi" level switches				
c. Components in filter pit				
(1) Inlet and outlet dampers and operating mechanism				
(2) Demoisturizer and Aerosolve filter bank				
(3) Two absolute-filter banks				
(4) Two charcoal-filter banks				

Trainer(s)	Date	Trainee	Date

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
1. **DESIGN AND DESCRIPTION OF FACILITY** (cont.)				
(5) Differential pressure gauges and tie-ins				
d. Ventilation duct monitor				
(1) Valving arrangements for air sample flow				
(2) Access to G-M tube				
e. Electric-motor-driven blower and dampers				
(1) Manually controlled inlet damper				
(2) Automatically controlled exit backdraft damper				
f. Steam turbine driven blower, dampers, and controls				
(1) Manual controlled inlet damper				
(2) Automatic controlled exit backdraft damper				
(3) Air-operated steam supply valve and controls to alarms and automatic operation				
(4) Solenoid-operated steam supply valve and controls to alarm and operation manual reset				

Trainer(s) Date Trainee Date

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
1. DESIGN AND DESCRIPTION OF FACILITY (cont.)				
g. Ventilation duct from blowers to stack flow element and tie-in to alarm				
h. Alarms in control room and their purposes				
i. Recorded temperatures in control room and purpose				
1.11.3. Liquids				
1. Intermediate-level waste system				
a. Plant system				
b. WC-19 complex				
c. ORR project system				
2. Low-level waste system (process sewer)				
ORR project system				
3. Sanitary sewer				
4. Storm sewer				
1.11.4. Normal, abnormal, and emergency procedures related to above items				
1.12. Emergency Systems				
1.12.1. Emergency power supply for 3042 area				
1. Diesel generator (13.5 kVA)				
2. Emergency-power outlets				

Trainer(s) Date Trainee Date

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
1. DESIGN AND DESCRIPTION OF FACILITY (cont.)				
1.12.2. Emergency cooling for reactor primary water				
2. Shutdown pump				
3. Battery-driven pony motors				
4. Gasoline pump				
5. Process water for primary cooling				
1.12.3. Emergency ventilation system				
1. Building containment system (shutdown system)				
2. Cell-ventilation system (see gaseous waste disposal)				
1.12.4. Normal, abnormal, and emergency procedures related to above items				
1.13. Support Systems Provided by ORNL				
1.13.1. Health Physics surveillance				
1.13.2. Fire Department				
1.13.3. Guard Department				
1.13.4. Dispensary				
1.13.5. Maintenance (electrical, etc.)				
1.13.6. Hot cells				
1.13.7. Tank farm				
1.13.8. Normal, abnormal, and emergency procedures related to above items				

Trainer(s) Date Trainee Date

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
2. OPERATIONAL ACTIVITIES				
2.1. Pool area				
2.1.1. Overhead crane				
2.1.2. Motorized bridge				
2.1.3. Isotope bridge				
2.1.4. Underwater lights				
2.1.5. Isotope platform				
2.1.6. Underwater saw				
2.1.7. Hydraulic tubes HT-1 and HT-2 (presently not in use)				
2.1.8. Removal of access cover				
2.1.9. Raising hold-down arms				
2.1.10. Removal of fuel elements from core				
2.1.11. Removal of reflector pieces (beryllium) from core				
2.1.12. Removal of reflector insert from hollow Be				
2.1.13. Removal of reflector isotope stringer (presently not in use)				
2.1.14. Removal of N_F stringer (presently not in use)				
2.1.15. Working isotope stringer (presently not in use)				

Trainer(s) Date Trainee Date

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
2. OPERATIONAL ACTIVITIES				
2.1.16. Working N_F stringer (presently not in use)				
2.1.17. Assembly/disassembly of iodine stringer				
2.1.18. Moving fuel between core and storage racks				
2.1.19. Shim rod moves				
2.1.20. Experiment insertion/removal from core				
2.1.21. Experiment vibration test				
2.1.22. Experiment reactivity test				
2.1.23. Locking of hold-down arms check				
2.1.24. Replacing access cover				
2.1.25. Replacement of control-rod-drive mechanisms				
2.1.26. Insertion/removal of end-box adapter				
2.1.27. Insertion/removal of hold-down arm				
2.1.28. Insertion/removal of shock-absorber assembly				
2.1.29. Removal of access cover ring				
2.1.30. Adjustment of ionization chambers				
2.1.31. Cutting spent fuel elements				
2.1.32. Cutting spent shim rods				

Trainer(s)	Date	Trainee	Date

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
2. OPERATIONAL ACTIVITIES (cont.)				
2.1.33. Shipping spent-fuel carrier				
2.1.34. Shipping isotope and iodine carriers				
2.1.35. Inserting/removing hydraulic tube samples, HT-1 and HT-2 (presently not in use)				
2.1.36. Transferring experiments, etc., to hot cells				
2.1.37. Normal, abnormal, and emergency procedures related to above items				
2.2. Cooling Systems				
2.2.1. Demineralizer regeneration				
2.2.2. Reactor cation and anion units				
2.2.3. Degasifier demineralizer				
2.2.4. Placing degasifier in service				
2.2.5. Filling/draining of north and south facilities				
2.2.6. Drain lines on reactor primary system				
2.2.7. Filling/draining reactor primary				
2.2.8. Emergency cooling valving				
2.2.9. Changing reactor primary filters				
2.2.10. Inspection of reactor primary strainer				

Trainer(s)	Date	Trainee	Date

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
2. OPERATIONAL ACTIVITIES (cont.)				
2.2.11. Equalizer leg - function				
2.2.12. Freezing precautions				
1. Steam tracings				
2. Reversing fans				
2.2.13. Checks on reactor primary water				
1. Radioactivity measurement				
2. Specific resistance measurement				
3. pH measurement				
2.2.14. Regeneration of pool demineralizer units				
2.2.15. Filling/draining reactor, center, and west pools				
2.2.16. Use of fill and drain pump				
2.2.17. Storage tank valving				
2.2.18. Filling/draining of beam holes				
2.2.19. Pool primary make-up from 3004				
2.2.20. Changing pool primary filters				
2.2.21. Inspection of pool primary strainer				
2.2.22. Cleaning of pool heat exchanger				
2.2.23. Checks on pool primary water				
1. Radioactivity measurement				
2. Specific resistance measurement				
3. pH measurement				

Trainer(s) ____________ Date ____________ Trainee ____________ Date

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
2. OPERATIONAL ACTIVITIES (cont.)				
2.2.23. Filling/draining pool secondary				
2.2.24. Treatment of pool secondary				
1. Continuous				
2. Periodic				
2.2.25. Filling/draining reactor secondary				
2.2.26. Treatment of reactor secondary				
1. Continuous (pH, T.S., phosphate, etc.)				
2. Periodic (F-14)				
3. Hazards involved in handling acid, polyphosphate, and microbiocide				
2.3. Control Room				
2.3.1. Console center panel				
1. Shim-rod-mode switch				
2. Withdraw and insert buttons				
3. Servo demand switch				
4. N_L and N_F lights (L-39 and L-40)				
5. Servo button				
6. Manual button				
7. Servo limit switches				
8. Servo rod indicator dial				
9. Servo limit switches				
10. Servo amplifier				
11. Servo chamber				
12. Digital voltmeter				
a. No. 1 safety				
b. No. 1 gamma				
c. N-16				
d. µµA				

Trainer(s) ____________ Date ____________ Trainee ____________ Date

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
2. OPERATIONAL ACTIVITIES (cont.)				
13. Fission chamber controls				
a. Selector switch (on V.B.)				
b. Automatic and manual				
c. Insert and withdraw				
2.3.2. Left inclined panel of console				
1. Scram switch				
a. Make-up and drop-out indicator light (L-38 and L-38X)				
b. Slow-scram short detector (relay cabinet A)				
c. Scram reset button				
2. Raise-test switch				
a. Raise				
b. Test				
3. Safety sensitivity meters				
4. Reverse-bypass switch				
a. Reverse light (L-36)				
b. Bypass				
c. Five-rod-insert light (L-35)				
5. Group-rod withdrawal switch				
a. Intermittent speed				
b. Timer				
c. High speed				
d. Permit withdraw light (L-4)				
e. Fast-period permit button (L-7)				

Trainer(s) ________ Date ________ Trainee ________ Date ________

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
2. OPERATIONAL ACTIVITIES (cont.)				
f. Operator start button (L-2)				
g. Instrument start button (L-1)				
h. Run button (L-3)				
6. ORR evacuation system				
a. Evacuation push button				
b. Silence push button				
7. Annunciator test push button				
2.3.3. Control power				
1. Special services panel				
2. Emergency services panel				
3. Normal services panel				
2.3.4. Amplifier cabinets				
1. E-panel switches				
2. Reactor power transmitter				
3. Servo limit switches				
4. Servo amplifier				
5. Noise monitor				
6. Micromicroammeter power supply				
7. Micromicroammeter range selector switch				
8. Gamma chambers power supply				
9. N-16 chamber voltage (1) μμA north and south				
10. ac line undervoltage				
11. FRCAS				
12. Trouble monitor				
13. I&C safety channel calibration				

Trainer(s) ____________ Date ____ Trainee ____________ Date ____

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
2. OPERATIONAL ACTIVITIES (cont.)				
14. ORR shim-rod-drop test unit				
a. Release time				
b. Push-rod response				
c. Time of flight				
15. Magnet amplifiers				
16. Sigma amplifier				
17. Sigma bus				
18. Gamma monitors (cell ventilation, NOG, reactor primary water, reactor secondary water, degasifier, etc.)				
19. Public-address amplifiers				
2.3.5. Annunciators - The annunciator diagram (print files) should be reviewed to acquaint the operator with the conditions which cause the alarms.				
1. Process				
2. Nuclear				
3. Experiment				
4. OGR				
5. Miscellaneous				
2.3.6. Normal, abnormal, and emergency procedures related to above items				
2.4. Routine Operation				
2.4.1. Checks				
Each shift checklist should be reviewed. The operator should be familiar with the effort that each item on the lists involves and why it is done.				

Trainer(s) _______ Date _______ Trainee _______ Date _______

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
2. OPERATIONAL ACTIVITIES (cont.)				
1. 8-4 shift checks				
2. 4-12 shift checks				
3. 12-8 shift checks				
4. Weekly checks				
5. Building radiation				
6. ORR daily water system checks				
7. Total solids check				
8. Resistivity check				
9. pH check				
10. Phosphate check				
11. Specific gravity check				
12. How to take and count water samples				
13. Power calculations				
2.4.2. Bookkeeping				
1. ORR logbook				
a. Demineralizers				
b. Pony motors				
c. Secondary				
2. ORR hourly readings				
3. ORR accumulated instrument power				
4. Startup power calculations				
5. ORR daily summary				
6. Daily graph				
7. Shim-rod-position graph				
8. Daily water system checks				
9. Daily routine instrument checklist				
2.4.3. Normal, abnormal, and emergency procedures related to above items				
2.5. Reactor Cycle				
2.5.1. Startup modes				
2.5.2. Startup checklist				

Trainer(s)	Date	Trainee	Date

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
2. OPERATIONAL ACTIVITIES (cont.)				
2.5.3. Operator start				
1. When to press button				
2. Status of system (servo or manual)				
3. Limitations				
2.5.4. Instrument start (conditions necessary)				
1. Servo limit switches				
2. 20 counts on CRM				
3. Neutron level below N_L				
4. Fission chamber moving and in automatic				
5. No servo withdrawal limit				
6. Not in run				
7. No servo insert error				
8. CRM in use and >20 count/s with the log-N <0.001 N_L				
2.5.5. Run				
1. When not to press				
2. Sag point				
3. When run starts				
2.5.6. Control Room Recorders				
The operator should learn the recorder switch set points and functions for the recorders listed. The type of sensing element used and its location should be known.				
1. Count rate				
2. Counting-rate period				
3. Log N				
4. Log-N period				

Trainer(s) Date Trainee Date

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
2. OPERATIONAL ACTIVITIES (cont.)				
5. Safety				
6. Gamma chamber				
7. Outlet temperature				
8. ^{16}N				
9. Differential temperature (ΔT)				
10. Reactor water activity				
11. Reactor secondary water activity				
12. Degasifier activity				
13. POG activity				
14. Pool water activity				
15. Pool pH				
16. Reactor pH				
17. POG vacuum (presently on standby)				
18. NOG vacuum				
19. Reactor water flow				
20. Reactor ΔP				
21. Reactor inlet temperature				
22. Reactor water resistivity				
23. Pool primary water flow				
24. Pool temperature				
25. Pool water resistivity				
26. Facility cooling flow				
27. Reactor demineralizer resistivity				
28. NOG filter-pit temperature				
29. Cell vent filter-pit temperature				
30. Syphon-break north standpipe level, syphon-break south standpipe level, and pool level				
31. Primary flow make-up				
2.5.7. Full power operation				
1. Normal instrument readings				
2. Drift of power (normal)				
3. Variation of safeties (normal)				

Trainer(s) ____________ Date ____________ Trainee ____________ Date

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
2. OPERATIONAL ACTIVITIES (cont.)				
4. Variation of gamma chambers (normal)				
5. Variation of reactor primary flow (normal)				
2.5.8. Rod drop and scram recoveries				
2.5.9. Shutdown				
1. Shutdown checklist				
2. Checking of rod-drive mechanisms				
3. Emergency-cooling checklist				
4. Reloading schedule				
2.5.10. Low-flow runs				
1. Use of raise-test switch				
2. High sensitivity of safety				
3. Manual and servo operation				
4. Critical run				
2.5.11. Normal, abnormal, and emergency procedures related to above items				
2.6. Operational Handbook				
2.6.1. Radiation safety and control				
2.6.2. Reactor physics				
2.6.3. Heat transfer and fluid flow				
2.6.4. Instruments and controls				
2.6.5. Normal, abnormal, and emergency procedures related to above items				

Trainer(s) Date Trainee Date

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
2. OPERATIONAL ACTIVITIES (cont.)				
2.7. Health Physics Aspects				
2.7.1. Use of radiation-contamination instruments				
1. ß-γ survey meter				
2. Cutie pie				
3. Continuous air monitor				
4. Monitron				
2.7.2. Radiation detectors				
1. Personal radiation monitor				
2. Pocket pencil meters				
3. Direct-reading dosimeter				
4. ORNL identification badge				
2.7.3. Regulated zones				
2.7.4. Radiation zones				
2.7.5. Contamination zones				
2.7.6. C-zone clothing				
2.7.7. Smearing for contamination				
1. α				
2. ß-γ				
2.7.8. Counting of smears				
2.7.9. Normal, abnormal, and emergency procedures related to above items				
2.8. Reference Information				
2.8.1. Blueprints				
2.8.2. Operating manual				

Trainer(s) Date Trainee Date

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
2. OPERATIONAL ACTIVITIES (cont.)				
2.8.3. Reactor controls change memoranda book				
2.8.4. ORR logbook				
2.8.5. ORR quarterly reports				
2.8.6. Special information book				
2.8.7. Experiment information book				
2.8.8. Elementary and logic diagrams				
2.8.9. Files				
2.8.10 Normal, abnormal, and emergency procedures related to above items				
2.9. Building 3004				
2.9.1. Deminerlizers				
2.9.2. Flow paths				
2.9.3. Valving/flow meters, etc.				
2.9.4. Safety equipment				
2.9.5. Checks				
2.9.6. Regeneration procedures				
2.9.7. Solu-bridge				
2.9.8. Conditions for putting unit on-line				
2.9.9. Neutralization tank				

Trainer(s) Date Trainee Date

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
2. OPERATIONAL ACTIVITIES (cont.)				
2.9.10. Alarms, remote monitoring				
2.9.11. Normal, abnormal, and emergency procedures related to above items				
2.10. LITR Standby				
2.10.1. General information on LITR standby				
1. Reactor vessel				
2. Reactor core				
3. Cell ventilation				
a. Schematic of air flow through vessel and piping				
b. Absolute filter				
c. Top room				
d. West room				
e. East room				
f. Subpile room				
4. NOG system				
5. POG system				
2.10.2. Radiation and contamination monitoring				
1. Monitrons				
2. Continuous air monitors				
2.10.3. Routine checks (refer to shift check sheet)				
1. Absolute filter ΔP				
2. Cold weather precautions				

Trainer(s) ____ Date ____ Trainee ____ Date ____

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
2. OPERATIONAL ACTIVITIES (cont.)				
2.11. Building 3001				
2.11.1. General Information				
1. Canal containment				
a. Purpose				
b. Schematic of air flow				
c. OGR negative pressure				
d. Duct negative pressure (normal reading)				
e. Electric blowers				
2. Canal use				
a. List materials that are stored in the canal				
b. Isotope storage tank				
c. Jetting water from back-side of canal walkway				
d. Potential contamination in area				
3. Canal demineralizer				
a. Schematic of water flow including isotope storage tank				
b. Regeneration procedure				
c. Isotope storage tank				
(1) Solenoid valve				
(2) Radiation sensor and purpose				
(3) Gamma monitor				
(4) Equalizer legs				
d. Canal makeup water				
4. Exit duct water drainage				
5. Building 3002 canal				

Trainer(s) Date Trainee Date

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
2. OPERATIONAL ACTIVITIES (cont.)				
2.11.2. Radiation and contamination monitoring				
1. Monitrons				
2. Continuous air monitors				
3. Alarms received at ORR				
2.11.3. Elevator alarm				
2.11.4. Emergency - diesel				
1. FRCAS				
2. Electric blowers				
2.11.5. Routine Checks (refer to shift check sheet)				
2.11.6. Heating System, Building 3001				
1. Object of heating system				
2. Location of heaters equipped with thermostats				
3. Procedure to take if indoor temperature drops to <50°F				
3. MISCELLANEOUS				
3.1. Job Performance Standards				
3.2. Quality Assurance				
3.2.1. Organization				
3.2.2. Application				
3.2.3. Reporting (audits, hotline)				

Trainer(s)   Date   Trainee   Date

SECTION 3. EMERGENCY PREPAREDNESS CHECKLIST

Trainee: ______________________ Badge No.: ____________

Facility: Oak Ridge Research Reactor (ORR) Buildings: 3042, 3001, 3004

Instructions

This checklist, on abnormal/emergency operating instructions (A/EOIs), is intended to ensure, in part, that an individual has received training in emergency procedures, as required by DOE Orders 5480.1A, Chapter VI (Safety of DOE-Owned Reactors) and 5500.3 (Reactor and Nonreactor Nuclear Facility Emergency Planning, Preparedness, and Response Program for DOE Operations).

This checklist is to be used for initial certification and for requalification training. It is required that all emergency procedures be reviewed on an annual basis.

(Recommendation: The shift supervisor should periodically cover with his or her crew a few A/EOIs and postulated emergency scenarios in the generic categories as talk-through exercises, as time allows. Toward the end of a certification period, return all checklists for auditing purposes.)

With the exception of Section 3, all items must be completed prior to the administering of the initial certification examination. Some of the subjects in this section are taught by training personnel in other ORNL organizations at different times throughout the year. These subjects (only) may be signed off after the initial certification examination but shall be acknowledged during requalification periods.

When the Trainer initials an item (and signs the bottom of each page), it should indicate that he/she has not only been assured that the material has been covered with the Trainee, it should also indicate that the Trainee knows the material well enough to be qualified in that subject area.

Upon completion, this checklist should be returned to the Training Manager; he/she shall submit it to the Examiner.

This material has been taught to the trainee. ______________________, ____________

Training Manager   Completion Date

This material has been taught to me by the training personnel. ______________________, ____________

Trainee   Completion Date

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
4. OPERATING EXPERIENCE				
1. Has performed a reactor startup (console operation or in a supervisory capacity)				
2. Has participated in reactor startups, other than console work				
3. Has participated in reactor refueling and/or core disassembly work				
4. Has participated in reactor shut-down work (other than refueling)				
5. Has participated in power changes of greater than 10%				
6. Has participated in control room work during normal operations				
7. Other ______________				

Trainer(s) ______ Date ______ Trainee ______ Date ______

SECTION 3. EMERGENCY PREPAREDNESS CHECKLIST

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
1. FACILITY-SPECIFIC ABNORMAL/EMERGENCY OPERATING INSTRUCTION (A/EOIs)				
1.1. Leaks in the primary cooling system				
1.2. Rapid loss of pool water				
1.3. Loss of TVA electrical power				
1.4. Response to setbacks, reverses, and scrams				
1.5. Loss of instrument air				
1.6. Loss of potable, process, or demineralized water systems				
1.7. Loss of steam				
1.8. Loss of one or more reactor primary cooling pumps				
1.9. Loss of pool cooling system				
1.10. Loss of secondary cooling system				
1.11. Loss of shutdown cooling capability				
1.12. Uncontrolled or unexpected changes in reactivity				
1.13. Stuck control rod				
1.14. Dropped control rod				
1.15. Loss of control-rod position indicator system				

Trainer(s)	Date	Trainee	Date

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
1. FACILITY-SPECIFIC ABNORMAL/EMERGENCY OPERATING INSTRUCTION (A/EOIs) (cont.)				
1.16. High radiation level in the reactor primary cooling system				
1.17. High radiation level in the secondary water systems				
1.18. Loss of building containment				
1.19. High radiation level in the reactor building or off-gas systems				
1.20. High radiation level in the liquid waste system				
2. GENERIC EMERGENCY PROCEDURES (as identified in DOE Order 5500.3)				
If any of the items below have been covered in the previous section, write NA in the space.				
2.1. Operational (on-site and off-site)				
2.1.1. Fires				
2.1.2. Explosion				
2.1.3. Industrial accidents				
2.1.4. Personnel injury or fatality				
2.1.5. Release of radioactive or toxic materials				
2.1.6. Personnel exposure				

Trainer(s) Date Trainee Date

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
2. **GENERIC EMERGENCY PROCEDURES** (cont.) (as identified in DOE Order 5500.3)				
2.1.7. Oil and hazardous material pollution				
2.1.8. Air and water pollution				
2.1.9. Transportation accident involving hazardous materials				
2.2. Natural phenomena				
2.2.1. Earthquake				
2.2.2. Tornado				
2.2.3. Flood				
2.2.4. Wind, snow, ice				
2.3. Special nuclear materials (SNM)				
2.3.1. Accidents or malevolent acts involving fuel				
2.4. Terrorist threats or acts				
2.4.1. Bomb threat				
2.4.2. Overt or covert actions, including sabotage				
2.4.3. Nuclear threats				
2.4.4. Extortion or kidnapping				
2.4.5. International threats				

Trainer(s) Date Trainee Date

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
3. OTHER SAFETY-RELATED SUBJECTS				
3.1. Has periodically participated in building and/or plant evacuation drills. (Required at least annually.)				
3.2. Has had fire-fighting training				
3.3. Has had training in the use of respiratory safety equipment				
3.4. Has had training in first aid and/or CPR				
3.5. Has had periodic safety meetings				
3.6. Has read all scenarios and/or reports on accident-type drills at this facility				
3.7. Has read all reactor-related Unusual Occurrence Reports generated at ORNL				
3.8. Has read the summaries of the Unusual Occurrence Reports generated by other DOE facilities				
3.9. Has read selected and/or significant unusual occurrence reports generated by the NRC				
3.10. Has reviewed all Mechanical and Instrumentation and Controls Design Change Memos applicable to this facility				

Trainer(s)	Date	Trainee	Date

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
3. OTHER SAFETY-RELATED SUBJECTS (cont.)				
3.11. Has been made aware of all significant changes in equipment and/or procedures at this facility				
3.12. Has periodically reviewed the following ORNL safety literature:				
1. Local Emergency Manual				
2. Laboratory Emergency Manual				
3. Safety Manual				
4. Health Physics Procedures Manual				
3.13. Knows the building evacuation procedures				
3.14. Knows the plant-wide evacuation procedure				
3.15. Knows the type and location of emergency equipment at the facility				

Trainer(s)	Date	Trainee	Date

SECTION 4. SUPERVISOR'S CHECKLIST

Trainee: ______________________________ Badge No.: ______________

Facility: Oak Ridge Research Reactor (ORR) Buildings: 3042, 3001, 3004

Instructions

Some of the material on supervisor training is covered by special courses given by ORNL instructors (other than Reactor Operations personnel) at various times throughout the year. To allow the candidate to take the Senior Reactor Operator examination and assume the duties of a Supervisor prior to attending these courses, the instructor shall cover the fundamentals of the various subjects to ensure that the individual is prepared to assume his supervisory responsibilities.

When the Trainer initials an item (and signs the bottom of each page), it should indicate that he/she has not only been assured that the material has been covered with the Trainee, it should also indicate that the Trainee knows the material well enough to be qualified in that subject area.

Upon completion, this checklist should be returned to the Training Manager; he/she shall submit it to the Examiner.

This material has been taught to the trainee. ______________________, ______________

Training Manager Completion Date

This material has been taught to me by the training personnel. ______________________, ______________

Trainee Completion Date

SECTION 4. SUPERVISOR'S CHECKLIST

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
1. LEADERSHIP				
1.1. Fundamentals				
1.2. Protocol				
1.3. Command responsibilities and limits				
1.4. Interpersonal communication				
1.5. Motivation of personnel and handling complaints				
1.6. Labor relations				
1.7. Problem/decisional analysis				
1.8. Job performance standards				
1.9. Organizing and planning				
2. ADMINISTRATIVE REQUIREMENTS				
2.1. Responsibilities during reactor-type operation				
2.2. Technical Specifications				
2.3. Reporting requirements				
2.4. Special forms to fill out and/or reports to write (RWP, work requests, etc.)				
2.5. Disseminating pertinent information to shift personnel				
2.6. Special projects				

Trainer(s)	Date	Trainee	Date

FACILITY TRAINING/QUALIFICATION CHECKLIST(S)

Trainee: ______________________ Badge No.: ____________

Facility: Bulk Shielding Reactor (BSR) Buildings: 3010 and 3004

Instructions

This composite checklist is comprised of four sections; these are (1) the Generic Subjects Checklist (i.e., reactor physics, heat transfer/fluid flow, radiation safety, and industrial safety); (2) the Facility-Specific Checklist; (3) the Emergency Preparedness Checklist; and (4) the Supervisor's Checklist. (Refer to the individual checklists for any special instructions.)

The topics herein are to be taught to the above-mentioned trainee by the Training Manager, or his/her designated instructors, to the extent that the trainee will be prepared for (1) the written, oral, and/or operating examinations required for certification or requalification and (2) solo operation at the above-mentioned facility. All items on each checklist are to be covered for the initial qualification; selected items, with emphasis on abnormal/emergency procedures, are to be covered for requalification training.

The training personnel shall be responsible for establishing learning objectives, as applicable. That is, they shall cover each subject with the primary objective of leaving the trainee with that essential information and/or knowledge needed to operate the reactor or auxiliary equipment in a safe, efficient, and reliable manner during normal, abnormal, and emergency conditions.

The Training Manager at this facility shall coordinate all training and shall sign the cover page of this and each individual checklist after all the required sections have been covered, as applicable. He/she shall also ensure that all required signatures are affixed prior to sending the composite checklist to the Examiner for filing. All sections should be completed prior to taking the written examination required for initial certification.

The composite checklist is intended to be used for the initial qualification and for one requalification; however, it may be used for an additional requalification (two-year period) by using a color code, or some similar scheme, to indicate continued use of the same checklist.

This material has been taught to the trainee. ______________________, ____________

Training Manager — Completion Date

This material has been taught to me by the training personnel. ______________________, ____________

Trainee — Completion Date

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SECTION 1. GENERIC SUBJECTS CHECKLIST

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
1. REACTOR PHYSICS				
1.1. Neutron Reactions				
1.1.1. Types of reactions				
1.1.2. Fast and thermal neutrons				
1.1.3. Prompt and delayed neutrons				
1.1.4. Multiplication factor				
1.1.5. Cross sections				
1.1.6. Neutron spectrum				
1.2. Nuclear Reactors				
1.2.1. Description of reactor components				
1.2.2. Reactivity and criticality				
1.2.3. The four-factor formula				
1.3. Reactivity and Reactor Period				
1.3.1. Reactivity calculations				
1.3.2. Reactor period				
1.3.3. Prompt criticality				
1.4. Fuel Burnup				
1.4.1. Fuel requirements for critical mass				
1.4.2. Fuel loading				
1.5. Xenon and Samarium Poisoning Effects				
1.5.1. Fission-product poisons				
1.5.2. Buildup and removal				

Trainer(s)	Date	Trainee	Date

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
1. REACTOR PHYSICS (cont.)				
1.5.3. Effect of shutdown on poison equilibrium				
1.6. Temperature Effects				
1.6.1. Reactivity and temperature				
1.6.2. Temperature coefficients				
1.6.3. Reactor control				
1.6.4. Doppler effect				
1.7. Neutron Flux Distribution				
1.7.1. Basic information				
1.7.2. Reflector effects				
1.7.3. Temperature effects				
1.7.4. Fuel burnup effects				
1.7.5. Control-rod effects				
1.7.6. Control-rod worth				
2. HEAT TRANSFER/FLUID FLOW				
2.1. Heat (Units, Definitions)				
2.1.1. Introduction				
2.1.2. Temperature units				
2.1.3. Heat units				
2.1.4. Thermal energy and power				
2.1.5. Thermal stress				
2.2. Heat Transfer				
2.2.1. Sources of heat				

Trainer(s) Date Trainee Date

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
2. HEAT TRANSFER/FLUID FLOW (cont.)				
2.2.2. Heat conduction				
2.2.3. Heat transfer by convection				
2.2.4. Nucleate, transition, and filler boiling				
2.3. Fluid Mechanics				
2.3.1. Hydraulic and pneumatic pressure				
2.3.2. Static pressure and force				
2.3.3. Dynamic pressures and forces				
2.3.4. Water hammer				
2.4. Heat Production and Control in Nuclear Reactors				
2.4.1. Fission-produced heating				
2.4.2. Temperature and heat transfer in reactors				
2.4.3. Heat transfer rates				
2.4.4. Determination of operating parameters				
2.4.5. Afterheat				
3. RADIATION SAFETY AND CONTROL				
3.1. Atoms				
3.1.1. Parts defined				
3.1.2. Characteristics of protons, neutrons, and electrons				
3.2. Radioactive Material and Radiation				
3.2.1. Unstable atoms				
3.2.2. Types of radioactive decay				

Trainer(s) Date Trainee Date

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
3. RADIATION SAFETY AND CONTROL (cont.)				
3.2.3. Radioactive contamination				
3.3. Ionization				
3.3.1. Ions				
3.3.2. Radiation and ionization				
3.3.3. Range				
3.3.4. Shielding				
3.4. Radiation Units				
3.4.1. The curie				
3.4.2. The roentgen				
3.4.3. The rad				
3.4.4. The relative biological effectiveness of radiation (RBE)				
3.4.5. The roentgen equivalent man (REM)				
3.5. Health Hazards of Radiation				
3.5.1. Radiation review				
3.5.2. Penetration effects				
3.5.3. Effects from ingested sources				
3.5.4. Radiation sensitivity of body organs				
3.5.5. Radiation dose rate				
3.6. Radiation Protection Methods				
3.6.1. Review				
3.6.2. Planning, to reduce exposure				
3.6.3. Reducing the dose rate				

Trainer(s)	Date	Trainee	Date

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
3. RADIATION SAFETY AND CONTROL (cont.)				
3.6.4. Shielding--tenth-value and half-value layers				
3.6.5. Radioactive decay				
3.6.6. Shielding with distance				
3.7. Radioactive Contamination - Protective Measures				
3.7.1. Review				
3.7.2. Radioactive contamination (solid, liquid, and gaseous)				
3.7.3. Contamination, surface and airborne				
3.7.4. Contamination zones				
3.7.5. Contamination clothing				
3.7.6. Regulated zones				
3.7.7. Continuous air monitors				
3.7.8. Maximum permissible body burden				
3.7.9. Maximum permissible concentration				
4. INDUSTRIAL SAFETY				
4.1. Operational Safety				
4.1.1. Safety organization and Safety Officer				
4.1.2. Protective equipment (use, location)				
4.1.3. Safety practices				
1. Pre-job planning				
2. Electrical safety				
3. Permits and tags				
4. Company vehicles				
4.1.4. Reporting of accidents				

Trainer(s)	Date	Trainee	Date

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
4. **INDUSTRIAL SAFETY** (cont.)				
4.1.5. Source of information (reference)				
1. Standard Practice Procedure				
2. Policy Procedure Manual				
3. Safety Manual				
4. Environmental Protection Manual				
5. ORNL Respiratory Program				
4.2. Industrial Hygiene				
4.2.1. Hearing/sight conservation				
4.2.2. Use and availability of respiratory equipment				
4.2.3. Control of toxic chemicals/acid spills				
4.2.4. Incompatible chemicals				
4.2.5. Reporting requirements				
4.3. Environmental Protection				
4.3.1. Organization (function, contact)				
4.3.2. General requirements for discharging of effluents to the environs				
4.3.3. Handling and disposing of hazardous materials				
4.3.4. Reporting				
4.4. Fire Protection				
4.4.1. Organization				
4.4.2. Location of alarm boxes and equipment				
4.4.3. Effects of smoke and hot, toxic gases				
4.4.4. Combating fires alone				

Trainer(s) Date Trainee Date

SECTION 2. FACILITY SPECIFIC CHECKLIST

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
1. GENERAL INFORMATION ON THE VARIOUS COMPONENTS IN THE BSR COMPLEX				
1.1. Pool				
1.1.1. Dimensions and configuration				
1.1.2. Lining				
1. Type				
2. Temperature limitations				
3. Radiation limitations				
4. Chemical limitations				
1.1.3. Water-level control				
1. Water make-up				
2. Determining water loss due to leakage				
3. How level is monitored				
4. Emergency shielding for reactor pool				
1.1.4. Water purity				
1. Limits on various parameters				
a. pH				
b. Resistivity				
c. Activity				
(1) Normally, when not operating				
(2) During 1-MW operation				
(3) During 2-MW operation				
2. Sampling points				

Trainer(s)   Date   Trainee   Date

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
1. **GENERAL INFORMATION ON THE VARIOUS COMPONENTS IN THE BSR COMPLEX** (cont.)				
1.1.5. Lowest permissible water depth				
1.1.6. Rules about proximity of reactors physical restrictions (PCA and BSR)				
1.1.7. Fuel storage				
1. Underwater racks				
2. Be				
3. Vault				
1.1.8. Emptying and filling the pool				
1.1.9. Miscellaneous				
1. Dam				
2. Fuel-handling and other tools used in the pool				
3. Disposition of off-shifts				
4. Overhead crane				
1.1.10. Normal, abnormal, and emergency procedures related to above items				
1.2. Water System				
1.2.1. Schematic flow system				
*1.2.2. Heat exchanger (2 MW)				
1. Capacity				
2. Flow diagram				
3. Normal temperature of inlet and exit water				
4. Construction materials				

*Units from old system are also available for use.

Trainer(s) ______ Date ______ Trainee ______ Date ______

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
1. **GENERAL INFORMATION ON THE VARIOUS COMPONENTS IN THE BSR COMPLEX** (cont.)				
*1.2.3. Demineralizer (30 gpm)				
1. Description				
2. Water flow				
3. Regeneration				
4. Checks				
5. Resins				
6. Alarm on low resistance				
*1.2.4. Filter (200 gpm)				
1. Pumping rate				
2. Flow				
3. Type of media				
4. Reason for filtering				
5. Skimmer				
*1.2.5. Vacuum cleaning pump				
1. Flow rate				
2. Filtering unit				
3. Flow diagram				
4. Radioactivity encountered				
*1.2.6. ^{16}N jets				
1. Function				
2. Location				
3. Placing in service				
4. When required				
*1.2.7. Flapper valve				
1. Describe the component				
2. Position indicators				
a. position switches				
b. orifice monitoring				

*Units from old system are also available for use.

Trainer(s)	Date	Trainee	Date

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
1. **GENERAL INFORMATION ON THE VARIOUS COMPONENTS IN THE BSR COMPLEX** (cont.)				
3. Mode 1 operation				
4. Mode 2 operation				
5. Checks to ensure proper mode and position				
1.2.8. Decay tank				
1. Dimensions				
2. Baffles - purpose				
3. Level indicators				
4. Water level during 2-MW operation				
5. Water level during no-flow conditions				
6. Surge tank				
1.2.9. Primary cooling system				
1. Primary pump				
a. Horse power				
b. Flow capacity (design)				
c. Packing gland water supply				
2. Orifice (main primary flow)				
a. Location				
3. Valve pit				
a. Valve control				
4. Syphon - break line				

Trainer(s) Date Trainee Date

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
1. **GENERAL INFORMATION ON THE VARIOUS COMPONENTS IN THE BSR COMPLEX** (cont.)				
5. Flex hose				
a. Material				
b. Purpose				
c. Precautions - general				
d. Precautions during movement of reactor				
e. Satisfactory condition for flow				
6. Degasser tank				
1.2.10. Secondary cooling system				
1. Flow range during operation				
2. How controlled				
3. Pump				
4. Basin - level - control				
5. Water treatment - pH, T.S., blowdown, makeup, daily and weekly				
6. Fans, speeds				
7. Tower, capacity				
8. How to place in operation				
9. A/C pump				
1.2.11. Normal, abnormal, and emergency procedures related to above items				
1.3. Bridges - Reactor, Experiment or Instrument and Mobile Catwalk				
1.3.1. Location - rules governing				

Trainer(s) Date Trainee Date

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
1. **GENERAL INFORMATION ON THE VARIOUS COMPONENTS IN THE BSR COMPLEX** (cont.)				
1.3.2. Limitations on materials, equipment, etc., that are normally permitted (or not permitted) on the bridge				
1.3.3. Repositioning the reactor bridge				
1. How the bridge is moved				
2. Reasons for moving the bridge				
3. Safety aspects				
a. Nuclear				
b. Non-nuclear				
c. Reactor power while moving				
d. Flex line				
4. Rules regarding moving				
a. Personnel authorized to move the bridge				
b. Checks to be made				
1.3.4. Location of power cut-off switches				
1.3.5. Physical dimensions of bridge				
1.3.6. Weight limitations				
1.3.7. Normal, abnormal, and emergency procedures related to above items				
1.4. Utilities				
1.4.1. Electrical power distribution				
1. Normal - Clean power				
- Normal power				

Trainer(s) Date Trainee Date

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
1. **GENERAL INFORMATION ON THE VARIOUS COMPONENTS IN THE BSR COMPLEX** (cont.)				
2. Emergency - diesel				
1.4.2. Water supply				
1. Potable				
2. Process				
3. Demineralized				
1.4.3. Waste systems				
1. Liquid				
a. Creek				
b. Low level				
c. ILW				
2. Gaseous				
a. Normal off-gas				
b. Pressurizable off-gas				
1.4.4. Heating and ventilation				
1. heaters				
a. Pool room				
b. Control rooms				
2. Ventilating				
a. Pool room				
b. Control rooms				
1.4.5. Normal, abnormal, and emergency procedures related to above items				

Trainer(s) Date Trainee Date

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
2. REACTOR COMPONENTS				
2.1. Fuel Element Grid				
2.1.1. Number of positions				
2.1.2. Size of positions				
2.1.3. Orientation; how maintained				
2.1.4. Distance from the floor in each pool section				
2.1.5. Method of attachment to the bridge				
2.1.6. Distance from the bridge				
2.1.7. Distance under water				
2.1.8. Over-all size				
2.1.9. Clearance between fuel element end box and grid position				
2.1.10. Removal from the pool				
2.1.11. Construction material				
2.1.12. Method of construction				
2.1.13. Method of supporting in the grid				
2.1.14. Normal, abnormal, and emergency procedures related to above items				
2.2. Fuel Elements				
2.2.1. Standard assembly				
1. Total amount of ^{235}U in new elements				
2. Number of plates				
a. Standard element				
b. Half-fuel element				
3. Weight of ^{235}U per plate				
4. Dimensions of composite element				
a. Length				
b. Cross section				
c. Cooling water gap				

Trainer(s) Date Trainee Date

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
2. **REACTOR COMPONENTS** (cont.)				
5. Dimensions of fuel plate				
a. Length, over-all				
b. Length of U-Al alloy section				
c. Cross section (cladding, fuel thickness and construction)				
6. Standard loading (including orientation of element in grid)				
7. Average burnup rate of ^{235}U				
2.2.2. Special fuel element for shim rods				
1. Dimensions of composite element				
a. Length				
b. Cross section				
c. Cooling water gap				
2. Dimensions of fuel plate				
3. Clearance				
4. Construction material				
5. ^{235}U Content				
2.2.3. Normal, abnormal, and emergency procedures related to above items				
2.3. Shim Rods and the Regulating Rod				
2.3.1. General or standard location - minimum number (safety limits)				

Trainer(s)	Date	Trainee	Date

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
2. REACTOR COMPONENTS (cont.)				
2.3.2. Dimensions				
2.3.3. Extension to shim rod				
2.3.4. Materials				
1. Shim rods				
2. Regulating rod				
2.3.5. Reactivity worth				
1. Minimum and maximum $\Delta k/k$ per in.				
2. Minimum and maximum $\Delta k/k$ per in.				
2.3.6. Guide bearings				
1. Position				
2. Materials				
2.3.7. Armature				
1. Location				
2. Dimensions				
3. Construction materials				
4. Seat switch design change (1969–1970)				
2.3.8. Shock absorber				
1. Theory of operation				
2. Location				
3. Materials				
2.3.9. Drive system				
1. Gear system				
2. Drive motors				
3. Speed				
4. Position indicator				
2.3.10. Normal, abnormal, and emergency procedures related to above items				

Trainer(s) Date Trainee Date

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
2. **REACTOR COMPONENTS** (cont.)				
2.4. High-Current, Low-Voltage Magnet				
2.4.1. Overall size and configuration				
2.4.2. Parts				
1. Housing and core				
2. Magnet coil and leads				
a. Potting material for coil				
b. Insulation for leads				
3. Retainer washer				
4. Split ring				
5. Clutch switch and leads				
6. Plating material, purpose, thickness				
2.4.3. Theory of operation				
1. Voltage levels expected				
2. Normal current				
3. Effect of water				
4. Corrosion control				
5. Flyback voltage control				
2.4.4. Normal, abnormal, and emergency procedures related to above items				
2.5. Solid State Electronics				
2.5.1. Sigma bus converter				
1. Input voltage range				
2. Output voltage range				
a. Negative voltage				
b. Positive voltage				

Trainer(s)	Date	Trainee	Date

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
2. **REACTOR COMPONENTS** (cont.)				
3. Pulse test components				
a. Pushbutton				
b. Indicator lights				
c. Pulse duration				
d. Purpose of test				
2.5.2. Dual voltage comparator				
1. Scram comparator				
2. "Bus protect" comparator				
3. Latch lights				
4. Trip lights				
5. Normal lights				
2.5.3. Magnet switch				
1. Purpose				
2. Switching capabilities				
a. Amperage limits				
b. Voltage limits				
2.5.4. Magnet power supply				
1. Voltage range				
2. Amperage range				
3. Normal output for BSR				
4. AC power from slow scram bus				
2.5.5. Modular power supply				
1. Regulated voltages				
2. Power for comparator				
3. Future capabilities				
2.5.6. Normal, abnormal, and emergency procedures related to above items				

Trainer(s) ____________ Date ____________ Trainee ____________ Date

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
2. REACTOR COMPONENTS (cont.)				
2.6. Nuclear Instrumentation				
2.6.1. Count-rate channel				
1. Fission chamber				
a. Type				
b. Dimensions				
c. Drive system				
d. ^{235}U content				
e. Normal location				
f. Reactivity effect upon moving				
g. Length of life				
h. Frequency of replacement				
i. PHS curve for chamber				
(1) Frequency for checking the curve				
(2) Importance of check				
2. Pre-amplifier				
3. Pulse amplifier				
4. Scaler				
5. Count-rate meter				
6. Count-rate recorder				
7. Count-rate period recorder				

Trainer(s)	Date	Trainee	Date

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
2. REACTOR COMPONENTS (cont.)				
2.6.2. Log-N Channel				
1. Log-N Chamber				
a. Type and frequency of compensation				
b. Negative voltage inhibit				
c. Dimensions				
d. Drive system				
e. Normal location				
f. Length of life				
g. Frequency of replacement				
2. Log-N Amplifier				
3. Fast period amplifier				
4. Period sigma amplifier				
5. Log-N recorder				
6. Log-N period recorder				
2.6.3. Safety Channels				
1. Safety chambers				
a. Type				
b. Dimensions				
c. Drive system				
d. Normal location				
e. Frequency of replacement				
2. Sigma amplifiers				
3. Safety recorders				
4. Mode 1 operation				
5. Mode 2 operation				
2.6.4. Trouble monitor				

Trainer(s)	Date	Trainee	Date

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
2. **REACTOR COMPONENTS** (cont.)				
2.6.5. Servo Channel				
1. Servo Chamber				
a. Type				
b. Dimensions				
c. Drive system				
d. Normal location				
e. Frequency of compensation				
f. Negative voltage inhibit				
2. Micromicrometer (Panel B)				
3. Servo recorder (Panel C)				
a. 50% switch				
4. Programmable controller				
a. Signal conditioner amplifier				
b. Programmer controller and calculator				
c. ΔT isolation amplifier				
d. Flow isolation amplifier				
e. Heat power recorder (Panel G)				
f. Servo control panel (Panel B)				
(a) Demand (Mode 1 and Mode 2 operation)				
(b) Setpoint				
(c) Flux				
(d) Withdraw, insert, light				
(e) Enter setpoint				
(f) Stop demand				
(g) Battery low light				

Trainer(s) Date Trainee Date

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
2. **REACTOR COMPONENTS** (cont.)				
g. Heat power panel (Panel B)				
(a) Heat power (MW)				
(b) Flux calibration, gain = 1.00				
(c) Flux calibration				
5. Local toggle switch, vernier (local console)				
6. Remote toggle switch, setback (remote console)				
7. Control rod				
8. Servo limit switches				
2.6.6. Normal, abnormal, and emergency procedures related to above items				
2.7. Neutron Sources				
2.7.1. Types				
2.7.2. Hazards				
2.7.3. Precautions				
2.7.4. Responsibility				
3. **EXPERIMENTS**				
3.1. Connection to Reactor Safety Circuits				
3.2. Reactivity Worth				
3.2.1. Total allowed (operating safety limits)				
3.2.2. Method for determining worth				

Trainer(s) ________ Date ________ Trainee ________ Date ________

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
3. EXPERIMENTS (cont.)				
3.3. Responsibility/Surveillance/Procedures				
3.3.1. Approval for operating experiments				
3.3.2. Operating the experiments				
3.3.3. Determining experiment failures				
3.3.4. Normal, abnormal, and emergency procedures related to above items				
4. RECORD KEEPING				
4.1. Core loading				
4.1.1. Responsibility				
4.1.2. Burnup calculations				
4.1.3. Flux mapping				
4.1.4. Past core configurations				
4.1.5. Techniques for establishing new configuation and/or loadings				
4.2. Operating Data				
4.2.1. Daily operation				
4.2.2. Log book				
4.2.3. 12 to 8 shift checks				
4.2.4. 8 to 4 shift checks				
4.2.5. 4 to 12 shift checks				
4.2.6. Area radiation survey				
4.3. Reactor control changes				
4.3.1. Responsibility for issuance				
4.3.2. Maintaining file				

Trainer(s) Date Trainee Date

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
5. RADIATION CONTROL				
5.1. Radiation and contamination monitoring				
5.1.1. Monitrons				
1. Location				
2. Number				
3. Remote readout				
4. Annunciator tie-in				
5. Alarm point				
5.1.2. Continuous air monitors				
1. Location				
2. Number				
3. Remote readout				
4. Annunciator tie-in				
5. Alarm point				
5.1.3. Pool outlet radiation monitor				
1. Location				
5.1.4. Off-gas radiation monitor				
1. Location				
5.1.5. Building ventilation duct				
5.1.6. Log gamma radiation monitor				
5.1.7. Lab facility radiation and contamination warning system				
5.1.8. Normal, abnormal, and emergency procedures related to above items				

Trainer(s)	Date	Trainee	Date

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
5. RADIATION CONTROL (cont.)				
5.2. Radioactivity released to building atmosphere				
5.2.1. Sources				
5.2.2. Normal level when reactor is operating at 1 MW and 2 MW				
5.2.3. At other power levels				
5.2.4. Normal, abnormal, and emergency procedures related to above items				
6. BUILDING CONTAINMENT				
6.1. Automatic closures in building				
6.2. Inter-connecting duct, filters, and stack area				
6.3. Normal flow conditions and CFM				
6.4. Containment flow conditions and CFM				
6.5. Cell vent low flow				
6.6. Checks for "in-flow" currents				
6.7. Conditions which require building containment				
6.8. Established				
6.8.1. Automatically				
6.8.2. Manually				
6.9. Normal, abnormal, and emergency procedures related to above items				

Trainer(s) Date Trainee Date

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
7. PROCESS INSTRUMENTATION (ORNL Dwg. RC 15-1-3)				
7.1. Primary Instrumentation				
7.1.1. Temperature measurements				
1. Core inlet: TE 16-1				
2. Core inlet: TE 16-2				
3. Pool temperature, near primary outlet: TE 16-3				
4. Pool temperature, near primary outlet: TE 16-4				
5. Differential temperature across core: Mode 2 operation				
a. How and where monitored (TdE-17A)				
b. How and where displayed (TdE-17B)				
c. Control and safety action				
d. Significance of				
6. Pool temperatures				
a. Where and how monitored (TE 16-9; TE 16-10; TE 16-11; TE 16-12)				
b. Where and how displayed				
c. Significance of				

Trainer(s)	Date	Trainee	Date

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
7. PROCESS INSTRUMENTATION (cont.)				
7. Inlet to heat exchanger: (TE 16-5)				
8. Outlet from heat exchanger: (TE 16-6)				
9. Where displayed				
10. Significance of				
7.2. Flow indication and pressures				
7.2.1. Differential pressure across core				
1. Pds/22A - closed for normal ΔP; open on low ΔP				
2. Pds/22B - closed for normal ΔP; open on low ΔP				
3. PdA/22 - alarm for abnormal (low) ΔP				
4. PdR/22 - readout for ΔP				
7.2.2. Flow element (FE-10)				
1. FT/10 - flow transmitter				
2. FS/10A - open for low flow				
3. FS/10B - closed for low flow				
4. FA/10 - alarm for low flow				
5. FR/10 - readout for flow				

Trainer(s) Date Trainee Date

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
7. PROCESS INSTRUMENTATION (cont.)				
7.2.3. Pressure indication				
1. PI-19A: upstream side of control valve on inlet line				
2. PI-19B: discharge side of circulating pump				
7.3. Level indication				
7.3.1. Pool				
1. LS/1B - low level for alarm (2 ft)				
2. LS/1C - low level for alarm (4 ft)				
3. LS/1D - low level for alarm (4 ft)				
4. LS/1A - low level for alarm (2 ft)				
7.3.2. Decay tank				
1. LT-4 - level transmitter for readout				
2. LS-4A - high level switch for alarm				
3. LS-4B - low level switch for alarm				
4. LI-4A				
5. LI-4B				
7.4. Radiation instrumentation				
7.4.1. RE-5 - detector on outlet line from pool				
1. RS-5 switch on monitor				
2. RS-5 - signal to alarm monitor				

Trainer(s) Date Trainee Date

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
7. PROCESS INSTRUMENTATION (cont.)				
7.4.2. RE-18 - detector on off-gas line from decay tank				
1. RS-18 - switch in monitor				
2. RA-18 - signal to alarm annunciator				
7.5. Flapper valve				
7.5.1. A scram results if valve is not fully opened or fully closed				
1. ZS-2A - position switch monitoring				
2. ZS-2B - fully open; produces scram when not fully open				
3. ZS-2C - position switch monitoring				
4. ZS-2D - fully closed; produces scram when not fully closed				
5. ZA-2A - alarms when not fully open				
6. ZA-2B - alarms when not fully closed				
7.6. Filter by-pass				
7.6.1. Pressure indicator				
1. PI-19C - outlet side of filter				
2. PI-19D - inlet side of filter				
7.6.2. Flow indicator				
1. FE-19 - flow element				
2. FI-19 - flow indicator (waste meter)				

Trainer(s)	Date	Trainee	Date

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
7. PROCESS INSTRUMENTATION (cont.)				
7.7. Normal, abnormal, and emergency procedures related to above items				
8. SECONDARY SYSTEM				
8.1. Temperature measurements				
8.1.1. Inlet to heat exchanger TE-16-7				
8.1.2. Outlet from heat exchanger TE-16-8				
8.1.3. Temperature control system:				
1. Primary to secondary - temperature of primary is input to valve control (TCV-13); TS-13, TT-13, TA-13, TR-13, TC-13				
2. TT-15 - temperature of tower basin which is input for fan controls				
8.2. Pressure indication				
8.2.1. PI-21 - inlet pressure to heat exchanger which is also discharge pressure of secondary pump				
8.2.2. PI-13 - on 100 psi air supply to (TCV-13) control valve on secondary line exit of heat exchanger				
8.2.3. PI-15 - on 100 psi air supply to TT-15 from tower basin temperature				

Trainer(s)	Date	Trainee	Date

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
8. SECONDARY SYSTEM (cont.)				
8.3. Flow indication				
8.3.1. FE-11 - flow indication on exit to heat exchanger				
1. FT-11 - flow transmitter				
2. FI-11 - flow indicator				
8.4. Normal, abnormal, and emergency procedures related to above items				
9. MISCELLANEOUS				
9.1. Job performance standards				
9.2. Quality assurance				
9.2.1. Organization				
9.2.2. Application				
9.2.3. Reporting (audits, hotline)				
10. OPERATING EXPERIENCE				
1. Has performed a reactor startup (console operation or in a supervisory capacity)				
2. Has participated in reactor startups, other than console work				
3. Has participated in reactor refueling and/or core disassembly work				
4. Has participated in reactor shut-down work (other than refueling)				
5. Has participated in power changes of greater than 10%				
6. Has participated in control room work during normal operations				
7. Other ______________________				

Trainer(s) ____________ Date ____________ Trainee ____________ Date

SECTION 2. FACILITY-SPECIFIC CHECKLIST

Trainee: ______________________________ Badge No.: ____________

Facility: Bulk Shielding Reactor (BSR) Buildings: 3010 and 3004

Instructions

This is a most important checklist. Each subject should be taught to the extent that the trainee will be capable of confidently operating equipment and/or executing a procedure without the need for direct supervision. Trainers should establish learning objectives to ensure that the trainee is left with that knowledge required to perform his/her job duties in a safe and reliable manner.

At the end of each section is an item entitled "normal, abnormal, and emergency procedures related to above items." This should serve, in part, as a review for the subjects in that section. Areas in which weaknesses are indicated should be repeated as needed.

When the Trainer initials an item (and signs the bottom of each page), it should indicate that he/she has not only been assured that the material has been covered with the Trainee, it should also indicate that the Trainee knows the material well enough to be qualified in that subject area.

Upon completion, this checklist should be returned first to the Training Manager. The Training Manager shall submit it to the Examiner at the time the request is made to administer the certification examination.

This material has been taught to the trainee. ____________________, ____________
Training Manager Completion Date

This material has been taught to me by the training personnel. ____________________, ____________
Trainee Completion Date

SECTION 3. EMERGENCY PREPAREDNESS CHECKLIST

Trainee: ______________________________ Badge No.: ____________

Facility: Bulk Shielding Reactor (BSR) Buildings: 3010 and 3004

Instructions

This checklist, on abnormal/emergency operating instructions (A/EOIs), is intended to ensure, in part, that an individual has received training in emergency procedures, as required by DOE Orders 5480.1A, Chapter VI (Safety of DOE-Owned Reactors) and 5500.3 (Reactor and Nonreactor Nuclear Facility Emergency Planning, Preparedness, and Response Program for DOE Operations).

This checklist is to be used for initial certification and for requalification training. It is required that all emergency procedures be reviewed on an annual basis.

(Recommendation: The shift supervisor should periodically cover with his or her crew a few A/EOIs and postulated emergency scenarios in the generic categories as talk-through exercises, as time allows. Toward the end of a certification period, return all checklists for auditing purposes.)

With the exception of Section 3, all items must be completed prior to the administering of the initial certification examination. Some of the subjects in this section are taught by training personnel in other ORNL organizations at different times throughout the year. These subjects (only) may be signed off after the initial certification examination but shall be acknowledged during requalification periods.

When the Trainer initials an item (and signs the bottom of each page), it should indicate that he/she has not only been assured that the material has been covered with the Trainee, it should also indicate that the Trainee knows the material well enough to be qualified in that subject area.

Upon completion, this checklist should be returned to the Training Manager; he/she shall submit it to the Examiner.

This material has been taught to the trainee. ______________________, ____________

Training Manager Completion Date

This material has been taught to me by the training personnel. ______________________, ____________

Trainee Completion Date

SECTION 1. GENERIC SUBJECTS CHECKLIST

Trainee: ______________________ Badge No.: ______________

Facility: Bulk Shielding Reactor (BSR) Buildings: 3010 and 3004

Instructions

The generic subjects may be covered by self study, viewing videotapes, and/or classroom work. Many of the subjects are academic in nature and serve as background material. Where possible, however, the practical applications should be emphasized.

Trainers should establish learning objectives to ensure that the trainee is left with the knowledge required to reliably operate the equipment or execute a procedure.

Each subject should be taught to the extent that the trainee will be prepared to take the certification examinations and be able to perform the required work, without direct supervision, in a safe and reliable manner.

When the Trainer initials an item (and signs the bottom of each page), it should indicate that he/she has not only been assured that the material has been covered with the Trainee, it should also indicate that the Trainee knows the material well enough to be qualified in that subject area.

Upon completion, this checklist should be returned to the Training Manager; he/she shall submit it to the Examiner.

This material has been taught to the trainee. ______________________, ______________
Training Manager Completion Date

This material has been taught to me by the training personnel. ______________________, ______________
Trainee Completion Date

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
1. FACILITY-SPECIFIC ABNORMAL/EMERGENCY OPERATING INSTRUCTION (A/EOIs)				
1.1. Leaks in the primary cooling system				
1.2. Rapid loss of pool water				
1.3. Loss of TVA electrical power				
1.4. Response to setbacks, reverses, and scrams				
1.5. Loss of instrument air				
1.6. Loss of potable, process, or demineralized water systems				
1.7. Loss of steam				
1.8. Loss of one or more reactor primary cooling pumps				
1.9. Loss of pool cooling system				
1.10. Loss of secondary cooling system				
1.11. Loss of shutdown cooling capability				
1.12. Uncontrolled or unexpected changes in reactivity				
1.13. Stuck control rod				
1.14. Dropped control rod				
1.15. Loss of control-rod position indicator system				

Trainer(s)	Date	Trainee	Date

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
1. FACILITY-SPECIFIC ABNORMAL/EMERGENCY OPERATING INSTRUCTION (A/EOIs) (cont.)				
1.16. High radiation level in the reactor primary cooling system				
1.17. High radiation level in the secondary water systems				
1.18. Loss of building containment				
1.19. High radiation level in the reactor building or off-gas systems				
1.20. High radiation level in the liquid waste system				
2. GENERIC EMERGENCY PROCEDURES (as identified in DOE Order 5500.3)				
If any of the items below have been covered in the previous section, write NA in the space.				
2.1. Operational (on-site and off-site)				
2.1.1. Fires				
2.1.2. Explosion				
2.1.3. Industrial accidents				
2.1.4. Personnel injury or fatality				
2.1.5. Release of radioactive or toxic materials				
2.1.6. Personnel exposure				

Trainer(s) Date Trainee Date

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
2. **GENERIC EMERGENCY PROCEDURES** (cont.) (as identified in DOE Order 5500.3)				
2.1.7. Oil and hazardous material pollution				
2.1.8. Air and water pollution				
2.1.9. Transportation accident involving hazardous materials				
2.2. Natural phenomena				
2.2.1. Earthquake				
2.2.2. Tornado				
2.2.3. Flood				
2.2.4. Wind, snow, ice				
2.3. Special nuclear materials (SNM)				
2.3.1. Accidents or malevolent acts involving fuel				
2.4. Terrorist threats or acts				
2.4.1. Bomb threat				
2.4.2. Overt or covert actions, including sabotage				
2.4.3. Nuclear threats				
2.4.4. Extortion or kidnapping				
2.4.5. International threats				

Trainer(s)	Date	Trainee	Date

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
3. OTHER SAFETY-RELATED SUBJECTS				
3.1. Has periodically participated in building and/or plant evacuation drills. (Required at least annually.)				
3.2. Has had fire-fighting training				
3.3. Has had training in the use of respiratory safety equipment				
3.4. Has had training in first aid and/or CPR				
3.5. Has had periodic safety meetings				
3.6. Has read all scenarios and/or reports on accident-type drills at this facility				
3.7. Has read all reactor-related Unusual Occurrence Reports generated at ORNL				
3.8. Has read the summaries of the Unusual Occurrence Reports generated by other DOE facilities				
3.9. Has read selected and/or significant unusual occurrence reports generated by the NRC				
3.10. Has reviewed all Mechanical and Instrumentation and Controls Design Change Memos applicable to this facility				

Trainer(s) Date Trainee Date

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
3. OTHER SAFETY-RELATED SUBJECTS (cont.)				
3.11. Has been made aware of all significant changes in equipment and/or procedures at this facility				
3.12. Has periodically reviewed the following ORNL safety literature:				
1. Local Emergency Manual				
2. Laboratory Emergency Manual				
3. Safety Manual				
4. Health Physics Procedures Manual				
3.13. Knows the building evaculation procedures				
3.14. Knows the plant-wide evaculation procedures				
3.15. Knows the type and location of emergency equipment				

Trainer(s)	Date	Trainee	Date

SECTION 4. SUPERVISOR'S CHECKLIST

Trainee: ______________________ Badge No.: ____________

Facility: Bulk Shielding Reactor (BSR) Buildings: 3010 and 3004

Instructions

Some of the material on supervisor training is covered by special courses given by ORNL instructors (other than Reactor Operations personnel) at various times throughout the year. To allow the candidate to take the Senior Reactor Operator examination and assume the duties of a Supervisor prior to attending these courses, the instructor shall cover the fundamentals of the various subjects to ensure that the individual is prepared to assume his/her supervisory responsibilities.

When the Trainer initials an item (and signs the bottom of each page), it should indicate that he/she has not only been assured that the material has been covered with the Trainee, it should also indicate that the Trainee knows the material well enough to be qualified in that subject area.

Upon completion, this checklist should be returned to the Training Manager; he/she shall submit it to the Examiner.

This material has been taught to the trainee. ______________________, ____________
Training Manager Completion Date

This material has been taught to me by the training personnel. ______________________, ____________
Trainee Completion Date

SECTION 4. SUPERVISOR'S CHECKLIST

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
1. LEADERSHIP				
1.1. Fundamentals				
1.2. Protocol				
1.3. Command responsibilities and limits				
1.4. Interpersonal communication				
1.5. Motivation of personnel and handling complaints				
1.6. Labor relations				
1.7. Problem/decisional analysis				
1.8. Job performance standards				
1.9. Organizing and planning				
2. ADMINISTRATIVE REQUIREMENTS				
2.1. Responsibilities during reactor-type operation				
2.2. Technical Specifications				
2.3. Reporting requirements				
2.4. Special forms to fill out and/or reports to write (RWP, work requests, etc.)				
2.5. Disseminating pertinent information to shift personnel				
2.6. Special projects				

Trainer(s) Date Trainee Date

FACILITY TRAINING/QUALIFICATION CHECKLIST(S)

Trainee: ______________________________ Badge No.: ____________

Facility: Tower Shielding Reactor (TSR) Buildings: 7702 and 7703

Instructions

This composite checklist is comprised of four sections; these are: (1) the Generic Subjects Checklist (i.e., reactor physics, heat transfer/fluid flow, radiation safety, and industrial safety); (2) the Facility-Specific Checklist; (3) the Emergency Preparedness Checklist; and (4) the Supervisor's Checklist. (Refer to the individual checklists for any special instructions.)

The topics herein are to be taught to the above-mentioned trainee by the Training Manager, or his designated instructors, to the extent that the trainee will be prepared for (1) the written, oral, and/or operating examinations required for certification or requalification and (2) solo operation at the above-mentioned facility. All items on each checklist are to be covered for the initial qualification; selected items, with emphasis on abnormal/emergency procedures, are to be covered for requalification training.

The training personnel shall be responsible for establishing learning objectives, as applicable. That is, they shall cover each subject with the primary objective of leaving the trainee with that essential information and/or knowledge needed to operate the reactor or auxiliary equipment in a safe, efficient, and reliable manner during normal, abnormal, and emergency conditions.

The Training Manager at this facility shall coordinate all training and shall sign the cover page of this and each individual checklist after all the required sections have been covered, as applicable. He/she shall also ensure that all required signatures are affixed prior to sending the composite checklist to the Examiner for filing. All sections should be completed prior to taking the written examination required for initial certification.

The composite checklist is intended to be used for the initial qualification and for one requalification; however, it may be used for an additional requalification (two-year period) by using a color code, or some similar scheme, to indicate continued use of the same checklist.

This material has been taught to the trainee. ______________________, ____________

Training Manager — Completion Date

This material has been taught to me by the training personnel. ______________________, ____________

Trainee — Completion Date

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1.1.2. Fast and thermal neutrons				
1.1.3. Prompt and delayed neutrons				
1.1.4. Multiplication factor				
1.1.5. Cross section				
1.1.6. Neutron spectrum				
1.2. Nuclear Reactors				
1.2.1. Description of reactor components				
1.2.2. Reactivity and criticality				
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1.3. Reactivity and Reactor Period				
1.3.1. Reactivity calculations				
1.3.2. Reactor period				
1.3.3. Prompt criticality				
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1.4.1. Fuel requirements for critical mass				
1.4.2. Fuel loading				
1.5. Xenon and Samarium Poisoning Effects				
1.5.1. Fission-product poisons				
1.5.2. Buildup and removal				

Trainer(s)	Date	Trainee	Date

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
1. **REACTOR PHYSICS** (cont.)				
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1.7.1. Basic information				
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1.7.3. Temperature effects				
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2.1.2. Temperature units				
2.1.3. Heat units				
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2.2.1. Sources of heat				

Trainer(s) Date Trainee Date

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
2. HEAT TRANSFER/FLUID FLOW (cont.)				
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2.4.4. Determination of operating parameters				
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3.2.1. Unstable atoms				
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Trainer(s) Date Trainee Date

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
3. **RADIATION SAFETY AND CONTROL** (cont.)				
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Trainer(s) Date Trainee Date

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
3. RADIATION SAFETY AND CONTROL (cont.)				
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3.6.5. Radioactive decay				
3.6.6. Shielding with distance				
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3.7.1. Review				
3.7.2. Radioactive contamination (solid, liquid, and gaseous)				
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3.7.4. Contamination zones				
3.7.5. Contamination clothing				
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3.7.9. Maximum permissible concentration				
4. INDUSTRIAL SAFETY				
4.1. Operational Safety				
4.1.1. Safety organization and Safety Officer				
4.1.2. Protective equipment (use, location)				
4.1.3. Safety practices				
1. Pre-job planning				
2. Electrical safety				
3. Permits and tags				
4. Company vehicles				
4.1.4. Reporting of accidents				

Trainer(s)	Date	Trainee	Date

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
4. INDUSTRIAL SAFETY (cont.)				
4.1.5. Source of information (reference)				
1. Standard Practice Procedure				
2. Policy Procedure Manual				
3. Safety Manual				
4. Environmental Protection Manual				
5. ORNL Respiratory Program				
4.2. Industrial Hygiene				
4.2.1. Hearing/sight conservation				
4.2.2. Use and availability of respiratory equipment				
4.2.3. Control of toxic chemicals/acid spills				
4.2.4. Incompatible chemicals				
4.2.5. Reporting requirements				
4.3. Environmental Protection				
4.3.1. Organization (function, contact)				
4.3.2. General requirements for discharging of effluents to the environs				
4.3.3. Handling and disposing of hazardous materials				
4.3.4. Reporting				
4.4. Fire Protection				
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4.4.2. Location of alarm boxes and equipment				
4.4.3. Effects of smoke and hot, toxic gases				
4.4.4. Combating fires alone (alkali, metal, other)				

Trainer(s) ________ Date ________ Trainee ________ Date

SECTION 2. FACILITY-SPECIFIC CHECKLIST

Trainee: ______________________ Badge No.: __________

Facility: Tower Shielding Reactor (TSR) Buildings: 7702 and 7703

Instructions

This is a most important checklist. Each subject should be taught to the extent that the trainee will be capable of confidently operating equipment and/or executing a procedure without the need for direct supervision. Trainers should establish learning objectives to ensure that the trainee is left with that knowledge required to perform his/her job duties in a safe and reliable manner.

At the end of each section is an item entitled "normal, abnormal, and emergency procedures related to above items." This should serve, in part, as a review for the subjects in that section. Areas in which weaknesses are indicated should be repeated as needed.

When the Trainer initials an item (and signs the bottom of each page), it should indicate that he/she has not only been assured that the material has been covered with the Trainee, it should also indicate that the Trainee knows the material well enough to be qualified in that subject area.

Upon completion, this checklist should be returned first to the Training Manager. The Training Manager shall submit it to the Examiner at the time the request is made to administer the certification examination.

This material has been taught to the trainee. ______________________, __________
Training Manager Completion Date

This material has been taught to me by the training personnel. ______________________, __________
Trainee Completion Date

SECTION 1. GENERIC SUBJECTS CHECKLIST

Trainee: ______________________________ Badge No.: ______________

Facility: Tower Shielding Reactor (TSR) Buildings: 7702 and 7703

Instructions

The generic subjects may be covered by self study, viewing videotapes, and/or classroom work. Many of the subjects are academic in nature and serve as background material. Where possible, however, the practical applications should be emphasized.

Trainers should establish learning objectives to ensure that the trainee is left with the knowledge required to reliably operate the equipment or execute a procedure.

Each subject should be taught to the extent that the trainee will be prepared to take the certification examinations and be able to perform the required work, without direct supervision, in a safe and reliable manner.

When the Trainer initials an item (and signs the bottom of each page), it should indicate that he/she has not only been assured that the material has been covered with the Trainee, it should also indicate that the Trainee knows the material well enough to be qualified in that subject area.

Upon completion, this checklist should be returned to the Training Manager; he/she shall submit it to the Examiner.

This material has been taught to the trainee. ______________________, ______________
Training Manager Completion Date

This material has been taught to me by the training personnel. ______________________, ______________
Trainee Completion Date

SECTION 2. FACILITY-SPECIFIC CHECKLIST

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
1. FACILITY AREA AND BUILDINGS				
1.1. Exclusion fences				
1.1.1. Extent				
1.2.3. Access to area				
1.2.4. Access gates				
1.2. Utilities				
1.3. Facility buildings				
1.1.1. Number				
1.1.2. Location				
1.1.3. Function				
1.4. Maintenance and operating problems in buildings not directly connected with reactor and/or experimental operations				
1.5. Normal, abnormal, and emergency procedures related to above items				
2. MECHANICAL FEATURES OF TSR-II				
2.1. Reactor suspension				
2.1.1. Method of support				
2.1.2. Reactor leveling procedure				
2.1.3. Sling bar supports				
2.1.4. Spreader bars				
2.1.5. Inspection				

Trainer(s) Date Trainee Date

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
2. MECHANICAL FEATURES OF TSR-II (cont.)				
2.2. Reactor rotation				
2.2.1. Description				
2.2.2. Rotation motor drive system				
2.2.3. Special precautions				
2.3. Bayonet support for shields and reactor				
2.3.1. Description				
2.3.2. Dimensions, loads, stresses				
2.3.3. Special precautions				
2.3.4. Inspection				
2.4. Construction of shields				
2.4.1. Description				
2.4.2. Specific shields				
2.4.3. Special precautions				
2.5. Reactor pressure vessel				
2.5.1. Description				
2.5.2. Dimensions, loads, stresses				
2.5.3. Special precautions				
2.6. Reactor containment				
2.6.1. System extent				
2.6.2. Special problems and precautions				
2.6.3. Inspection				

Trainer(s)	Date	Trainee	Date

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
2. **MECHANICAL FEATURES OF TSR-II** (cont.)				
2.7. Ionization chamber guide assembly				
2.7.1. Description				
2.7.2. Method of support				
2.7.3. Inspection				
2.8. Flow baffles				
2.8.1. Description				
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2.9. Fuel elements				
2.9.1. Description				
2.9.2. Fabrication				
2.9.3. Tests, inspections				
2.9.4. Assembly in core				
2.9.5. Fuel burnup				
2.10. Control plates				
2.10.1. Description				
2.10.2. Operation				
2.10.3. Fabrication				
2.10.4. Tests, inspections				
2.11. Control mechanism housing (CMH)				
2.11.1. Description				

Trainer(s) ____________ Date ____ Trainee ____________ Date

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
2. **MECHANICAL FEATURES OF TSR-II** (cont.)				
2.11.2. Fuel cover plates				
2.11.3. Water displacement with aluminum				
2.11.4. CMH cooling				
2.12. Control mechanism housing support tube				
2.12.1. Plate drives				
2.12.2. Water passages				
2.12.3. Seals, bearings, guides				
2.13. Turret				
2.13.1. Description				
2.13.2. Weather proofing				
2.14. Motor drives				
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2.14.3. Regulating plate drive, limits, selsyn-servo error				
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2.15.2. Electrical and hydraulic characteristics				

Trainer(s) Date Trainee Date

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
2. MECHANICAL FEATURES OF TSR-II (cont.)				
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2.17.3. Special precautions				
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3.1.2. Eddy current brakes				
3.1.3. Resistor brakes				

Trainer(s)	Date	Trainee	Date

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
3. TSR HOIST SYSTEM AND TOWER STRUCTURE (cont.)				
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3.2.12. Lower limit switch				
3.2.13. Altitude indication system				
3.3. Hoist maintenance				
3.3.1. Motors, generators				
3.3.2. Gears, shafts				

Trainer(s) Date Trainee Date

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
3. **TSR HOIST SYSTEM AND TOWER STRUCTURE** (cont.)				
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3.5.2. Hoist control station breaker				
3.5.3. Hoist house main breaker				
3.5.4. Individual hoist control cabinets				

Trainer(s) Date Trainee Date

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
3. **TSR HOIST SYSTEM AND TOWER STRUCTURE** (cont.)				
3.6. Hoist operation				
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3.6.3. Slack line between blocks				
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3.6.8. Load detachment				
3.7. Emergency lower				
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3.7.2. Batteries, battery charger				
3.7.3. Maintenance				
3.7.4. Hydraulic hoist				
3.8. Cable maintenance				
3.8.1. Cleaning of blocks, sheaves, idlers				
3.8.2. Lubrication of cables, blocks, sheaves, idlers				
3.8.3. Painting of blocks, sheaves, idlers, hardware				

Trainer(s) Date Trainee Date

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
3. TSR HOIST SYSTEM AND TOWER STRUCTURE (cont.)				
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3.9.4. Hoist operation beyond normal limits				
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2. Block overhaul				
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4. Excess cable on drums				
3.9.5. Load tests				
3.10. Hydraulic hoist				
3.10.1. Brake set				
3.10.2. Cable overhaul				
3.10.3. Potential line pull				
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3.11.2. Minor attachments or modifications				
3.11.3. Loading				

Trainer(s) Date Trainee Date

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
3. TSR HOIST SYSTEM AND TOWER STRUCTURE (cont.)				
3.11.4. Bases				
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3.11.6. Guys				
3.11.7. Lightning counterpoise system				
3.12. Tower maintenance				
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3.12.2. Guys				
3.12.3. Anchors and bases				
3.13. Tower inspections				
3.13.1. Tower framework				
3.13.2. Guys				
3.13.3. Bases, anchors				
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3.14.1. Operation				
3.14.2. Capacity				
3.14.3. Maintenance and inspection				
3.15. Aircraft warning lights				
3.15.1. Wiring diagrams				
3.15.2. Operation and controls				

Trainer(s) Date Trainee Date

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
3. TSR HOIST SYSTEM AND TOWER STRUCTURE (cont.)				
3.15.3. Precautions				
3.15.4. Responsibility				
3.16. Weather instruments				
3.16.1. Radar				
3.16.2. Anemometer				
3.16.3. Thermocouples				
3.16.4. Telemetering equipment				
3.16.5. Hazards				
1. Radar scanner				
2. Service on wet or icy towers				
3.17. Normal, abnormal, and emergency procedures related to above items				
4. TSR-II COOLING WATER SYSTEM COMPONENTS				
4.1. Demineralized water storage				
4.1.1. Description				
4.1.2. Operation				
4.1.3. Maintenance				
4.2. Detention tank				
4.2.1. Description				
4.2.2. Operation				
4.2.3. Maintenance				

Trainer(s) Date Trainee Date

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
4. **TSR-II COOLING WATER SYSTEM COMPONENTS** (cont.)				
4.3. Make-up tank				
4.3.1. Description				
4.3.2. Operation				
4.3.3. Maintenance				
4.4. Fill and pressure pump				
4.4.1. Description				
4.4.2. Operation				
4.4.3. Maintenance				
4.5. Emergency pump				
4.5.1. Description				
4.5.2. Operation				
4.5.3. Maintenance				
4.6. Main pump				
4.6.1. Description				
4.6.2. Operation				
4.6.3. Maintenance				
4.7. Shim pump				
4.7.1. Description				
4.7.2. Operation				
4.7.3. Maintenance				

Trainer(s) Date Trainee Date

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
4. **TSR-II COOLING WATER SYSTEM COMPONENTS** (cont.)				
4.8. Demineralizer and pump				
4.8.1. Description				
4.8.2. Operation				
4.8.3. Maintenance				
4.8.4. Regeneration				
4.9. Heat exchanger				
4.9.1. Description				
4.9.2. Operation				
4.9.3. Maintenance				
4.9.4. Inspection				
4.10. Base pressure regulator				
4.10.1. Description				
4.10.2. Operation				
4.10.3. Maintenance				
4.11. Pneumatically and electrically controlled valves				
4.11.1. Description				
4.11.2. Operation				
4.11.3. Maintenance				

Trainer(s) Date Trainee Date

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
4. TSR-II COOLING WATER SYSTEM COMPONENTS (cont.)				
4.12. Critical manual valves				
4.12.1. Description				
4.12.2. Operation				
4.12.3. Maintenance				
4.13. Fission break monitor				
4.13.1. Description				
4.13.2. Operation				
4.13.3. Maintenance				
4.14. System filters				
4.14.1. Description				
4.14.2. Operation				
4.14.3. Maintenance				
4.15. Waste tank				
4.15.1. Description				
4.15.2. Operation				
4.15.3. Maintenance				
4.16. Reactor storage pool				
4.16.1. Description				
4.16.2. Operation				
4.16.3. Maintenance				

Trainer(s)	Date	Trainee	Date

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
4. TSR-II COOLING WATER SYSTEM COMPONENTS (cont.)				
4.17. Pressure relief valves, both air and water				
4.17.1. Description				
4.17.2. Operation				
4.17.3. Maintenance				
4.18. Air compressor				
4.18.1. Description				
4.18.2. Operation				
4.18.3. Maintenance				
4.19. Rectifier and battery circuit				
4.19.1. Description				
4.19.2. Operation				
4.19.3. Maintenance				
4.20. Water system components on reactor				
4.20.1. Flow turbines				
4.20.2. Scram valves				
4.20.3. Fittings, connectors, piping				
4.20.4. Shim supply hoses				
4.21. Interlocks on water system that affect reactor operations				
4.22. Normal, abnormal, and emergency procedures related to above items				

Trainer(s)	Date	Trainee	Date

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
5. TSR-II COOLING WATER SYSTEM PROCEDURES				
5.1. Procedure for filling and draining system				
5.2. Removal of contaminated waste water				
5.3. Chemical and radiochemical analysis				
5.4. Proper startup procedure for reactor operations				
5.5. Normal operating ranges of all components				
5.6. Winter freeze-up protection				
5.7. Normal pressures, flows, temperatures, for day-to-day reactor operation versus any abnormalities				
5.8. Isolation of reactor from cooling system				
5.9. Importance of keeping reactor free of foreign objects				
5.10. Procedures for removing any component for tests and maintenance				
5.11. Winter freeze-up protection on reactor				
1. Turret heater				
2. Pump modes				
3. External heaters, lights				
5.12. Potential hazards of reactor cooling system				
5.13. Normal, abnormal, and emergency procedures related to above items				

Trainer(s) Date Trainee Date

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
6. TSR-II INSTRUMENT CONTROL SECTION				
6.1. Instrumentation which can shut down operation of the reactor				
6.1.1. Reactor water flow				
6.1.2. Main pump suction <45 psi				
6.1.3. Reactor outlet T high				
6.1.4. Reactor ΔT high (2 channels) 45°F				
6.1.5. Heat exchanger T 160°F				
6.1.6. Emergency pump flow				
6.2. Instrumentation which will annunciate only during routine operation				
6.2.1. Makeup water level high				
6.2.2. Makeup water level low				
6.2.3. Reactor water flow <750 gpm				
6.2.4. Low air pressure				
6.2.5. Water resistivity				
6.2.6. Pump room pneumatic control				
6.2.7. Demineralizer pump vacuum				
6.2.8. Louvers not open				
6.2.9. Main pump suction <45 psi				
6.2.10. Reactor ΔT >34°F				
6.2.11. Demineralized water level low				

Trainer(s) Date Trainee Date

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
6. TSR-II INSTRUMENT CONTROL SECTION (cont.)				
6.3. Instrumentation which will vary routine operating mode of reactor without causing either positive action or alarm				
6.3.1. Shim pump pressure adjustment				
6.3.2. Cooling fans and fan pitch				
6.3.3. Wet air from air compressor				
6.3.4. dc pump on batteries				
6.3.5. Solenoid valve failure				
6.4. Pertinent electrical circuits				
6.5. Special precautions involved with removal or repair of instrument control section				
6.6. Normal, abnormal, and emergency procedures related to above items				
7. TSR-II REACTOR CONTROLS				
7.1. Control logic diagram				
7.2. Elementary diagram				
7.3. Wiring diagram				
7.4. Location (relays, switches, interlocks, etc.)				
7.5. Operation				
7.6. Maintenance				
7.7. Special (control plates)				

Trainer(s) Date Trainee Date

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
7. TSR-II REACTOR CONTROLS (cont.)				
7.8. Single line diagram	______	______	______	______
7.9. Normal, abnormal, and emergency procedures related to above items	______	______	______	______
8. TSR-II INSTRUMENT CHANNELS				
8.1. Startup channel				
8.1.1. Control logic diagram	______	______	______	______
8.1.2. Block diagram	______	______	______	______
8.1.3. Location	______	______	______	______
8.1.4. Maintenance	______	______	______	______
8.2. Safety Temperatures (inlet, outlet, ΔT)				
8.2.1. Block diagram	______	______	______	______
8.3. Water temperature				
8.3.1. Location	______	______	______	______
8.3.2. Maintenance	______	______	______	______
8.3.3. Single line diagram	______	______	______	______
8.4. Air temperature				
8.4.1. Location	______	______	______	______
8.4.2. Maintenance	______	______	______	______
8.4.3. Single line diagram	______	______	______	______

Trainer(s) ____________ Date ____________ Trainee ____________ Date ____________

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
8. TSR-II INSTRUMENT CHANNELS (cont.)				
8.5. Log N period				
8.5.1. Block diagram				
8.5.2. Location				
8.5.3. Maintenance				
8.5.4. Special (interlocks)				
8.6. Picoammeter				
8.6.1. Block diagram				
8.6.2. Location				
8.6.3. Maintenance				
8.6.4. Special (servo)				
8.7. Level safety				
8.7.1. Block diagram				
8.7.2. Location				
8.7.3. Operation				
8.7.4. Maintenance				
8.7.5. Special (scrams)				
8.7.6. Single line diagram				
8.8. Period safety				
8.8.1. Block diagram				
8.8.2. Location				

Trainer(s) Date Trainee Date

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
8. TSR-II INSTRUMENT CHANNELS (cont.)				
8.8.3. Operation				
8.8.4. Maintenance				
8.8.5. Special (scrams)				
8.8.6. Single line diagram				
8.9. Normal, abnormal, and emergency procedures related to above items				
9. TECHNICAL SPECIFICATIONS				
9.1. Terms				
9.2. Safety limits and limiting safety system settings				
9.3. Limiting conditions for operation				
9.4. Surveillance				
9.5. Administrative control				
9.6. Normal, abnormal, and emergency procedures related to above items				
10. OPERATING PROCEDURES				
10.1. Reactor				
10.1.1. Preoperational checkouts				
10.1.2. Startup of cooling systems				
10.1.3. Personnel safety precautions				
10.1.4. Reactor startup				

Trainer(s) Date Trainee Date

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
10. OPERATING PROCEDURES (cont.)				
10.1.5. Establishing power level				
10.1.6. Power calibration				
10.1.7. Scheduled shutdowns				
10.1.8. Unscheduled shutdowns				
10.2. Reactor assembly, disassembly, and critical experiments				
10.2.1. Reactor disassembly necessary for control mechanism housing (CMH) removal				
10.2.2. Procedure for installing CMH and re-assembly of reactor				
10.2.3. Critical experiments associated with shield changes				
10.3. Normal, abnormal, and emergency procedures related to above items				
11. RADIATION PROTECTION SYSTEMS				
11.1. Reactor operation interlocks				
11.2. Stop buttons				
11.3. Radiation level warning systems				
11.4. Operation procedure checks				
11.5. Normal, abnormal, and emergency procedures related to above items				

Trainer(s) ____ Date ____ Trainee ____ Date ____

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
1. FACILITY-SPECIFIC ABNORMAL/EMERGENCY OPERATING INSTRUCTION (A/EOIs)				
1.1. Leaks in the primary cooling system				
1.2. Rapid loss of primary coolant				
1.3. Loss of TVA electrical power				
1.4. Response to reverses, and scrams				
1.5. Loss of instrument air				
1.6. Loss of potable or demineralized water systems				
1.7. Loss of reactor primary cooling pump				
1.8. Loss of shutdown cooling capability				
1.9. Uncontrolled or unexpected changes in reactivity				
1.10. Stuck control plate				
1.11. Loss of control-plate position indicator system				
1.12. Criticality accident				
1.13. Jamming of reactor shut-down devices				
1.14. Reactor handling device fails to operate				
1.15. Reactor damaged				
1.16. Loss of communications				
1.17. Damage to buildings or equipment				
1.18. Emergency lowering of loads				

Trainer(s) ____________ Date ____________ Trainee ____________ Date

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
1. FACILITY-SPECIFIC ABNORMAL/EMERGENCY OPERATING INSTRUCTION (A/EOIs) (cont.)				
1.19. Operations during inclement weather				
1.20. High radiation level in the reactor primary cooling system				
1.21. High radiation level in the reactor control building				
2. GENERIC EMERGENCY PROCEDURES (as identified in DOE Order 5500.3)				
If any of the items below have been covered in the previous section, write NA in the space.				
2.1. Operational (on-site and off-site)				
2.1.1. Fires				
2.1.2. Explosion				
2.1.3. Industrial accidents				
2.1.4. Personnel injury or fatality				
2.1.5. Release of radioactive or toxic materials				
2.1.6. Personnel exposure				
2.1.7. Oil and hazardous material pollution				
2.1.8. Air and water pollution				
2.1.9. Transportation accident involving hazardous materials				

Trainer(s) Date Trainee Date

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
2. **GENERIC EMERGENCY PROCEDURES** (cont.) (as identified in DOE Order 5500.3)				
2.2. Natural phenomena				
2.2.1. Earthquake				
2.2.2. Tornado				
2.2.3. Flood				
2.2.4. Wind, snow, ice				
2.3. Special nuclear materials (SNM)				
2.3.1. Accidents or malevolent acts involving fuel				
2.4. Terrorist threats or acts				
2.4.1. Bomb threat				
2.4.2. Overt or covert actions, including sabotage				
2.4.3. Nuclear threats				
2.4.4. Extortion or kidnapping				
2.4.5. International threats				
3. **OTHER SAFETY-RELATED SUBJECTS**				
3.1. Has periodically participated in building and/or plant evacuation drills. (Required at least annually.)				
3.2. Has had fire-fighting training				
3.3. Has had training in the use of respiratory safety equipment				

Trainer(s) ______ Date ______ Trainee ______ Date ______

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
3. **OTHER SAFETY-RELATED SUBJECTS** (cont.)				
3.4. Has had training in first aid and/or CPR				
3.5. Has had periodic safety meetings				
3.6. Has read all scenarios and/or reports on accident-type drills at this facility				
3.7. Has read all reactor-related Unusual Occurrence Reports generated at ORNL				
3.8. Has read the summaries of the Unusual Occurrence Reports generated by other DOE facilities				
3.9. Has read selected and/or significant unusual occurrence reports generated by the NRC				
3.10. Has reviewed all Mechanical and Instrumentation and Controls Design Change Memos applicable to this facility				
3.11. Has been made aware of all significant changes in equipment and/or procedures at this facility				
3.12. Has periodically reviewed the following ORNL safety literature:				
1. Local Emergency Manual				
2. Laboratory Emergency Manual				
3. Safety Manual				
4. Health Physics Procedures Manual				
3.13. Knows the building evacuation procedures				
3.14. Knows the plant-wide evacuation procedures				
3.15. Knows the type and location of emergency equipment				

Trainer(s) Date Trainee Date

SECTION 3. EMERGENCY PREPAREDNESS CHECKLIST

Trainee: ________________________________ Badge No.: ____________

Facility: Tower Shielding Reactor (TSR) Buildings: 7702 and 7703

Instructions

This checklist, on abnormal/emergency operating instructions (A/EOIs), is intended to ensure, in part, that an individual has received training in emergency procedures, as required by DOE Orders 5480.1A, Chapter VI (Safety of DOE-Owned Reactors) and 5500.3 (Reactor and Nonreactor Nuclear Facility Emergency Planning, Preparedness, and Response Program for DOE Operations).

This checklist is to be used for initial certification and for requalification training. It is required that all emergency procedures be reviewed on an annual basis.

(Recommendation: The shift supervisor should periodically cover with his or her crew a few A/EOIs and postulated emergency scenarios in the generic categories as talk-through exercises, as time allows. Toward the end of a certification period, return all checklists for auditing purposes.)

With the exception of Section 3, all items must be completed prior to the administering of the initial certification examination. Some of the subjects in this section are taught by training personnel in other ORNL organizations at different times throughout the year. These subjects (only) may be signed off after the initial certification examination but shall be acknowledged during requalification periods.

When the Trainer initials an item (and signs the bottom of each page), it should indicate that he/she has not only been assured that the material has been covered with the Trainee, it should also indicate that the Trainee knows the material well enough to be qualified in that subject area.

Upon completion, this checklist should be returned to the Training Manager; he/she shall submit it to the Examiner.

This material has been taught to the trainee. ________________________, ______________
Training Manager Completion Date

This material has been taught to me by the training personnel. ________________________, ______________
Trainee Completion Date

SECTION 4. SUPERVISOR'S CHECKLIST

Trainee: ______________________________ Badge No.: ____________

Facility: Tower Shielding Reactor (TSR) Buildings: 7702 and 7703

Instructions

Some of the material on supervisor training is covered by special courses given by ORNL instructors (other than Reactor Operations personnel) at various times throughout the year. To allow the candidate to take the Senior Reactor Operator examination and assume the duties of a Supervisor prior to attending these courses, the instructor shall cover the fundamentals of the various subjects to ensure that the individual is prepared to assume his/her supervisory responsibilities.

When the Trainer initials an item (and signs the bottom of each page), it should indicate that he/she has not only been assured that the material has been covered with the Trainee, it should also indicate that the Trainee knows the material well enough to be qualified in that subject area.

Upon completion, this checklist should be returned to the Training Manager; he/she shall submit it to the Examiner.

This material has been taught to the trainee. ____________________, ____________
Training Manager — Completion Date

This material has been taught to me by the training personnel. ____________________, ____________
Trainee — Completion Date

SECTION 4. SUPERVISOR'S CHECKLIST

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
1. LEADERSHIP				
1.1. Fundamentals				
1.2. Protocol				
1.3. Command responsibilities and limits				
1.4. Interpersonal communication				
1.5. Motivation of personnel and handling complaints				
1.6. Labor relations				
1.7. Problem/decisional analysis				
1.8. Job performance standards				
1.9. Organizing and planning				
2. ADMINISTRATIVE REQUIREMENTS				
2.1. Responsibilities during reactor-type operation				
2.2. Technical Specifications				
2.3. Reporting requirements				
2.4. Special forms to fill out and/or reports to write (RWP, work requests, etc.)				
2.5. Disseminating pertinent information to shift personnel				
2.6. Special projects				

Trainer(s) Date Trainee Date

FACILITY TRAINING/QUALIFICATION CHECKLIST(S)

Trainee: ______________________ Badge No.: __________

Facility: Health Physics Research Reactor (HPRR) Buildings: 7709 and 7710

Instructions

This composite checklist is comprised of four sections; these are: (1) the Generic Subjects Checklist (i.e., reactor physics, heat transfer/fluid flow, radiation safety, and industrial safety); (2) the Facility-Specific Checklist; (3) the Emergency Preparedness Checklist; and (4) the Supervisor's Checklist. (Refer to the individual checklists for any special instructions.)

The topics herein are to be taught to the above-mentioned trainee by the Training Manager, or his/her designated instructors, to the extent that the trainee will be prepared for (1) the written, oral, and/or operating examinations required for certification or requalification and (2) solo operation at the above-mentioned facility. All items on each checklist are to be covered for the initial qualification; selected items, with emphasis on abnormal/emergency procedures, are to be covered for requalification training.

The training personnel shall be responsible for establishing learning objectives, as applicable. That is, they shall cover each subject with the primary objective of leaving the trainee with that essential information and/or knowledge needed to operate the reactor or auxiliary equipment in a safe, efficient, and reliable manner during normal, abnormal, and emergency conditions.

The Training Manager at this facility shall coordinate all training and shall sign the cover page of this and each individual checklist after all the required sections have been covered, as applicable. He/she shall also ensure that all required signatures are affixed prior to sending the composite checklist to the Examiner for filing. All sections should be completed prior to taking the written examination required for initial certification.

The composite checklist is intended to be used for the initial qualification and for one requalification; however, it may be used for an additional requalification (two-year period) by using a color code, or some similar scheme, to indicate continued use of the same checklist.

This material has been taught to the trainee. ______________________, ______________
Training Manager — Completion Date

This material has been taught to me by the training personnel. ______________________, ______________
Trainee — Completion Date

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1.1. Neutron Reactions				
1.1.1. Type of reactions				
1.1.2. Fast and thermal neutrons				
1.1.3. Prompt and delayed neutrons				
1.1.4. Multiplication factor				
1.1.5. Cro[illegible]tion				
1.1.6. Neutron spectrum				
1.2. Nuclear Reactors				
1.2.1. Description of reactor components				
1.2.2. Reactivity and criticality				
1.2.3. The four-factor formula				
1.3. Reactivity and Reactor Period				
1.3.1. Reactivity calculations				
1.3.2. Reactor period				
1.3.3. Prompt criticality				
1.4. Fuel Burnup				
1.4.1. Fuel requirements for critical mass				
1.4.2. Fuel loading				
1.5. Xenon and Samarium Poisoning Effects				
1.5.1. Fission-product poisons				
1.5.2. Buildup and removal				

Trainer(s)   Date   Trainee   Date

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
1. **REACTOR PHYSICS** (cont.)				
1.5.3. Effect of shutdown on poison equilibrium				
1.6. Temperature Effects				
1.6.1. Reactivity and temperature				
1.6.2. Temperature coefficients				
1.6.3. Reactor control				
1.6.4. Doppler effect				
1.7. Neutron Flux Distribution				
1.7.1. Basic information				
1.7.2. Reflector effects				
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1.7.5. Control-rod effects				
1.7.6. Control-rod worth				
1.8. Pulse description				
1.9. Definition of reactivity unit				
1.10. Pulse Experiments				
1.11. Critical Experiments				
2. **HEAT TRANSFER/FLUID FLOW**				
2.1. Heat (Units, Definitions)				
2.1.1. Introduction				
2.1.2. Temperature units				

Trainer(s) Date

Trainee Date

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
2. HEAT TRANSFER/FLUID FLOW (cont.)				
2.1.3. Heat units				
2.1.4. Thermal energy and power				
2.1.5. Thermal stress				
2.2. Heat Transfer				
2.2.1. Sources of heat				
2.2.2. Heat conduction				
2.2.3. Heat transfer by convection				
2.2.4. Nucleate, transition, and filler boiling				
2.3. Fluid Mechanics				
2.3.1. Hydraulic and pneumatic pressure				
2.3.2. Static pressure and force				
2.3.3. Dynamic pressures and forces				
2.3.4. Water hammer				
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2.4.1. Fission-produced heating				
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2.4.3. Heat transfer rates				
2.4.4. Determination of operating parameters				
2.4.5. Afterheat				

Trainer(s) Date Trainee Date

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
3. RADIATION SAFETY AND CONTROL				
3.1. Atoms				
3.1.1. Parts defined				
3.1.2. Characteristics of protons, neutrons, and electrons				
3.2. Radioactive Material and Radiation				
3.2.1. Unstable atoms				
3.2.2. Types of radioactive decay				
3.2.3. Radioactive contamination				
3.3. Ionization				
3.3.1. Ions				
3.3.2. Radiation and ionization				
3.3.3. Range				
3.3.4. Shielding				
3.4. Radiation Units				
3.4.1. The curie				
3.4.2. The roentgen				
3.4.3. The rad				
3.4.4. The relative biological effectiveness of radiation (RBE)				
3.4.5. The roentgen equivalent man (REM)				
3.5. Health Hazards of Radiation				
3.5.1. Radiation review				

Trainer(s)	Date	Trainee	Date

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
3. RADIATION SAFETY AND CONTROL (cont.)				
3.5.2. Penetration effects				
3.5.3. Effects from ingested sources				
3.5.4. Radiation sensitivity of body organs				
3.5.5. Radiation dose rate				
3.6. Radiation Protection Methods				
3.6.1. Review				
3.6.2. Planning, to reduce exposure				
3.6.3. Reducing the dose rate				
3.6.4. Shielding--tenth-value and half-value layers				
3.6.5. Radioactive decay				
3.6.6. Shielding with distance				
3.7. Radioactive Contamination - Protective Measures				
3.7.1. Review				
3.7.2. Radioactive contamination (solid, liquid, and gaseous)				
3.7.3. Contamination, surface and airborne				
3.7.4. Contamination zones				
3.7.5. Contamination clothing				
3.7.6. Regulated zones				

Trainer(s) Date

Trainee Date

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
3. RADIATION SAFETY AND CONTROL (cont.)				
3.7.7. Continuous air monitors				
3.7.8. Maximum permissible body burden				
3.7.9. Maximum permissible concentration				
4. INDUSTRIAL SAFETY				
4.1. Operational Safety				
4.1.1. Safety organization and Safety Officer				
4.1.2. Protective equipment (use, location)				
4.1.3. Safety practices				
1. Pre-job planning				
2. Electrical safety				
3. Permits and tags				
4. Company vehicles				
4.1.4. Reporting of accidents				
4.1.5. Source of information (reference)				
1. Standard Practice Procedure				
2. Policy Procedure Manual				
3. Safety Manual				
4. Environmental Protection Manual				
5. ORNL Respiratory Program				
4.2. Industrial Hygiene				
4.2.1. Hearing/sight conservation				
4.2.2. Use and availability of respiratory equipment				
4.2.3. Control of toxic chemicals/acid spills				

Trainer(s) ______________ Date ______________ Trainee ______________ Date

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
4. **INDUSTRIAL SAFETY** (cont.)				
4.2.4. Incompatible chemicals				
4.2.5. Reporting requirements				
4.3. Environmental Protection				
4.3.1. Organization (function, contact)				
4.3.2. General requirements for discharging of effluents to the envi-ons				
4.3.3. Handling and disposing of hazardous materials				
4.3.4. Reporting				
4.4. Fire Protection				
4.4.1. Organization				
4.4.2. Location of alarm boxes and equipment				
4.4.3. Effects of smoke and hot, toxic gases				
4.4.4. Combating fires alone				

Trainer(s)	Date	Trainee	Date

SECTION 1. GENERIC SUBJECTS CHECKLIST

Trainee: ______________ , ______________________ Badge No.: ______________

Facility: Health Physics Research Reactor (HPRR) Buildings: 7709 and 7710

Instructions

The generic subjects may be covered by self study, viewing videotapes, and/or classroom work. Many of the subjects are academic in nature and serve as background material. Where possible, however, the practical applications should be emphasized.

Trainers should establish learning objectives to ensure that the trainee is left with the knowledge required to reliably operate the equipment or execute a procedure.

Each subject should be taught to the extent that the trainee will be prepared to take the certification examinations and be able to perform the required work, without direct supervision, in a safe and reliable manner.

When the Trainer initials an item (and signs the bottom of each page), it should indicate that he/she has not only been assured that the material has been covered with the Trainee, it should also indicate that the Trainee knows the material well enough to be qualified in that subject area.

Upon completion, this checklist should be returned to the Training Manager; he/she shall submit it to the Examiner.

This material has been taught to the trainee. ________________________, ______________

Training Manager Completion Date

This material has been taught to me by the training personnel. ________________________, ______________

Trainee Completion Date

SECTION 2. FACILITY-SPECIFIC CHECKLIST

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
1. MECHANICAL AND ELECTRICAL COMPONENTS OF REACTOR				
1.1. Superstructure				
1.1.1. Engineering drawings				
1.2. Core				
1.2.1. Engineering drawings				
1.2.2. Location				
1.2.3. Operation				
1.2.4. Maintenance				
1.2.5. Hazards/precautions				
1.3. Pneumatic system				
1.3.1. Control logic diagram				
1.3.2. Engineering drawings				
1.3.3. Location				
1.3.4. Operation				
1.3.5. Maintenance				
1.3.6. Single line diagram				
1.4. Safety block drive unit				
1.4.1. Control logic diagram				
1.4.2. Elementary diagram				
1.4.3. Engineering drawings				

Trainer(s)	Date	Trainee	Date

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
1. **MECHANICAL AND ELECTRICAL COMPONENTS OF REACTOR** (cont.)				
1.4.4. Location				
1.4.5. Operation				
1.4.6. Special				
1.4.7. Single line diagram				
1.5. Regulating rod drive unit				
1.5.1. Control logic diagram				
1.5.2. Elementary diagram				
1.5.3. Engineering drawings				
1.5.4. Location				
1.5.5. Maintenance				
1.5.6. Single line diagram				
1.6. Mass adjustment rod drive unit				
1.6.1. Control logic diagram				
1.6.2. Elementary diagram				
1.6.3. Engineering drawings				
1.6.4. Location				
1.6.5. Maintenance				
1.6.6. Single line diagram				
1.7. Source drive unit and shield				
1.7.1. Elementary diagram				

Trainer(s) Date Trainee Date

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
1. **MECHANICAL AND ELECTRICAL COMPONENTS OF REACTOR** (cont.)				
1.7.2. Engineering drawings				
1.7.3. Location				
1.7.4. Precautions				
1.7.5. Special				
1.7.6. Single line diagram				
1.8. Ion chamber and fission chamber holders and shields				
1.8.1. Location				
1.8.2. Special (field location)				
1.9. Cable guides				
1.9.1. Engineering drawings				
1.9.2. Location				
1.10. Normal, abnormal, and emergency procedures related to above items				
2. **REACTOR POSITIONING DEVICE**				
2.1. Reactor Pickup Mechanism				
2.1.1. Control logic diagram				
2.1.2. Elementary diagram				
2.1.3. Engineering drawings				
2.1.4. Location				
2.1.5. Operation				
2.1.6. Maintenance				

Trainer(s) Date Trainee Date

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
2. **REACTOR POSITIONING DEVICE** (cont.)				
2.1.7. Single line diagram				
2.2. Superstructure				
2.2.1. Engineering drawings				
2.2.2. Location				
2.3. Elevator drive				
2.3.1. Control logic diagram				
2.3.2. Elementary diagram				
2.3.3. Engineering drawings				
2.3.4. Location				
2.3.5. Operation				
2.3.6. Maintenance				
2.3.7. Single line diagram				
2.4. Pick-up clamp mechanism				
2.4.1. Control logic diagram				
2.4.2. Elementary diagram				
2.4.3. Engineering drawings				
2.4.4. Location				
2.4.5. Operation				
2.4.6. Maintenance				
2.4.7. Single line diagram				
2.5. Drift pin drive unit				
2.5.1. Control logic diagram				

Trainer(s) Date Trainee Date

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
2. **REACTOR POSITIONING DEVICE** (cont.)				
2.5.2. Elementary diagram				
2.5.3. Engineering drawings				
2.5.4. Location				
2.5.5. Operation				
2.5.6. Maintenance				
2.5.7. Single line diagram				
2.6. Cable handling track				
2.6.1. Engineering drawings				
2.7. Control panels				
2.7.1. Control logic diagram				
2.7.2. Elementary diagram				
2.7.3. Location				
2.7.4. Hazards				
2.7.5. Single line diagram				
2.8. Height indicator				
2.8.1. Location				
2.8.2. Single line diagram				
2.9. Horizontal drive unit				
2.9.1. Control logic diagram				
2.9.2. Elementary diagram				
2.9.3. Engineering drawings				

Trainer(s)	Date	Trainee	Date

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
4. HYDRAULIC LIFT (cont.)				
4.2.4. Engineering drawings				
4.2.5. Location				
4.2.6. Maintenance				
4.2.7. Single line diagram				
4.2.8. Security				
4.3. Normal, abnormal, and emergency procedures related to above items				
5. COOLING AIR UNITS				
5.1. Fan				
5.1.1. Wiring diagram				
5.1.2. Location				
5.1.3. Operation				
5.1.4. Maintenance				
5.1.5. Single line diagram				
5.2. Outlets				
5.2.1. Location				
5.2.2. Operation				
5.3. Normal, abnormal, and emergency procedures related to above items				

Trainer(s) ______________________ Date Trainee ______________________ Date

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
6. REACTOR BUILDING HEATING AND AIR CONDITIONING				
6.1. Fans				
6.1.1. Engineering drawings				
6.1.2. Location				
6.1.3. Maintenance				
6.1.4. Single line diagram				
6.2. Filters				
6.2.1. Engineering drawings				
6.2.2. Location				
6.2.3. Maintenance				
6.3. Normal, abnormal, and emergency procedures related to above items				
7. AUXILIARY GENERATOR				
7.1. Fuel tank				
7.1.1. Location				
7.2. Reset switch				
7.2.1. Elementary diagram				
7.2.2. Location				
7.3. Emergency power distribution				
7.3.1. Elementary diagram				
7.3.2. Location				

Trainer(s) Date Trainee Date

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
7. AUXILIARY GENERATOR (cont.)				
7.4. Motor generator				
7.4.1. Location				
7.4.2. Maintenance				
7.5. Normal, abnormal, and emergency procedures related to above items				
8. OUTDOOR CRANE				
8.1. Controls				
8.1.1. Control logic diagram				
8.1.2. Elementary diagram				
8.1.3. Wiring diagram				
8.1.4. Maintenance				
8.2. Superstructure and drive units				
8.2.1. Engineering drawings				
8.2.2. Location				
8.2.3. Maintenance				
8.2.4. Single line diagram				
8.3. Normal, abnormal, and emergency procedures related to above items				
9. EXCLUSION AND SECURITY FENCES				
9.1. Special (gates)				
9.2. Normal, abnormal, and emergency procedures related to above items				

Trainer(s) Date Trainee Date

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
10. EXCLUSION AREA INTERLOCKS				
10.1. Special (reactor building door and gate switches)				
10.2. Location				
10.3. Single line diagram				
10.4. Normal, abnormal, and emergency procedures related to above items				
11. REACTOR CONTROLS				
11.1. Control logic diagram				
11.2. Elementary diagram				
11.3. Wiring diagram				
11.4. Location (relays, switches, interlocks, etc.)				
11.5. Operation				
11.6. Maintenance				
11.7. Special (fuel pieces)				
11.8. Security system interlocks				
11.9. Single line diagram				
11.10 Normal, abnormal, and emergency procedures related to above items				
12. REACTOR INSTRUMENT CHANNELS				
12.1. Count rate channels (fission)				
12.1.1. Control logic diagram				

Trainer(s)	Date	Trainee	Date

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
12. REACTOR INSTRUMENT CHANNELS				
12.1.2. Block diagram				
12.1.3. Location				
12.1.4. Operation				
12.1.5. Maintenance				
12.1.6. Special (interlocks)				
12.1.7. Single line diagram				
12.2. Safety temperatures				
12.2.1. Block diagram				
12.2.2. Elementary diagram				
12.2.3. Location				
12.3. Air temperature				
12.3.1. Location				
12.3.2. Maintenance				
12.3.3. Single line diagram				
12.4. Ambient core temperature for pulse				
12.4.1. Maintenance				
12.4.2. Location				
12.4.3. Single line diagram				
12.5. Log N period				
12.5.1. Block diagram				
12.5.2. Location				

Trainer(s) Date Trainee Date

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
12. **REACTOR INSTRUMENT CHANNELS**				
12.5.3. Operation				
12.5.4. Maintenance				
12.5.5. Special (interlocks)				
12.5.6. Single line diagram				
12.6. Picoammeter				
12.6.1. Block diagram				
12.6.2. Location				
12.6.3. Operation				
12.6.4. Maintenance				
12.6.5. Special (servo)				
12.6.1. Single line diagram				
12.7. Level safety				
12.7.1. Block diagram				
12.7.2. Location				
12.7.3. Operation				
12.7.4. Maintenance				
12.7.5. Special (scrams)				
12.7.6. Single line diagram				
12.8. Period safety				
12.8.1. Block diagram				
12.8.2. Location				
12.8.3. Operation				

Trainer(s) Date Trainee Date

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
12. REACTOR INSTRUMENT CHANNELS				
12.8.4. Maintenance				
12.8.5. Special (scrams)				
12.8.6. Single line diagram				
12.9. Safety monitor				
12.9.1. Location				
12.9.2. Function				
12.9.3. Special (scrams)				
12.9.4. Single line diagram				
12.10. Pulse detector unit				
12.10.1. Block diagram				
12.10.2. Location				
12.10.3. Operation				
12.10.4. Special				
12.10.5. Single line diagram				
12.11. Ion and scintillation detectors				
12.11.1. Engineering drawings				
12.11.2. Location				
12.11.3. Special				
12.11.4. Single line diagram				
12.12. Normal, abnormal, and emergency procedures related to above items				

Trainer(s) Date Trainee Date

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
13. POWER AND DOSE DETERMINATIONS				
13.1. Power level determinations				
13.2. Pulse yield determinations				
13.3. Dose determinations				
13.4. Normal, abnormal, and emergency procedures related to above items				
14. EXPERIMENT APPROVALS, DESIGNATIONS, ETC.				
14.1. Approval procedure				
14.2. Approval documents				
14.3. Experiment numbering system				
14.4. Normal, abnormal, and emergency procedures related to above items				
15. TECHNICAL SPECIFICATIONS				
15.1. Safety limits and limiting safety system settings				
15.2. Limiting conditions for operators				
15.3. Surveillance				
15.4. Administrative control				
15.5. Normal, abnormal, and emergency procedures related to above items				
16. REACTOR OPERATING PROCEDURES				
16.1. Steady-state operating procedure				
16.1.1. Preoperational duties				
16.1.2. Preoperational checkouts				
16.1.3. Startup				

Trainer(s) Date Trainee Date

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
16. REACTOR OPERATING PROCEDURES (cont.)				
16.1.4. Shutdown				
16.1.5. Successive runs				
16.1.6. Postoperational duties				
16.2. Pulse-operation procedures				
16.2.1. Preoperational duties				
16.2.2. Preoperational checkouts				
16.2.3. Setting reactivity				
16.2.4. Pulsing				
16.2.5. Successive runs				
16.2.6. Postoperational and shutdown				
16.3. Core inspection				
16.3.1. Core removal				
16.3.2. Disassembly				
16.3.3. Inspection				
16.4. Special procedures				
16.4.1. Critical experiments				
16.4.2. Reactivity worth of reflectors				
16.4.3. Worth of pulse rod				
16.5. Normal, abnormal, and emergency procedures related to above items				

Trainer(s)	Date	Trainee	Date

SECTION 3. EMERGENCY PREPAREDNESS CHECKLIST

Trainee: ______________________________ Badge No.: ____________

Facility: Health Physics Research Reactor (HPRR) Buildings: 7709 and 7710

Instructions

This checklist, on abnormal/emergency operating instructions (A/EOIs), is intended to ensure, in part, that an individual has received training in emergency procedures, as required by DOE Orders 5480.1A, Chapter VI (Safety of DOE-Owned Reactors) and 5500.3 (Reactor and Nonreactor Nuclear Facility Emergency Planning, Preparedness, and Response Program for DOE Operations).

This checklist is to be used for initial certification and for requalification training. It is required that all emergency procedures be reviewed on an annual basis.

(Recommendation: The shift supervisor should periodically cover with his or her crew a few A/EOIs and postulated emergency scenarios in the generic categories as talk-through exercises, as time allows. Toward the end of a certification period, return all checklists for auditing purposes.)

With the exception of Section 3, all items must be completed prior to the administering of the initial certification examination. Some of the subjects in this section are taught by training personnel in other ORNL organizations at different times throughout the year. These subjects (only) may be signed off after the initial certification examination but shall be acknowledged during requalification periods.

When the Trainer initials an item (and signs the bottom of each page), it should indicate that he/she has not only been assured that the material has been covered with the Trainee, it should also indicate that the Trainee knows the material well enough to be qualified in that subject area.

Upon completion, this checklist should be returned to the Training Manager; he/she shall submit it to the Examiner.

This material has been taught to the trainee. ______________________, ______________
Training Manager Completion Date

This material has been taught to me by the training personnel. ______________________, ______________
Trainee Completion Date

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
17. RADIATION PROTECTION SYSTEMS				
17.1. Reactor interlocks				
17.2. Stop buttons				
17.3. Neutron detector system				
17.4. Gamma-ray warning systems				
17.5. Operating procedures checks				
17.6. Normal, abnormal, and emergency procedures related to above items				

Trainer(s)	Date	Trainee	Date

SECTION 3. EMERGENCY PREPAREDNESS CHECKLIST

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
1. FACILITY-SPECIFIC ABNORMAL/EMERGENCY OPERATING INSTRUCTION (A/EOIs)				
1.1. Loss of TVA electrical power				
1.2. Response to reverses, and scrams				
1.3. Loss of pneumatic systems				
1.4. Loss of potable, process, or water systems				
1.5. Uncontrolled or unexpected changes in reactivity				
1.6. Stuck control device				
1.7. Loss of control-device position indicator system				
1.8. Criticality accident				
1.9. Jamming of reactor safety block				
1.10. Reactor handling devices fail to operate				
1.11. Reactor damaged				
1.12. Loss of communications, TV				
1.13. Inadvertant movement of experimental apparatus				
1.14. Potential breach of security				
1.15. High radiation level in the control or reactor buildings				

Trainer(s) ____________ Date ____ Trainee ____________ Date ____

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
2. **GENERIC EMERGENCY PROCEDURES** (as identified in DOE Order 5500.3)				
If any of the items below have been covered in the previous section, write NA in the space.				
2.1. Operational (on-site and off-site)				
2.1.1. Fires (in control room; in reactor building)				
2.1.2. Explosion				
2.1.3. Industrial accidents				
2.1.4. Personnel injury or fatality				
2.1.5. Release of radioactive or toxic materials				
2.1.6. Personnel exposure				
2.1.7. Oil and hazardous material pollution				
2.1.8. Air and water pollution				
2.1.9. Transportation accident involving hazardous materials				
2.2. Natural phenomena				
2.2.1. Earthquake				
2.2.2. Tornado				
2.2.3. Flood				
2.2.4. Wind, snow, ice				

Trainer(s)	Date	Trainee	Date

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
2. GENERIC EMERGENCY PROCEDURES (cont.) (as identified in DOE Order 5500.3)				
2.3. Special nuclear materials (SNM)				
2.3.1. Accidents or malevolent acts involving fuel				
2.4. Terrorist threats or acts				
2.4.1. Bomb threat				
2.4.2. Overt or covert actions, including sabotage				
2.4.3. Nuclear threats				
2.4.4. Extortion or kidnapping				
2.4.5. International threats				
3. OTHER SAFETY-RELATED SUBJECTS				
3.1. Has periodically participated in building and/or plant evacuation drills. (Required at least annually.)				
3.2. Has had fire-fighting training				
3.3. Has had training in the use of respiratory safety equipment				
3.4. Has had training in first aid and/or CPR				
3.5. Has had periodic safety meetings				
3.6. Has read all scenarios and/or reports on accident-type drills at this facility				

Trainer(s) Date Trainee Date

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
3. OTHER SAFETY-RELATED SUBJECTS (cont.)				
3.7. Has read all reactor-related Unusual Occurrence Reports generated at ORNL				
3.8. Has read the summaries of the Unusual Occurrence Reports generated by other DOE facilities				
3.9. Has read selected and/or significant unusual occurrence reports generated by the NRC				
3.10. Has reviewed all Mechanical and Instrumentation and Controls Design Change Memos applicable to this facility				
3.11. Has been made aware of all significant changes in equipment and/or procedures at this facility				
3.12. Has periodically reviewed the following ORNL safety literature:				
1. Local Emergency Manual				
2. Laboratory Emergency Manual				
3. Safety Manual				
4. Health Physics Procedures Manual				
3.13. Knows the building evaculation procedures				
3.14. Knows the plant-wide evaculation procedures				
3.15. Knows the type and location of emergency equipment				

Trainer(s)	Date	Trainee	Date

SECTION 4. SUPERVISOR'S CHECKLIST

Trainee: ______________________ Badge No.: __________

Facility: Health Physics Research Reactor (HPRR) Buildings: 7709 and 7710

Instructions

Some of the material on supervisor training is covered by special courses given by ORNL instructors (other than Reactor Operations personnel) at various times throughout the year. To allow the candidate to take the Senior Reactor Operator examination and assume the duties of a Supervisor prior to attending these courses, the instructor shall cover the fundamentals of the various subjects to ensure that the individual is prepared to assume his/her supervisory responsibilities.

When the Trainer initials an item (and signs the bottom of each page), it should indicate that he/she has not only been assured that the material has been covered with the Trainee, it should also indicate that the Trainee knows the material well enough to be qualified in that subject area.

Upon completion, this checklist should be returned to the Training Manager; he/she shall submit it to the Examiner.

This material has been taught to the trainee. ______________________, __________
Training Manager Completion Date

This material has been taught to me by the training personnel. ______________________, __________
Trainee Completion Date

SECTION 4. SUPERVISOR'S CHECKLIST

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
1. LEADERSHIP				
1.1. Fundamentals				
1.2. Protocol				
1.3. Command responsibilities and limits				
1.4. Interpersonal communication				
1.5. Motivation of personnel and handling complaints				
1.6. Labor relations				
1.7. Problem/decisional analysis				
1.8. Job performance standards				
1.9. Organizing and planning				
2. ADMINISTRATIVE REQUIREMENTS				
2.1. Responsibilities during reactor-type operation				
2.2. Technical Specifications				
2.3. Reporting requirements				
2.4. Special forms to fill out and/or reports to write (RWP, work requests, etc.)				
2.5. Disseminating pertinent information to shift personnel				
2.6. Special projects				

Trainer(s) Date Trainee Date

SECTION 2. FACILITY-SPECIFIC CHECKLIST

Trainee: ______________________________ Badge No.: __________

Facility: Health Physics Research Reactor (HPRR) Buildings: 7709 and 7710

Instructions

This is a most important checklist. Each subject should be taught to the extent that the trainee will be capable of confidently operating equipment and/or executing a procedure without the need for direct supervision. Trainers should establish learning objectives to ensure that the trainee is left with that knowledge required to perform his/her job duties in a safe and reliable manner.

At the end of each section is an item entitled "normal, abnormal, and emergency procedures related to above items." This should serve, in part, as a review for the subjects in that section. Areas in which weaknesses are indicated should be repeated as needed.

When the Trainer initials an item (and signs the bottom of each page), it should indicate that he/she has not only been assured that the material has been covered with the Trainee, it should also indicate that the Trainee knows the material well enough to be qualified in that subject area.

Upon completion, this checklist should be returned first to the Training Manager. The Training Manager shall submit it to the Examiner at the time the request is made to administer the certification examination.

This material has been taught to the trainee. ______________________, ______________
Training Manager Completion Date

This material has been taught to me by the training personnel. ______________________, ______________
Trainee Completion Date

FACILITY TRAINING/QUALIFICATION CHECKLIST(S)

Trainee: ______________________ Badge No.: ____________

Facility: Pool Critical Assembly (PCA) Buildings: 3010 and 3004

Instructions

This composite checklist is comprised of four sections; these are (1) the Generic Subjects Checklist (i.e., reactor physics, heat transfer/fluid flow, radiation safety, and industrial safety); (2) the Facility-Specific Checklist; (3) the Emergency Preparedness Checklist; and (4) the Supervisor's Checklist. (Refer to the individual checklists for any special instructions.)

The topics herein are to be taught to the above-mentioned trainee by the Training Manager, or his designated instructors, to the extent that the trainee will be prepared for (1) the written, oral, and/or operating examinations required for certification or requalification and (2) solo operation at the above-mentioned facility. All items on each checklist are to be covered for the initial qualification; selected items, with emphasis on abnormal/emergency procedures, are to be covered for requalification training.

The training personnel shall be responsible for establishing learning objectives, as applicable. That is, they shall cover each subject with the primary objective of leaving the trainee with that essential information and/or knowledge needed to operate the reactor or auxiliary equipment in a safe, efficient, and reliable manner during normal, abnormal, and emergency conditions.

The Training Manager at this facility shall coordinate all training and shall sign the cover page of this and each individual checklist after all the required sections have been covered, as applicable. He/she shall also ensure that all required signatures are affixed prior to sending the composite checklist to the Examiner for filing. All sections should be completed prior to taking the written examination required for initial certification.

The composite checklist is intended to be used for the initial qualification and for one requalification; however, it may be used for an additional requalification (two-year period) by using a color code, or some similar scheme, to indicate continued use of the same checklist.

This material has been taught to the trainee. ______________________, ____________
Training Manager Completion Date

This material has been taught to me by the training personnel. ______________________, ____________
Trainee Completion Date

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SECTION 1. GENERIC SUBJECTS CHECKLIST

Trainee: ______________________________ Badge No.: ______________

Facility: Pool Critical Assembly (PCA) Buildings: 3010 and 3004

Instructions

The generic subjects may be covered by self study, viewing videotapes, and/or classroom work. Many of the subjects are academic in nature and serve as background material. Where possible, however, the practical applications should be emphasized.

Trainers should establish learning objectives to ensure that the trainee is left with the knowledge required to reliably operate the equipment or execute a procedure.

Each subject should be taught to the extent that the trainee will be prepared to take the certification examinations and be able to perform the required work, without direct supervision, in a safe and reliable manner.

When the Trainer initials an item (and signs the bottom of each page), it should indicate that he/she has not only been assured that the material has been covered with the Trainee, it should also indicate that the Trainee knows the material well enough to be qualified in that subject area.

Upon completion, this checklist should be returned to the Training Manager; he/she shall submit it to the Examiner.

This material has been taught to the trainee. ______________________, ______________
Training Manager Completion Date

This material has been taught to me by the training personnel. ______________________, ______________
Trainee Completion Date

SECTION 1. GENERIC SUBJECTS CHECKLIST

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
1. REACTOR PHYSICS				
1.1. Neutron Reactions				
1.1.1. Type of reactions				
1.1.2. Fast and thermal neutrons				
1.1.3. Prompt and delayed neutrons				
1.1.4. Multiplication factor				
1.1.5. Cross section				
1.1.6. Neutron spectrum				
1.2. Nuclear Reactors				
1.2.1. Description of reactor components				
1.2.2. Reactivity and criticality				
1.2.3. The four-factor formula				
1.3. Reactivity and Reactor Period				
1.3.1. Reactivity calculations				
1.3.2. Reactor period				
1.3.3. Prompt criticality				
1.4. Fuel Burnup				
1.4.1. Fuel requirements for critical mass				
1.4.2. Fuel loading				
1.5. Xenon and Samarium Poisoning Effects				
1.5.1. Fission-product poisons				
1.5.2. Buildup and removal				

Trainer(s) Date Trainee Date

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
1. REACTOR PHYSICS (cont.)				
1.5.3. Effect of shutdown on poison equilibrium				
1.6. Temperature Effects				
1.6.1. Reactivity and temperature				
1.6.2. Temperature coefficients				
1.6.3. Reactor control				
1.6.4. Doppler effect				
1.7. Neutron Flux Distribution				
1.7.1. Basic information				
1.7.2. Reflector effects				
1.7.3. Temperature effects				
1.7.4. Fuel burnup effects				
1.7.5. Control-rod effects				
1.7.6. Control-rod worth				
2. HEAT TRANSFER/FLUID FLOW				
2.1. Heat (Units, Definitions)				
2.1.1. Introduction				
2.1.2. Temperature units				
2.1.3. Heat units				
2.1.4. Thermal energy and power				
2.1.5. Thermal stress				
2.2. Heat Transfer				
2.2.1. Sources of heat				

Trainer(s) Date Trainee Date

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
2. HEAT TRANSFER/FLUID FLOW (cont.)				
2.2.2. Heat conduction				
2.2.3. Heat transfer by convection				
2.2.4. Nucleate, transition, and filler boiling				
2.3. Fluid Mechanics				
2.3.1. Hydraulic and pneumatic pressure				
2.3.2. Static pressure and force				
2.3.3. Dynamic pressures and forces				
2.3.4. Water hammer				
2.4. Heat Production and Control in Nuclear Reactors				
2.4.1. Fission-produced heating				
2.4.2. Temperature and heat transfer in reactors				
2.4.3. Heat transfer rates				
2.4.4. Determination of operating parameters				
2.4.5. Afterheat				
3. RADIATION SAFETY AND CONTROL				
3.1. Atoms				
3.1.1. Parts defined				
3.1.2. Characteristics of protons, neutrons, and electrons				
3.2. Radioactive Material and Radiation				
3.2.1. Unstable atoms				
3.2.2. Types of radioactive decay				

Trainer(s) Date Trainee Date

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
3. RADIATION SAFETY AND CONTROL (cont.)				
3.2.3. Radioactive contamination				
3.3. Ionization				
3.3.1. Ions				
3.3.2. Radiation and ionization				
3.3.3. Range				
3.3.4. Shielding				
3.4. Radiation Units				
3.4.1. The curie				
3.4.2. The roentgen				
3.4.3. The rad				
3.4.4. The relative biological effectiveness of radiation (RBE)				
3.4.5. The roentgen equivalent man (REM)				
3.5. Health Hazards of Radiation				
3.5.1. Radiation review				
3.5.2. Penetration effects				
3.5.3. Effects from ingested sources				
3.5.4. Radiation sensitivity of body organs				
3.5.5. Radiation dose rate				
3.6. Radiation Protection Methods				
3.6.1. Review				
3.6.2. Planning, to reduce exposure				
3.6.3. Reducing the dose rate				

Trainer(s)	Date	Trainee	Date

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
3. RADIATION SAFETY AND CONTROL (cont.)				
3.6.4. Shielding--tenth-value and half-value layers				
3.6.5. Radioactive decay				
3.6.6. Shielding with distance				
3.7. Radioactive Contamination - Protective Measures				
3.7.1. Review				
3.7.2. Radioactive contamination (solid, liquid, and gaseous)				
3.7.3. Contamination, surface and airborne				
3.7.4. Contamination zones				
3.7.5. Contamination clothing				
3.7.6. Regulated zones				
3.7.7. Continuous air monitors				
3.7.8. Maximum permissible body burden				
3.7.9. Maximum permissible concentration				
4. INDUSTRIAL SAFETY				
4.1. Operational Safety				
4.1.1. Safety organization and Safety Officer				
4.1.2. Protective equipment (use, location)				
4.1.3. Safety practices				
1. Pre-job planning				
2. Electrical safety				
3. Permits and tags				
4. Company vehicles				
4.1.4. Reporting of accidents				

Trainer(s) Date Trainee Date

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
4. INDUSTRIAL SAFETY (cont.)				
4.1.5. Source of information (reference)				
1. Standard Practice Procedure				
2. Policy Procedure Manual				
3. Safety Manual				
4. Environmental Protection Manual				
5. ORNL Respiratory Program				
4.2. Industrial Hygiene				
4.2.1. Hearing/sight conservation				
4.2.2. Use and availability of respiratory equipment				
4.2.3. Control of toxic chemicals/acid spills				
4.2.4. Incompatible chemicals				
4.2.5. Reporting requirements				
4.3. Environmental Protection				
4.3.1. Organization (function, contact)				
4.3.2. General requirements for discharging of effluents to the environs				
4.3.3. Handling and disposing of hazardous materials				
4.3.4. Reporting				
4.4. Fire Protection				
4.4.1. Organization				
4.4.2. Location of alarm boxes and equipment				
4.4.3. Effects of smoke and hot, toxic gases				
4.4.4. Combating fires alone				

Trainer(s)	Date	Trainee	Date

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
1. GENERAL INFORMATION				
1.1. Pool				
1.1.1. Dimensions and Configurations				
1.1.2. Lowest permissible water depth				
1.1.3. Rules about proximity of reactors - physical restrictions (PCA and BSR)				
1.1.4. Fuel storage				
1. Underwater racks				
2. Nonfueled core pieces				
3. Vault				
1.1.5. Water (responsibility of BSR-qualified personnel for all adjustments of water level and for all changes of condition of water)				
1.1.6. Miscellaneous				
1. Fuel handling and other tools used in pool				
2. Overhead crane (use of in moving equipment in pool)				
3. Removable sources (neutron and gamma)				
4. Disposition of off-shift of items 6.1 through 6.3, above				

Trainer(s) Date Trainee Date

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
1. **GENERAL INFORMATION** (cont.)				
1.2. Utilities				
1.2.1. Electrical power				
1. Normal				
2. Emergency (lighting)				
3. Circuits to be de-energized following failure of PCA ac unit				
1.2.2. Responsibility for obtaining approval of BSR supervisor prior to use of any utilities (other than PCA electrical circuits)				
1.2.3. PCA air-conditioning unit				
1.3. Reactor platform				
1.3.1. Limitations on materials, equipment, etc., that are normally permitted (or not permitted) on the platform				
1.3.2. Movement of platform (to allow access to cable tray)				
1.4. Instrument bridge, BSR bridge, and spectrometer crane (responsibility of BSR-qualified personnel for movement of these units)				
2. **REACTOR COMPONENTS**				
2.1. Fuel element grids				
2.1.1. Number of positions				
2.1.2. Size of positions				

Trainer(s) Date Trainee Date

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
2. **REACTOR COMPONENTS** (cont.)				
2.1.3. Orientation (how this is maintained)				
2.1.4. Distance from the floor to the reactor centerline				
2.1.5. Method of attachment to the platform				
2.1.6. Distance from the platform				
2.1.7. Distance under water				
2.1.8. Over-all size				
2.1.9. Clearance between fuel element end box and grid position				
2.1.10. Removal from the pool				
2.1.11. Construction material				
2.1.12. Method of construction				
2.1.13. Removal and installation of BSR-type grid				
2.2. Fuel elements				
2.2.1. Standard assembly				
1. Total amount of ^{235}U in elements				
2. Number of plates per element				
3. Amount of ^{235}U per plate				

Trainer(s)	Date	Trainee	Date

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
2. REACTOR COMPONENTS (cont.)				
4. Dimensions of composite element				
a. Length				
b. Cross section				
c. Cooling water gap				
5. Dimensions of fuel plates				
a. Length, over-all				
b. Length of U-Al alloy section				
c. Cross section (cladding and fuel thickness and construction)				
6. Standard loadings (previously proven, including orientation of element in grid)				
2.2.2. Special fuel element for control rods				
1. Total amount of ^{235}U in elements				
2. Number of plates per element				
3. Amount of ^{235}U per plate				
4. Dimensions of composite element				
a. Length				

Trainer(s) Date Trainee Date

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
2. **REACTOR COMPONENTS** (cont.)				
b. Cross section				
c. Cooling water gap				
5. Dimensions of fuel plate (compare to plate for standard element)				
6. Clearance for control rod				
7. Construction material				
2.3. Shim rods and the regulating rods				
2.3.1. General or standard location - minimum number (operating safety limits)				
2.3.2. Dimensions				
2.3.3. Materials				
1. Shim rods				
2. Regulating rod				
2.3.4. Reactivity worth (operating safety limits)				
1. Shim rod minimum and maximum $\Delta k/k$ per inch				
2. Regulating rod minimum and maximum $\Delta k/k$ per inch				
2.3.5. Position guides				
1. Locations				
2. Materials				

Trainer(s) Date Trainee Date

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
2. **REACTOR COMPONENTS** (cont.)				
2.3.6. Magnet				
1. Holding power versus current				
2. Release time (normal and maximum)				
3. Current limits - upper and lower				
4. Construction				
5. Tests				
2.3.7. Armature				
1. Location				
2. Dimensions				
3. Construction materials				
2.3.8. Shock absorber				
1. Theory/principle of operation				
2. Location				
3. Materials				
2.3.9. Drive system				
1. Gear system				
2. Drive motors				
3. Speed				
4. Position indicator				

Trainer(s)	Date	Trainee	Date

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
2. **REACTOR COMPONENTS** (cont.)				
2.3.10. Time-of-flight requirements (normal and maximum)				
2.3.11. Problems encountered (such as swelling)				
2.4. Chambers				
2.4.1. Fission chambers				
1. Type				
2. Dimensions				
3. Drive system				
4. ^{235}U content				
5. Normal locations				
6. Reactivity effect upon moving				
7. Length of life				
8. Frequency of replacement				
9. PHS curve for channel				
a. Frequency of checking the curve				
b. Importance of check				
2.4.2. Log-N chamber				
1. Type and frequency of compensation				
2. Dimensions				
3. Positioning mechanism				

Trainer(s)	Date	Trainee	Date

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
2. **REACTOR COMPONENTS** (cont.)				
4. Normal location				
5. Length of life				
6. Frequency of compensation and replacement				
2.4.3. Safety chambers				
1. Type				
2. Dimensions				
3. Positioning mechanism				
4. Normal location				
5. Frequency of replacement				
2.4.4. Servo chamber				
1. Type				
2. Dimensions				
3. Positioning mechanism				
4. Normal location				
5. Length of life				
6. Frequency of compensation and replacement				
2.5. Neutron sources				
2.5.1. Types				
2.5.2. Hazards				
2.5.3. Precautions				
2.5.4. Responsibility				
2.5.5. Vital importance at PCA				

Trainer(s) Date Trainee Date

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
3. EXPERIMENTS				
3.1. Reactivity worth				
3.1.1. Total allowed (operating safety limits)				
3.1.2. Method for determining worth				
3.2. Responsibility				
3.2.1. For approval for operating experiments				
3.2.2. For operating the experiments				
3.3. Determining experiment failures				
4. RECORD KEEPING				
4.1. Core loading				
4.1.1. Responsibility				
4.1.2. Flux mapping				
4.1.3. Past core configurations				
4.1.4. Techniques for establishing new configuration and/or loading:				
1. Category A				
2. Category B				
3. Category C				
4.2. Operating data				
4.2.1. Daily operation				
4.2.2. Log book				
4.3. Reactor controls change memoranda				
4.3.1. Responsibility for issuance				
4.3.2. Maintaining file				

Trainer(s) Date Trainee Date

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
5. RADIATION CONTROL				
5.1. Radiation and contamination monitoring				
5.1.1. Monitrons				
1. Location				
2. Number				
3. Alarm point				
a. Facility radiation and contamination system				
b. PCA control system				
5.1.2. Continuous air monitors				
1. Location				
2. Number				
3. Alarm point				
a. Facility radiation and contamination system				
b. Local alarm only				
6. MISCELLANEOUS				
6.1. Job performance				
6.2. Quality assurance				
6.2.1. Organization				
6.2.2. Application				
6.2.3. Reporting (audits, hotline)				

Trainer(s) Date Trainee Date

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
7. OPERATING EXPERIENCE				
1. Has performed a reactor startup (console operation or in a supervisory capacity)				
2. Has participated in reactor startups, other than console work				
3. Has participated in reactor refueling and/or core disassembly work				
4. Has participated in reactor shut-down (other than refueling)				
5. Has participated in power changes of greater than 10%				
6. Has participated in control room work during normal operations				
7. Other ______________				

Trainer(s) Date Trainee Date

SECTION 2. FACILITY-SPECIFIC CHECKLIST

Trainee: ______________________ Badge No.: ____________

Facility: Pool Critical Assembly (PCA) Buildings: 3010 and 3004

Instructions

This is a most important checklist. Each subject should be taught to the extent that the trainee will be capable of confidently operating equipment and/or executing a procedure without the need for direct supervision. Trainers should establish learning objectives to ensure that the trainee is left with that knowledge required to perform his/her job duties in a safe and reliable manner.

At the end of each section is an item entitled "normal, abnormal, and emergency procedures related to above items." This should serve, in part, as a review for the subjects in that section. Areas in which weaknesses are indicated should be repeated as needed.

When the Trainer initials an item (and signs the bottom of each page), it should indicate that he/she has not only been assured that the material has been covered with the Trainee, it should also indicate that the Trainee knows the material well enough to be qualified in that subject area.

Upon completion, this checklist should be returned first to the Training Manager. The Training Manager shall submit it to the Examiner at the time the request is made to administer the certification examination.

This material has been taught to the trainee. ______________________, ____________
Training Manager, Completion Date

This material has been taught to me by the training personnel. ______________________, ____________
Trainee, Completion Date

Title	Trainer/ Trainee	Date	er/ e	Date
1. FACILITY-SPECIFIC ABNORMAL/EMERGENCY OPERATING INSTRUCTION (A/EOIs)				
1.1. Loss of electrical power				
1.2. Loss of instrument air				
1.3. Dropped/damaged unit				
1.4. Evacuation signals				
1.5. Monitoring procedures				
1.6. Emergency escalation				
1.7. ORNL/Y-12 interactions/responsibilities				
1.8. Fire/sprinkler system				
1.9. Criticality				
1.9.1. Prompt-jump criticality				
1.9.2. Unannounced scram				
2. GENERIC EMERGENCY PROCEDURES (as identified in DOE Order 5500.3) If any of the items below have been covered in the previous section, write NA in the space.				
2.1. Operational (on-site and off-site)				
2.1.1. Fires				
2.1.2. Explosion				
2.1.3. Industrial accidents				

Trainer(s) Date Trainee Date

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
2. **GENERIC EMERGENCY PROCEDURES** (cont.) (as identified in DOE Order 5500.3)				
2.1.4. Personnel injury or fatality				
2.1.5. Release of radioactive or toxic materials				
2.1.6. Personnel exposure				
2.1.7. Oil and hazardous material pollution				
2.1.8. Air and water pollution				
2.1.9. Transportation accident involving hazardous materials				
2.2. Natural phenomena				
2.2.1. Earthquake				
2.2.2. Tornado				
2.2.3. Flood				
2.2.4. Wind, snow, ice				
2.3. Special nuclear materials (SNM)				
2.3.1. Accidents or malevolent acts involving fuel				
2.4. Terrorist threats or acts				
2.4.1. Bomb threat				
2.4.2. Overt or covert actions, including sabotage				
2.4.3. Nuclear threats				
2.4.4. Extortion or kidnapping				
2.4.5. International threats				

Trainer(s) Date Trainee Date

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
3. OTHER SAFETY-RELATED SUBJECTS				
3.1. Has periodically participated in building and/or plant evacuation drills. (Required at least annually.)				
3.2. Has had fire-fighting training				
3.3. Has had training in the use of respiratory safety equipment				
3.4. Has had training in first aid and/or CPR				
3.5. Has had periodic safety meetings				
3.6. Has read all scenarios and/or reports on accident-type drills at this facility				
3.7. Has read all reactor-related Unusual Occurrence Reports generated at ORNL				
3.8. Has read the summaries of the Unusual Occurrence Reports generated by other DOE facilities				
3.9. Has read selected and/or significant unusual occurrence reports generated by the NRC				
3.10. Has reviewed all Mechanical and Instrumentation and Controls Design Change Memos applicable to this facility				

Trainer(s) Date Trainee Date

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
3. OTHER SAFETY-RELATED SUBJECTS (cont.)				
3.11. Has been made aware of all significant changes in equipment and/or procedures at this facility				
3.12. Has periodically reviewed the following ORNL safety literature:				
1. Local Emergency Manual				
2. Laboratory Emergency Manual				
3. Safety Manual				
4. Health Physics Procedures Manual				
3.13. Knows the building evacuation procedures				
3.14. Knows the plant-wide evacuation procedures				
3.15. Knows the type and location of emergency equipment at the facility				

Trainer(s)	Date	Trainee	Date

SECTION 4. SUPERVISOR'S CHECKLIST

Trainee: ______________________ Badge No.: ______________

Facility: Pool Critical Assembly (PCA) Buildings: 3010 and 3004

Instructions

Some of the material on supervisor training is covered by special courses given by ORNL instructors (other than Reactor Operations personnel) at various times throughout the year. To allow the candidate to take the Senior Reactor Operator examination and assume the duties of a Supervisor prior to attending these courses, the instructor shall cover the fundamentals of the various subjects to ensure that the individual is prepared to assume his/her supervisory responsibilities.

When the Trainer initials an item (and signs the bottom of each page), it should indicate that he/she has not only been assured that the material has been covered with the Trainee, it should also indicate that the Trainee knows the material well enough to be qualified in that subject area.

Upon completion, this checklist should be returned to the Training Manager; he/she shall submit it to the Examiner.

This material has been taught to the trainee. ______________________, ______________
Training Manager Completion Date

This material has been taught to me by the training personnel. ______________________, ______________
Trainee Completion Date

SECTION 3. EMERGENCY PREPAREDNESS CHECKLIST

Trainee: ______________________________ Badge No.: ____________

Facility: Pool Critical Assembly (PCA) Buildings: 3010 and 3004

Instructions

This checklist, on abnormal/emergency operating instructions (A/EOIs), is intended to ensure, in part, that an individual has received training in emergency procedures, as required by DOE Orders 5480.1A, Chapter VI (Safety of DOE-Owned Reactors) and 5500.3 (Reactor and Nonreactor Nuclear Facility Emergency Planning, Preparedness, and Response Program for DOE Operations).

This checklist is to be used for initial certification and for requalification training. It is required that all emergency procedures be reviewed on an annual basis.

(Recommendation: The shift supervisor should periodically cover with his or her crew a few A/EOIs and postulated emergency scenarios in the generic categories as talk-through exercises, as time allows. Toward the end of a certification period, return all checklists for auditing purposes.)

With the exception of Section 3, all items must be completed prior to the administering of the initial certification examination. Some of the subjects in this section are taught by training personnel in other ORNL organizations at different times throughout the year. These subjects (only) may be signed off after the initial certification examination but shall be acknowledged during requalification periods.

When the Trainer initials an item (and signs the bottom of each page), it should indicate that he/she has not only been assured that the material has been covered with the Trainee, it should also indicate that the Trainee knows the material well enough to be qualified in that subject area.

Upon completion, this checklist should be returned to the Training Manager; he/she shall submit it to the Examiner.

This material has been taught to the trainee. ______________________, ____________

Training Manager — Completion Date

This material has been taught to me by the training personnel. ______________________, ____________

Trainee — Completion Date

SECTION 4. SUPERVISOR'S CHECKLIST

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
1. LEADERSHIP				
1.1. Fundamentals				
1.2. Protocol				
1.3. Command responsibilities and limits				
1.4. Interpersonal communication				
1.5. Motivation of personnel and handling complaints				
1.6. Labor relations				
1.7. Problem/decisional analysis				
1.8. Job performance standards				
1.9. Organizing and planning				
2. ADMINISTRATIVE REQUIREMENTS				
2.1. Responsibilities during reactor-type operation				
2.2. Technical Specifications				
2.3. Reporting requirements				
2.4. Special forms to fill out and/or reports to write (RWP, work requests, etc.)				
2.5. Disseminating pertinent information to shift personnel				
2.6. Special projects				

Trainer(s) Date Trainee Date

FACILITY TRAINING/QUALIFICATION CHECKLIST(S)

Trainee: ______________________________ Badge No.: ____________

Facility: Critical Experiments Facility (CEF) Buildings: 9213 (Y-12)

Instructions

This composite checklist is comprised of four sections; these are: (1) the Generic Subjects Checklist (i.e., reactor physics, heat transfer/fluid flow, radiation safety, and industrial safety); (2) the Facility-Specific Checklist; (3) the Emergency Preparedness Checklist; and (4) the Supervisor's Checklist. (Refer to the individual checklists for any special instructions.)

The topics herein are to be taught to the above-mentioned trainee by the Training Manager, or his/her designated instructors, to the extent that the trainee will be prepared for (1) the written, oral, and/or operating examinations required for certification or requalification and (2) solo operation at the above-mentioned facility. All items on each checklist are to be covered for the initial qualification; selected items, with emphasis on abnormal/emergency procedures, are to be covered for requalification training.

The training personnel shall be responsible for establishing learning objectives, as applicable. That is, they shall cover each subject with the primary objective of leaving the trainee with that essential information and/or knowledge needed to operate the reactor or auxiliary equipment in a safe, efficient, and reliable manner during normal, abnormal, and emergency conditions.

The Training Manager at this facility shall coordinate all training and shall sign the cover page of this and each individual checklist after all the required sections have been covered, as applicable. He/she shall also ensure that all required signatures are affixed prior to sending the composite checklist to the Examiner for filing. All sections should be completed prior to taking the written examination required for initial certification.

The composite checklist is intended to be used for the initial qualification and for one requalification; however, it may be used for an additional requalification (two-year period) by using a color code, or some similar scheme, to indicate continued use of the same checklist.

This material has been taught to the trainee. ______________________, ____________

Training Manager — Completion Date

This material has been taught to me by the training personnel. ______________________, ____________

Trainee — Completion Date

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SECTION 1. GENERIC SUBJECTS CHECKLIST

Trainee: ______________________ Badge No.: ______________

Facility: Critical Experiments Facility (CEF) Buildings: 9213 (Y-12)

Instructions

The generic subjects may be covered by self study, viewing videotapes, and/or classroom work. Many of the subjects are academic in nature and serve as background material. Where possible, however, the practical applications should be emphasized.

Trainers should establish learning objectives to ensure that the trainee is left with the knowledge required to reliably operate the equipment or execute a procedure.

Each subject should be taught to the extent that the trainee will be prepared to take the certification examinations and be able to perform the required work, without direct supervision, in a safe and reliable manner.

When the Trainer initials an item (and signs the bottom of each page), it should indicate that he/she has not only been assured that the material has been covered with the Trainee, it should also indicate that the Trainee knows the material well enough to be qualified in that subject area.

Upon completion, this checklist should be returned to the Training Manager; he/she shall submit it to the Examiner.

This material has been taught to the trainee. ______________________, ______________
Training Manager — Completion Date

This material has been taught to me by the training personnel. ______________________, ______________
Trainee — Completion Date

SECTION 1. GENERIC SUBJECTS CHECKLIST

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
1. REACTOR PHYSICS				
1.1. Neutron Reactions				
1.1.1. Type of reactions				
1.1.2. Fast and thermal neutrons				
1.1.3. Prompt and delayed neutrons				
1.1.4. Multiplication factor				
1.1.5. Cross section				
1.1.6. Neutron spectrum				
1.2. Nuclear Reactors				
1.2.1. Description of reactor components				
1.2.2. Reactivity and criticality				
1.2.3. The four-factor formula				
1.3. Reactivity and Reactor Period				
1.3.1. Reactivity calculations				
1.3.2. Reactor period				
1.3.3. Prompt criticality				
1.4. Fuel Burnup				
1.4.1. Fuel requirements for critical mass				
1.4.2. Fuel loading				
1.5. Xenon and Samarium Poisoning Effects				
1.5.1. Fission-product poisons				
1.5.2. Buildup and removal				

Trainer(s)	Date	Trainee	Date

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
1. REACTOR PHYSICS (cont.)				
1.5.3. Effect of shutdown on poison equilibrium				
1.6. Temperature Effects				
1.6.1. Reactivity and temperature				
1.6.2. Temperature coefficients				
1.6.3. Reactor control				
1.6.4. Doppler effect				
1.7. Neutron Flux Distribution				
1.7.1. Basic information				
1.7.2. Reflector effects				
1.7.3. Temperature effects				
1.7.4. Fuel burnup effects				
1.7.5. Control-rod effects				
1.7.6. Control-rod worth				
2. HEAT TRANSFER/FLUID FLOW				
2.1. Heat (Units, Definitions)				
2.1.1. Introduction				
2.1.2. Temperature units				
2.1.3. Heat units				
2.1.4. Thermal energy and power				
2.1.5. Thermal stress				
2.2. Heat Transfer				
2.2.1. Sources of heat				

Trainer(s) Date Trainee Date

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
2. HEAT TRANSFER/FLUID FLOW (cont.)				
2.2.2. Heat conduction				
2.2.3. Heat transfer by convection				
2.2.4. Nucleate, transition, and filler boiling				
2.3. Fluid Mechanics				
2.3.1. Hydraulic and pneumatic pressure				
2.3.2. Static pressure and force				
2.3.3. Dynamic pressures and forces				
2.3.4. Water hammer				
2.4. Heat Production and Control in Nuclear Reactors				
2.4.1. Fission-produced heating				
2.4.2. Temperature and heat transfer in reactors				
2.4.3. Heat transfer rates				
2.4.4. Determination of operating parameters				
2.4.5. Afterheat				
3. RADIATION SAFETY AND CONTROL				
3.1. Atoms				
3.1.1. Parts defined				
3.1.2. Characteristics of protons, neutrons, and electrons				
3.2. Radioactive Material and Radiation				
3.2.1. Unstable atoms				
3.2.2. Types of radioactive decay				

Trainer(s) Date Trainee Date

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
3. RADIATION SAFETY AND CONTROL (cont.)				
3.2.3. Radioactive contamination				
3.3. Ionization				
3.3.1. Ions				
3.3.2. Radiation and ionization				
3.3.3. Range				
3.3.4. Shielding				
3.4. Radiation Units				
3.4.1. The curie				
3.4.2. The roentgen				
3.4.3. The rad				
3.4.4. The relative biological effectiveness of radiation (RBE)				
3.4.5. The roentgen equivalent man (REM)				
3.5. Health Hazards of Radiation				
3.5.1. Radiation review				
3.5.2. Penetration effects				
3.5.3. Effects from ingested sources				
3.5.4. Radiation sensitivity of body organs				
3.5.5. Radiation dose rate				
3.6. Radiation Protection Methods				
3.6.1. Review				
3.6.2. Planning, to reduce exposure				
3.6.3. Reducing the dose rate				

Trainer(s) Date Trainee Date

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
3. RADIATION SAFETY AND CONTROL (cont.)				
3.6.4. Shielding--tenth-value and half-value layers				
3.6.5. Radioactive decay				
3.6.6. Shielding with distance				
3.7. Radioactive Contamination - Protective Measures				
3.7.1. Review				
3.7.2. Radioactive contamination (solid, liquid, and gaseous)				
3.7.3. Contamination, surface and airborne				
3.7.4. Contamination zones				
3.7.5. Contamination clothing				
3.7.6. Regulated zones				
3.7.7. Continuous air monitors				
3.7.8. Maximum permissible body burden				
3.7.9. Maximum permissible concentration				
4. INDUSTRIAL SAFETY				
4.1. Operational Safety				
4.1.1. Safety organization and Safety Officer				
4.1.2. Protective equipment (use, location)				
4.1.3. Safety practices				
1. Pre-job planning				
2. Electrical safety				
3. Permits and tags				
4. Company vehicles				
4.1.4. Reporting of accidents				

Trainer(s) Date Trainee Date

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
4. INDUSTRIAL SAFETY (cont.)				
4.1.5. Source of information (reference)				
1. Standard Practice Procedure				
2. Policy Procedure Manual				
3. Safety Manual				
4. Environmental Protection Manual				
5. ORNL Respiratory Program				
4.2. Industrial Hygiene				
4.2.1. Hearing/sight conservation				
4.2.2. Use and availability of respiratory equipment				
4.2.3. Control of toxic chemicals/acid spills				
4.2.4. Incompatible chemicals				
4.2.5. Reporting requirements				
4.3. Environmental Protection				
4.3.1. Organization (function, contact)				
4.3.2. General requirements for discharging of effluents to the environs				
4.3.3. Handling and disposing of hazardous materials				
4.3.4. Reporting				
4.4. Fire Protection				
4.4.1. Organization				
4.4.2. Location of alarm boxes and equipment				
4.4.3. Effects of smoke and hot, toxic gases				
4.4.4. Combating fires alone				

Trainer(s) Date Trainee Date

SECTION 2. FACILITY-SPECIFIC CHECKLIST

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
1. OPERATIONS				
1.1. Criticality Testing				
1.1.1. Responsibilities, precautions				
1.1.2. Personnel hazards during testing				
1.1.3. Preparation for testing				
1. Minimum monitoring and safety instrumentation requirements				
2. Communication requirements				
3. Exclusion area requirements				
4. Radiation monitoring				
5. Daily checks				
1.1.4. Fuel assembly configuration				
1. First run of testing series				
2. First run on each unit				
3. Subsequent runs				
1.1.5. SPERT elements				
1.1.6. Boron strips				
1.1.7. Test tank fill procedures				
1.1.8. Reactivity and period measurement and calculation				
1.1.9. Neutron source				
1. Administrative requirements				
2. Storage and handling				

Trainer(s)	Date	Trainee	Date

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
1. OPERATIONS (cont.)				
1.2. Shutdown				
1.2.1. Accidental scrams				
1.2.2. Scram modes				
1.2.3. Shutdown procedures				
1.2.4. Securing CEF-West				
1.3. Normal, abnormal, and emergency procedures related to above items				
2. INSTRUMENTATION AND CONTROL				
2.1. Safety systems				
2.1.1. Ionization chambers				
2.1.2. Photomultiplier tubes				
2.1.3. Scram setpoints				
2.1.4. Dump, drain, and feed				
2.1.5. Interlocks				
2.1.6. Technical specifications				
2.2. Monitoring				
2.2.1. Ionization chambers				
2.2.2. Log N				
2.2.3. Instrument response				
2.2.4. Water level				
2.2.5. Detector location				
2.2.6. Surveillance requirements				

Trainer(s)	Date	Trainee	Date

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
2. INSTRUMENTATION AND CONTROL (cont.)				
2.3. Radiation monitoring				
2.3.1. Radiation detectors				
2.3.2. Surveillance requirements				
2.3.3. Portable detectors				
2.4. Normal, abnormal, and emergency procedures related to above items				
3. CONTAINMENT				
3.1. Requirements during testing				
3.2. Ventilation, heating, and air conditioning				
3.2.1. Air flow path				
3.2.2. Ties to evacuation alarm				
3.2.3. controller location				
3.3. Normal, abnormal, and emergency procedures related to above items				
4. AUXILIARY SYSTEMS				
4.1. Liquid waste				
4.2. Radioactive waste				
4.3. Crane operation				
4.4. Normal, abnormal, and emergency procedures related to above items				

Trainer(s) Date Trainee Date

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
5. ADMINISTRATION				
5.1. Security				
5.1.1. Cover-badge system				
5.1.2. Personnel access				
5.1.3. Fuel handling				
5.2. Log keeping				
5.3. Incident reporting requirements				
5.4. Technical specifications				
5.5. Normal, abnormal, and emergency procedures related to above items				
6. MISCELLANEOUS				
6.1. Job performance				
6.2. Quality assurance				
6.2.1. Organization				
6.2.2. Application				
6.2.3. Reporting (audits, hotline)				
7. OPERATING EXPERIENCE				
1. Has operated crane to load a unit (inner and outer)				
2. Has performed a criticality test from control panel				
3. Has performed SPERT element and boron strip loading				

Trainer(s) Date Trainee Date

SECTION 2. FACILITY-SPECIFIC CHECKLIST

Trainee: ______________________________ Badge No.: ____________

Facility: Critical Experiments Facility (CEF) Buildings: 9213 (Y-12)

Instructions

This is a most important checklist. Each subject should be taught to the extent that the trainee will be capable of confidently operating equipment and/or executing a procedure without the need for direct supervision. Trainers should establish learning objectives to ensure that the trainee is left with that knowledge required to perform his/her job duties in a safe and reliable manner.

At the end of each section is an item entitled "normal, abnormal, and emergency procedures related to above items." This should serve, in part, as a review for the subjects in that section. Areas in which weaknesses are indicated should be repeated as needed.

When the Trainer initials an item (and signs the bottom of each page), it should indicate that he/she has not only been assured that the material has been covered with the Trainee, it should also indicate that the Trainee knows the material well enough to be qualified in that subject area.

Upon completion, this checklist should be returned first to the Training Manager. The Training Manager shall submit it to the Examiner at the time the request is made to administer the certification examination.

This material has been taught to the trainee. ____________________, ____________
Training Manager, Completion Date

This material has been taught to me by the training personnel. ____________________, ____________
Trainee, Completion Date

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
7. **OPERATING EXPERIENCE** (cont.)				
4. Has participated in fuel shipment operations				
5. Has calculated unit reactivity and assembly period				
6. Has performed daily checks from control panel				
7. Has performed daily checks in cell				
8. Normal, abnormal, and emergency procedures related to above items				

Trainer(s)	Date	Trainee	Date

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
1. FACILITY-SPECIFIC ABNORMAL/EMERGENCY OPERATING INSTRUCTION (A/EOIs)				
1.1. Loss of electrical power				
1.2. Loss of instrument air				
1.3. Dropped/damaged unit				
1.4. Evacuation signals				
1.5. Monitoring procedures				
1.6. Emergency escalation				
1.7. ORNL/Y-12 interactions/responsibilities				
1.8. Fire/sprinkler system				
1.9. Criticality				
1.9.1. Prompt-jump criticality				
1.9.2. Unannounced scram				
2. GENERIC EMERGENCY PROCEDURES (as identified in DOE Order 5500.3) If any of the items below have been covered in the previous section, write NA in the space.				
2.1. Operational (on-site and off-site)				
2.1.1. Fires				
2.1.2. Explosion				
2.1.3. Industrial accidents				

Trainer(s) Date Trainee Date

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
2. **GENERIC EMERGENCY PROCEDURES** (cont.) (as identified in DOE Order 5500.3)				
2.1.4. Personnel injury or fatality				
2.1.5. Release of radioactive or toxic materials				
2.1.6. Personnel exposure				
2.1.7. Oil and hazardous material pollution				
2.1.8. Air and water pollution				
2.1.9. Transportation accident involving hazardous materials				
2.2. Natural phenomena				
2.2.1. Earthquake				
2.2.2. Tornado				
2.2.3. Flood				
2.2.4. Wind, snow, ice				
2.3. Special nuclear materials (SNM)				
2.3.1. Accidents or malevolent acts involving fuel				
2.4. Terrorist threats or acts				
2.4.1. Bomb threat				
2.4.2. Overt or covert actions, including sabotage				
2.4.3. Nuclear threats				
2.4.4. Extortion or kidnapping				
2.4.5. International threats				

Trainer(s) Date Trainee Date

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
3. OTHER SAFETY-RELATED SUBJECTS				
3.1. Has periodically participated in building and/or plant evacuation drills. (Required at least annually.)				
3.2. Has had fire-fighting training				
3.3. Has had training in the use of respiratory safety equipment				
3.4. Has had training in first aid and/or CPR				
3.5. Has had periodic safety meetings				
3.6. Has read all scenarios and/or reports on accident-type drills at this facility				
3.7. Has read all reactor-related Unusual Occurrence Reports generated at ORNL				
3.8. Has read the summaries of the Unusual Occurrence Reports generated by other DOE facilities				
3.9. Has read selected and/or significant unusual occurrence reports generated by the NRC				
3.10. Has reviewed all Mechanical and Instrumentation and Controls Design Change Memos applicable to this facility				

Trainer(s) ____________ Date ____________ Trainee ____________ Date

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
3. OTHER SAFETY-RELATED SUBJECTS (cont.)				
3.11. Has been made aware of all significant changes in equipment and/or procedures at this facility				
3.12. Has periodically reviewed the following ORNL safety literature:				
1. Local Emergency Manual				
2. Laboratory Emergency Manual				
3. Safety Manual				
4. Health Physics Procedures Manual				
3.13. Knows the building evacuation procedures				
3.14. Knows the plant-wide evacuation procedures				
3.15. Knows the type and location of emergency equipment at the facility				

Trainer(s) Date Trainee Date

SECTION 3. EMERGENCY PREPAREDNESS CHECKLIST

Trainee: ______________________ Badge No.: ____________

Facility: Critical Experiments Facility (CEF) Buildings: 9213 (Y-12)

Instructions

This checklist, on abnormal/emergency operating instructions (A/EOIs), is intended to ensure, in part, that an individual has received training in emergency procedures, as required by DOE Orders 5480.1A, Chapter VI (Safety of DOE-Owned Reactors) and 5500.3 (Reactor and Nonreactor Nuclear Facility Emergency Planning, Preparedness, and Response Program for DOE Operations).

This checklist is to be used for initial certification and for requalification training. It is required that all emergency procedures be reviewed on an annual basis.

(Recommendation: The shift supervisor should periodically cover with his or her crew a few A/EOIs and postulated emergency scenarios in the generic categories as talk-through exercises, as time allows. Toward the end of a certification period, return all checklists for auditing purposes.)

With the exception of Section 3, all items must be completed prior to the administering of the initial certification examination. Some of the subjects in this section are taught by training personnel in other ORNL organizations at different times throughout the year. These subjects (only) may be signed off after the initial certification examination but shall be acknowledged during requalification periods.

When the Trainer initials an item (and signs the bottom of each page), it should indicate that he/she has not only been assured that the material has been covered with the Trainee, it should also indicate that the Trainee knows the material well enough to be qualified in that subject area.

Upon completion, this checklist should be returned to the Training Manager; he/she shall submit it to the Examiner.

This material has been taught to the trainee. ______________________, ____________

Training Manager — Completion Date

This material has been taught to me by the training personnel. ______________________, ____________

Trainee — Completion Date

SECTION 4. SUPERVISOR'S CHECKLIST

Trainee: ______________________________ Badge No.: ____________

Facility: Critical Experiments Facility (CEF) Buildings: 9213 (Y-12)

Instructions

Some of the material on supervisor training is covered by special courses given by ORNL instructors (other than Reactor Operations personnel) at various times throughout the year. To allow the candidate to take the Senior Reactor Operator examination and assume the duties of a Supervisor prior to attending these courses, the instructor shall cover the fundamentals of the various subjects to ensure that the individual is prepared to assume his/her supervisory responsibilities.

When the Trainer initials an item (and signs the bottom of each page), it should indicate that he/she has not only been assured that the material has been covered with the Trainee, it should also indicate that the Trainee knows the material well enough to be qualified in that subject area.

Upon completion, this checklist should be returned to the Training Manager; he/she shall submit it to the Examiner.

This material has been taught to the trainee. ______________________, ____________

Training Manager   Completion Date

This material has been taught to me by the training personnel. ______________________, ____________

Trainee   Completion Date

SECTION 4. SUPERVISOR'S CHECKLIST

Title	Trainer/ Trainee	Date	Trainer/ Trainee	Date
1. LEADERSHIP				
1.1. Fundamentals				
1.2. Protocol				
1.3. Command responsibilities and limits				
1.4. Interpersonal communication				
1.5. Motivation of personnel and handling complaints				
1.6. Labor relations				
1.7. Problem/decisional analysis				
1.8. Job performance standards				
1.9. Organizing and planning				
2. ADMINISTRATIVE REQUIREMENTS				
2.1. Responsibilities during reactor-type operation				
2.2. Technical Specifications				
2.3. Reporting requirements				
2.4. Special forms to fill out and/or reports to write (RWP, work requests, etc.)				
2.5. Disseminating pertinent information to shift personnel				
2.6. Special projects				

Trainer(s) Date Trainee Date

APPENDIX D. GENERIC DOCUMENTATION

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D.1. TRAINING SCHEDULE FOR REACTOR-OPERATOR TRAINEES

The order of subject presentation and duration of study time indicated may be considered flexible, depending on the background of the trainee; however, significant deviations and/or omissions from the schedule must be approved by the Training Manager.

Subject	Duration
1. Plant Safety	
a. Radiological/industrial safety	1½ days
b. Plant protection and services (security, fire, and medical)	½ day
c. Performance standards/Dos and Don'ts Checklist	½ day
d. ORNL safety manuals	3 days
2. Plant Orientation	
a. General layout and location of equipment	½ day
b. Observation of operating activities	2 days
3. Self-Study of General Information (programmed instruction manuals)	
a. Basic mathematics	½ day
b. Basic physics (heat transfer, fluid flow, thermodynamics) and basic chemistry	1 day
c. Reactor physics	4 days
d. Radiation control and safety	3 days
e. Instrumentation and control	4 days
4. Lectures and/or Videotapes	
This will be scheduled by the Training Manager on the subjects listed in Item 3 and may be followed by a written or an oral quiz to monitor progress.	2 days
5. Self-Study of Descriptive and Procedure Manuals	
a. Reactor vessel and core components	2 days
b. Cooling systems	4 days
c. Control systems	4 days
d. Safety systems	4 days
e. Auxiliary systems	4 days

D.1. TRAINING SCHEDULE FOR REACTOR-OPERATOR TRAINEES
(continued)

Subject	Duration
6. Lectures and/or Videotapes	
This will be scheduled by the Training Manager on the subjects covered in Item 5 and may be followed by a written or an oral quiz to monitor progress.	2 days
7. Self-Study of Descriptive and Procedure Manuals	
a. Electrical systems	2 days
b. Pneumatic systems	2 days
c. Emergency and standby equipment	3 days
8. Lectures and/or Videotape Viewing	
This will be scheduled by the Training Manager on the subjects listed in Item 7 and may be followed by a written or an oral quiz to monitor progress.	2 days
9. Self-Study of Descriptive and Procedure Manuals	
a. Off-gas systems	5 days
b. Liquid-waste systems	4 days
c. On-site utilities	3 days
d. Computer	½ day
10. Lectures and/or Videotapes	
This will be scheduled by the Training Manager on the subjects listed in Item 9 and may be followed by a written or an oral quiz to monitor progress.	2 days
11. Self-Study of Descriptive and Procedure Manuals	
a. Annunciator procedures	2 days
b. Normal operating procedures/checklists	5 days
c. Abnormal/emergency operating procedures	5 days
12. Lectures and/or Videotapes	
This will be scheduled by the Training Manager on the subjects covered in Item 11 and may be followed by a written or an oral quiz to monitor progress.	2 days

D.1. TRAINING SCHEDULE FOR REACTOR-OPERATOR TRAINEES (continued)

	Subject	Duration
13.	Facility's Technical Specifications	2 days
14.	Cover each item on the Training Checklists (one-on-one basis with the Training Manager)	5 days
15.	Practical manipulation of fuel-handling tools, manipulation of reactor-console controls, and/or participation in other work at the facility. (This training must be scheduled during reactor shutdowns and under the direct supervision of the Training Manager.)	5 days
16.	Shift experience	10 days*
17.	Certification Examination by the Examiner	
	a. Written examination	7 hours
	b. Oral examination	5 hours
	c. Operating examination	2 hours

*Training on shift work may coincide with other training topics and/or objectives.

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D.2. REACTOR OPERATIONS SECTION TRAINING PROGRESS REVIEW

________________________ ________________ ____________________________
Name Badge No. Facility

________________________ ____
Date Hired Reviewed by (Training Manager)

Instructions

If the trainee's progress appears to be average or below, identify the problem areas and inform the individual of areas of needed improvement.

1. Academic Progress

   a. Excellent ___ Good ___ Average ___ Poor ___ Unsatisfactory ___

   b. Remarks: ____

2. Operating Skills

   a. Excellent ___ Good ___ Average ___ Poor ___ Unsatisfactory ___

   b. Remarks: ____

3. Attitude

   a. Excellent ___ Good ___ Average ___ Poor ___ Unsatisfactory ___

   b. Remarks: ____

4. Employee advised he/she must do the following or be subject to transfer or termination because of an unsatisfactory probationary period.

   ____

   ____

   ____

D.3. TRAINING SCHEDULE FOR SENIOR REACTOR-OPERATOR CANDIDATES

This schedule is intended for Senior Reactor-Operator candidates having had one year of experience as a Reactor Operator at the facility. It is intended primarily as a review. For candidates not having had the one year of experience, the Reactor-Operator's Training Schedule should be used initially followed by the supervisory training requirements.

Subject	Duration
1. Review of Generic Material	
a. Reactor theory	2 days
b. Radiation control and safety	1 day
c. Heat transfer, fluid flow, and thermodynamics	1 day
2. Review of Plant Specifics (Systems)	
a. Core components	1 day
b. Cooling systems	1 day
c. Safety/control systems	2 days
d. Auxiliary systems	1 day
e. Instrumentation and control	2 days
f. System schematics	2 days
g. Pneumatic systems	1 day
h. Emergency and standby equipment	2 days
i. Electrical systems	1 day
j. Off-gas systems	1 day
k. Liquid-waste systems	1 days
l. On-site utilities	1 day
3. Review of Plant Specifics (Procedures)	
a. Checklists	1 day
b. Normal operating procedures	3 days
c. Abnormal/emergency operating procedures	3 days
4. Supervisory Training	
a. Leadership	½ day
b. Command responsibilities and limits	½ day
c. Interpersonal communications	½ day
d. Motivation of personnel	½ day
e. Performance standards	½ day
f. Organizing and planning	½ day
g. Technical Specifications/reporting requirements	2 days
5. Certification Examination by the Examiner	
a. Written examination	6 hours
b. Oral examination	3 hours

D.4. INTERIM CERTIFICATION FOR REACTOR OPERATOR[a]
(Effective for Duration of Probationary Period)

This is an interim certification and is limited to the duration of the probationary period.[b] The individual's performance shall be re-evaluated at the end of this period and, if satisfactory, the certification shall be extended to the normal two-year period by completing the Initial Certification form.

Name	Badge No.	Reactor Facility

Certification Starting Date	Certification Expiration Date

Reactor Operator Qualification[c]

1. The above-named individual has satisfactorily completed the Reactor Operator training program which includes: (a) having completed the Training Checklists; (b) having made prestartup checks; (c) having brought the reactor critical and to power under the direction of the Training Manager; (d) having made the poststartup checks; (e) having made all routine checks during normal operations; (f) having demonstrated an acceptable level of knowledge of radiation safety and control practices; and (g) having indicated that he/she can execute his/her duties in a safe and reliable manner and in accordance with established performance standards.

Training Manager	Date

2. The above-named individual has satisfactorily completed the written, oral, and operating examinations required for certification.

Examiner for Written	Date	Examiner for Oral/Operating	Date

3. The above-named individual's qualifications have been reviewed and approved by the following people:

Reactor Supervisor	Date	Reactor Operations Section Head	Date

NOTE: This certification becomes valid only after the final review/approval by the Division Director.

Operations Division Director[d]	Date

---

[a]The official title for Reactor Operator in the bargaining group at ORNL is "Nuclear Reactor Controller."

[b]The probationary period for new employees is six months; for transfer from within the Company, it is three months.

[c]The two main documents in which Reactor Operator qualification requirements are stated are: (1) Martin Marietta Energy Systems, Inc. Standard Practice Procedure 18 and 18B (Nuclear Reactor Safety) and (2) DOE Order No. 5480.1A, Chapter VI, (Safety of DOE-Owned Reactors).

[d]Required information from ORNL's Health Division regarding the acceptability of the individual's general health and physical ability to perform in the capacity of a Reactor Operator has been received by the Division Director.

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D.5. INITIAL CERTIFICATION FOR REACTOR OPERATOR[a]
(Effective for a Period of Two Years)

Name	Badge No.	Reactor Facility

Certification Starting Date	Certification Expiration Date

Reactor Operator Qualification[b]

1. The above-named individual has satisfactorily completed the Reactor Operator training program which includes: (a) having completed the Training Checklists; (b) having made prestartup checks; (c) having brought the reactor critical and to power under the direction of the Training Manager; (d) having made the poststartup checks; (e) having made all routine checks during normal operations; (f) having demonstrated an acceptable level of knowledge of radiation safety and control practices; and (g) having indicated that he/she can execute his/her duties in a safe and reliable manner and in accordance with established performance standards.

Training Manager ________ Date ________

2. The above-named individual has satisfactorily completed the written, oral, and operating examinations required for certification.

Examiner for Written ________ Date ________ Examiner for Oral/Operating ________ Date ________

3. The above-named individual's qualifications have been reviewed and approved by the following people:

Reactor Supervisor ________ Date ________ Reactor Operations Section Head ________ Date ________

NOTE: This certification becomes valid only after the final review/approval by the Division Director.

Operations Division Director[c] ________ Date ________

[a]The official title for Reactor Operators in the bargaining group at ORNL is "Nuclear Reactor Controllers."

[b]The two main documents in which Reactor Operator qualification requirements are stated are: (1) Martin Marietta Energy Systems, Inc. Standard Practice Procedure 18 and 18B (Nuclear Reactor Safety) and (2) DOE Order No. 5480.1A, Chapter VI, (Safety of DOE-Owned Reactors).

[c]Required information from ORNL's Health Division regarding the acceptability of the individual's general health and physical ability to perform in the capacity of a Reactor Operator has been received by the Division Director.

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Date ________

D.6. INITIAL CERTIFICATION FOR SENIOR REACTOR OPERATOR
(Effective for a Period of Two Years)

Name	Badge No.	Reactor Facility
Certification Starting Date		Certification Expiration Date

Senior Reactor Operator Qualification[a]

1. The above-named individual has satisfactorily completed the Senior Reactor Operator training program which includes: (a) having completed the Training Checklists; (b) having made prestartup checks; (c) having brought the reactor critical and to power under the direction of the Training Manager; (d) having made the poststartup checks; (e) having made all routine checks during normal operations; (f) having demonstrated an acceptable level of knowledge of radiation safety and control practices; and (g) having indicated that he/she can execute his/her duties in a safe and reliable manner and in accordance with established performance standards.

Training Manager ________ Date ________

2. The above-named individual has satisfactorily completed the written, oral, and operating examinations required for certification.

Examiner for Written ________ Date ________ Examiner for Oral/Operating ________ Date ________

3. The above-named individual's qualifications have been reviewed and approved by the following people:

Reactor Supervisor ________ Date ________ Reactor Operations Section Head ________ Date ________

NOTE: This certification becomes valid only after the final review/approval by the Division Director.

Operations Division Director[b] ________ Date ________

[a]The two main documents in which Reactor Operator qualification requirements are stated are: (1) Martin Marietta Energy Systems, Inc. Standard Practice Procedure 18 and 18B (Nuclear Reactor Safety) and (2) DOE Order No. 5480.1A, Chapter VI, (Safety of DOE-Owned Reactors).

[b]Required information from ORNL's Health Division regarding the acceptability of the individual's general health and physical ability to perform in the capacity of a Reactor Operator has been received by the Division Director.

D.7. SUBJECT AND STUDY-TIME CHECKLIST FOR THE 1986-1987 RECERTIFICATION PERIOD

Name: ______ ______
RO, SRO

Subject for written exam*	RO/ SRO**	Date	Documentation***	Supervisor in charge
1.		Jan. 1986		
2. Radiation Safety and Control	RO	February		
3.		March		
4.		April		
5. Features of Facility Design/ Plant Systems: Design, Control and Instrumentation	RO/ SRO	May		
6.		June		
7.		July		
8. Normal, Abnormal, and Emergency Operating Procedures/ Administrative Procedures, Conditions, and Limitations	RO/ SRO	August		
9.		September		

Name: ____________________

Subject for written exam*	RO/ SRO**	Date	Documentation***	Supervisor in charge
10.		October		
11. Instrumentation and Controls/Procedures; Normal, Abnormal, Emergency, Radiological Control	RO/ SRO	November		
12.		December		
13.		Jan. 1987		
14. Principles of Reactor Operations (Reactor Physics, Heat, Fluids)/Theory of Nuclear Plant Operation (Reactor Physics, Heat, Fluids, Thermodynamics)	RO/ SRO	February		
15.		March		
16.		April		
17. Normal, Abnormal, and Emergency Operating Procedures	RO	May		

 Name: ____________

Subject for written exam*	RO/ SRO**	Date	Documentation***	Supervisor in charge
18.		June		
19.		July		
20.	RO	August		
21.		September		
22. Safety and Emergency Systems	RO	October		
23.		November		
24.		December		

*All written examinations will be closed-book, administered in Building 7910, and proctored by the Examiner or his designated alternate. For the Category-A reactors and the BSR, written examinations should be given during the months indicated. For the Category-B reactors, the all-category or emergency-procedures written examinations should be administered during the latter part of each year, as applicable.

**SROs will take the RO exams also.

***The Supervisor should record dates on which lectures were attended, video tapes viewed, hours spent reading texts, etc.

D.8. RENEWAL OF REACTOR OPERATOR CERTIFICATION[a] (Effective for a Period of Two Years)

Name | Badge No. | Reactor Facility

Start of Certification Renewal Date | Certification Expiration Date

Review of Reactor Operator Qualification[b]

1. The above-named individual has been actively and extensively engaged as a Reactor Operator under his/her existing certification. This individual has performed his/her required duties in a safe, responsible, and reliable manner and is considered capable of continuing to do so.

Training Manager | Date

2. The above-named individual has participated in and successfully completed the Reactor Operator Requalification Training Program during the period that this certification was in effect.

Examiner for Requalification, Written Examinations | Date | Examiner for Requalification, Oral/Operating Examinations | Date

3. The above-named individual's qualifications for renewal of his/her certification as a Reactor Operator have been reviewed and approved by the following people:

Reactor Supervisor | Date | Reactor Operations Section Head | Date

NOTE: This certification becomes valid only after the final review/approval by the Division Director.

Operations Division Director[c] | Date

[a]The official title for Reactor Operator in the bargaining group at ORNL is "Nuclear Reactor Controller."

[b]The two main documents in which Reactor-Operator qualification requirements are stated are: (1) Martin Marietta Energy Systems, Inc. Standard Practice Procedure 18 and 18B (Nuclear Reactor Safety) and (2) DOE Order No. 5480.1A, Chapter VI, (Safety of DOE-Owned Reactors).

[c]Required information from ORNL's Health Division regarding the acceptability of the individual's general health and physical ability to perform in the capacity of a Reactor Operator has been received by the Division Director.

D.9. RENEWAL OF SENIOR REACTOR OPERATOR CERTIFICATION (Effective for a Period of Two Years)

Name	Badge No.	Reactor Facility

Start of Certification Renewal Date — Certification Expiration Date

Review of Senior Reactor Operator Qualifications[a]

1. The above-named individual has been actively and extensively engaged as a Senior Reactor Operator under his/her existing certification. This individual has performed his/her required duties in a safe, responsible, and reliable manner and is considered capable of continuing to do so.

Training Manager — Date

2. The above-named individual has participated in and successfully completed the Senior Reactor Operator Requalification Training Program during the period that this certification was in effect.

Examiner for Requalification, Written Examinations — Date — Examiner for Requalification, Oral/Operating Examinations — Date

3. The above-named individual's qualifications for renewal of his/her certification as a Senior Reactor Operator have been reviewed and approved by the following people:

Reactor Supervisor — Date — Reactor Operations Section Head — Date

NOTE: This certification becomes valid only after the final review/approval by the Division Director.

Operations Division Director[b] — Date

[a]The two main documents in which Reactor-Operator qualification requirements are stated are: (1) Martin Marietta Energy Systems, Inc. Standard Practice Procedure 18 and 18B (Nuclear Reactor Safety) and (2) DOE Order No. 5480.1A, Chapter VI, (Safety of DOE-Owned Reactors).

[b]Required information from ORNL's Health Division regarding the acceptability of the individual's general health and physical ability to perform in the capacity of a Reactor Operator has been received by the Division Director.

D.10. INSTRUCTIONS FOR ORNL EMPLOYEES WORKING AT A REACTOR FACILITY

[This applies to all personnel (i.e., secretaries, technicians, engineers, maintenance personnel, etc.) working at any ORNL reactor complex, as applicable to the particular facility.]

Please follow these simple "DOs" and "DON'TS" when working in any security and/or regulated areas at a reactor complex.

DOs

1. Wear badges in plain view.
2. Hand badges to Guard for check when entering a security area.
3. Wear all required radiation detectors and/or monitors.
4. Call the supervisor in the control room if you work in the reactor building on off shifts (4-12, 12-8, weekends, and/or holidays).
5. Be aware of those operational procedures requiring Health Physics coverage and/or assistance.
6. Be aware of the requirements and/or procedures for Contamination Zones, Radiation Zones, Radiation Work Permits, and Do Not Operate Tags.
7. Be aware of the Health Physics requirements for transferring, shipping, and/or disposing of radioactive materials.
8. Be observant of arrows on the walls or floor indicating building evacuation routes and know the evacuation procedure, assembly areas, and signals (call 4-4462).
9. If any loud, continuous alarm should sound while in a reactor building, evacuate the building to the outside assembly area and/or follow the instructions given over the public-address system.
10. Be aware of the location of certain emergency equipment and/or alarm actuators.

DOs (continued)

11. Inform the supervisor in the control room if you accidentally drop something into a reactor pool or accidentally touch some of the equipment in a contamination zone.
12. Report a spills of contaminated materials to the Reactor Supervisor.

DON'Ts

1. Don't use your badge for building access for anyone but yourself. (Everyone is required to run his/her badge through the reader even if the door is open.)
2. Don't hold automatic security doors open for anyone unless you remain an escort.
3. Don't enter a building if the magenta lights on the building are flashing.
4. Don't go into any roped-off or barricaded areas.
5. Don't enter the reactor control room if not on official business.
6. Don't walk in any water/wet areas.
7. Don't step on any paper, plastic, or any other item on the floor.
8. Don't handle any tools, equipment, casks, etc., that should be used only by the reactor operators.
9. Don't drop anything into the pool or put your hand in the water.

This material has been covered by the Training Coordinator, his designated alternate, or escort.

Training Coordinator, Supervisor, or escort	Date	Person to be working at reactor (print and sign name)	Date
Division, if other than Operations	Badge No.	Division	Badge No.
Reason for Access	Facility	Access Approved by:	Date

Rev. ________
Date ________

D.11. INSTRUCTIONS FOR ORNL EMPLOYEES WORKING AT THE DOSAR FACILITY

[This applies to all personnel (i.e., secretaries, technicians, engineers, maintenance personnel, etc.) working at any ORNL reactor complex, as applicable to the particular facility].

Please follow these simple "DOs" and "DON'TS" when working in any security and/or [illegible] lated areas at a reactor complex.

DOs

1. Wear badges in plain view.
2. Hand badges to Guard for check when entering a security area.
3. Wear all required radiation detectors and/or monitors.
4. Call the Laboratory Shift Supervisor if you work in the area on off shifts (4-12, 12-8, weekends, and/or holidays).
5. Be aware of those operational procedures requiring Health Physics coverage and/or assistance.
6. Be aware of the requirements and/or procedures for Contamination Zones, Radiation Zones, Radiation Work Permits, and Do Not Operate Tags.
7. Be aware of the Health Physics requirements for transferring, shipping, and/or disposing of radioactive materials.
8. Be observant of arrows on the walls or floor indicating building evacuation routes and know the evacuation procedure, assembly areas, and signals (call 4-4462).
9. If any loud, continuous alarm should sound while in a reactor building, go through the turnstile and proceed to the control building.
10. Be aware of the location of certain emergency equipment and/or alarm actuators.

DOs (continued)

11. Inform the supervisor in the control room if you accidentally touch some of the equipment in a contamination zone.
12. Report all spills of contaminated materials to the Reactor Supervisor.

DON'Ts

1. Don't use your badge for building access for anyone but yourself. (Everyone is required to run his/her badge through the reader even if the door is open or in use.)
2. Don't hold automatic security doors open for anyone unless you remain an escort.
3. Don't enter the reactor building if the magenta lights on the building are flashing.
4. Don't go into any roped-off or barricaded areas.
5. Don't enter the control room if not on official business.
6. Don't walk in any water/wet areas.
7. Don't step on any paper, plastic, or any other item on the floor.
8. Don't handle any tools, equipment, casks, etc., that should be used only by the reactor operators.

This material has been covered by the Training Coordinator, his designated alternate, or escort.

Training Coordinator, Supervisor, or escort	Date	Person to be working at reactor (print and sign name)	Date
Division, if other than Operations	Badge No.	Division	Badge No.
Reason for Access	Facility	Access Approved by	Date

D.12. INSTRUCTIONS FOR VISITORS TO ORNL REACTORS

Please follow these simple "DOs" and "DON'Ts" when entering security and/or regulated areas, as applicable to the particular facility.

1. Wear badges in plain view.
2. Hand badges to Guard for check when entering a security area.
3. Stay with your group.
4. Follow all instructions of your tour guide or escort.
5. Be observant of arrows on the walls or floor indicating building evacuation routes to ouside assembly areas.
6. Be aware that nuclear facilities are required to have periodic evacuation drills. If any loud, continuous alarm should sound while in the reactor building, stay with your tour guide who will direct your evacuation from the building to the outside assembly area and/or follow the instructions given over the public-address system.
7. Inform your tour guide if you accidentally drop something into a reactor pool or accidentally touch some of the equipment.
8. Return your visitor's badge when leaving the plant.

DON'Ts

1. Don't hold automatic security doors open for anyone not in your group.
2. Don't stray from your tour group.
3. Don't enter a building if the magenta lights on the building are flashing.
4. Don't enter any area not designated for visitors by your escort.
5. Don't go into any roped-off or barricaded areas.
6. Don't enter the reactor control room.
7. Don't walk in any water or wet areas.
8. Don't step on any paper, plastic, or any other item on the floor.
9. Don't handle any tools, equipment, casks, or refuse containers (yellow cans, dumpster, etc.) that might be close by.
10. Don't drop anything into the pool or put your hand in the water.

This material has been covered, as applicable to the group, by the tour guide or escort for today's (or week's) group of visitors.

______________________ Tour Guide ______ Date

D.13. ORAL/OPERATING EXAMINATION EVALUATION FORM

________________________________ Name ________________ Badge No. ________________ Reactor Facility

________________________________ Examiner ________ Date

Instructions

The Examiner shall spend three to five hours administering the oral/operating examination. The rating scheme is based on the Examiner's judgment as to whether the examinee:

1. has no knowledge of the subject,

2. has a superficial knowledge of the subject and is not recommended to perform solo operation in subject area,

3. has a satisfactory knowledge of the subject and is considered capable of solo operation, and

4. has a knowledge of the subject that would allow solo operation and allow the individual to help teach the subject.

For the initial certification, all listed areas must be covered; for requalification, it will suffice to cover only selected areas.

A passing grade shall be 80%; this shall be determined by adding the sum of all the "1s," "2s," "3s," and "4s" and dividing by four times the total number of subject areas covered. If an individual passes the examination, he/she shall be required to submit, in writing, the answers to allmissed questions prior to being recommended for certification.

Rev. ________
Date ________

Subject	Rating (circle one)			
1. Control Room Area				
a. Nuclear Instrumentation				
(1) Safety system	1	2	3	4
(2) Control system	1	2	3	4
(3) Chambers (operation, location)	1	2	3	4
(4) Block diagram of control system	1	2	3	4
(5) Miscellaneous ____________________	1	2	3	4
b. Process Instrumentation				
(1) Location of detectors	1	2	3	4
(2) Control actions	1	2	3	4
(3) Related procedures	1	2	3	4
c. Liquid Waste Systems				
(1) Location of detectors	1	2	3	4
(2) Control actions	1	2	3	4
(3) Related procedures	1	2	3	4
d. Gaseous Waste Systems				
(1) Location of detectors	1	2	3	4
(2) Control actions	1	2	3	4
(3) Related procedures	1	2	3	4
e. Electrical Systems				
(1) Control actions	1	2	3	4
(2) Related procedures	1	2	3	4
f. Emergency Systems				
(1) Core cooling	1	2	3	4
(2) Reactor shutdown/poison injection	1	2	3	4
(3) Related procedures	1	2	3	4
g. Operating Procedures				
(1) Console	1	2	3	4
(2) Normal	1	2	3	4
(3) Abnormal	1	2	3	4
(4) Emergency	1	2	3	4
(5) Knowledge of duties	1	2	3	4
(6) Shift changeover, logs	1	2	3	4

Rev. ________
Date ________

Subject	Rating (circle one)			
2. Plant Tour				
a. Reactor Area				
(1) Reactor fuel	1	2	3	4
(2) Safety systems, equipment	1	2	3	4
(3) Beam tubes, experiment facilities	1	2	3	4
(4) Refueling tools: design, use	1	2	3	4
(5) Storage areas	1	2	3	4
(6) Related procedures	1	2	3	4
b. Control Element Drives				
(1) Components	1	2	3	4
(2) Related procedures	1	2	3	4
c. Cooling Systems (Primary, Secondary)				
(1) Location of sensing elements	1	2	3	4
(2) Heat exchangers (fill, drain, switch)	1	2	3	4
(3) Pumps	1	2	3	4
(4) Filters/demineralizers	1	2	3	4
(5) Acid-addition systems	1	2	3	4
(6) Control: temperature, pressure, chemical additions	1	2	3	4
(7) Lines to/from major components (head tank, surge tank)	1	2	3	4
(8) Related procedures	1	2	3	4
d. Auxiliary Systems (in Field)				
(1) Off-gas filters	1	2	3	4
(2) Liquid-waste systems	1	2	3	4
(3) Other: ____________	1	2	3	4
(4) Related procedures	1	2	3	4
3. Discussion				
a. Radiation Protection				
(1) Application and demonstration of radiation detectors	1	2	3	4
(2) RWPs, Work Permits	1	2	3	4
(3) Radiation zones/contamination zones	1	2	3	4
(4) Related procedures	1	2	3	4
b. Reactor Theory	1	2	3	4
c. Heat Transfer, Fluid Flow	1	2	3	4
d. Annunicator Procedures	1	2	3	4

Rev. ________
Date ________

Subject	Rating (circle one)			
4. Operating Test				
a. Startup and shutdown checklists	1	2	3	4
b. Type of manipulation: ________________________	1	2	3	4
c. Understanding of reactivity effects	1	2	3	4
d. Predictions of instrument response	1	2	3	4
e. Operating technique	1	2	3	4
5. Technical Specifications				
a. Understanding of significance	1	2	3	4
b. LSSS/LCOs/abnormal occurrences	1	2	3	4
c. Related procedures	1	2	3	4
6. Evaluation of Supervisory Candidates				
a. Better understanding of most systems than RO . .	1	2	3	4
b. Leadership	1	2	3	4
c. Interpersonal communication, protocol	1	2	3	4
d. Problem/decisional analysis	1	2	3	4
e. Administrative requirements	1	2	3	4

Rev. ________
Date ________

D.14. INITIAL CERTIFICATION EXAMINATION FOR REACTOR OPERATOR

Facility: ______________________ Examiner: ______________

Reactor Type: Research Applicant: ______________

Date Administered: ______________

INSTRUCTIONS TO APPLICANT:

1. Fill out the information required at the top of this page.
2. Use separate paper for answers unless otherwise noted.
3. Be sure to identify the specific questions you have answered (e.g., A.1, C.2, etc.).
4. Do not use red pencil or write on the backside of the page.
5. Write page numbers on the upper right hand corner of your answer sheet.
6. Upon completion, staple the answer sheets under the exam sheets.
7. Sign, date, and write "Last Page" on the last answer sheet.

NOTE: The point value for each question is indicated in parentheses after each question. The criteria for a passing grade in the written exam are 70% in each category and 80% overall.

Category Value	% of Total	Applicant's Score	% of Cat. Value	Category
				A. Principles of Reactor Operation
				B. Features of Facility Design
				C. Instrumentation and Controls
				D. Safety and Emergency Systems
				E. Normal, Abnormal, and Emergency Procedures
				F. Radiation Control and Safety
				G. Fundamentals of Thermodynamics, Heat Transfer, and Fluid Flow
100				Totals Final Grade ____ %

Reviewed and approved by: ______________________ Date: ________
Reactor Operations Section Head

The graded test has been reviewed by: ______________ Date: ________
Applicant

Rev. ________
Date ________

D.15. INITIAL CERTIFICATION EXAMINATION FOR SENIOR REACTOR OPERATOR

Facility: ______________________ Examiner: W. H. Culbert

Reactor Type: Research Applicant: ______________

Date Administered: ______________

INSTRUCTIONS TO APPLICANT:

1. Fill out the information required at the top of this page.
2. Use separate paper for answers unless otherwise noted.
3. Be sure to identify the specific questions you have answered (e.g., A.1, C.2, etc.).
4. Do not use red pencil or write on the backside of the page.
5. Write page numbers on the upper right hand corner of your answer sheet.
6. Upon completion, staple the answer sheets under the exam sheets.
7. Sign, date, and write "Last Page" on the last answer sheet.

NOTE: The point value for each question is indicated in parentheses after each question. The criteria for a passing grade in the written exam are 70% in each category and 80% overall.

Category Value	% of Total	Applicant's Score	% of Cat. Value	Category
				A. Theory of Nuclear Plant Operation
				B. Theory of Fluids & Thermodynamics
				C. Plant Systems: Design, Control and Instrumentation
				D. Procedures: Normal, Abnormal, Emergency, & Radiological Control
				E. Administrative Procedures, Conditions, and Limitations
100				Totals Final Grade ______ %

Reviewed and approved by: ______________________ Date: ________
Reactor Operations Section Head

The graded test has been reviewed by: ______________________ Date: ________
Applicant

Rev. ________
Date ________

D.16. SUMMARY OF REQUALIFICATION EXAMINATION GRADES

Reactor: (Category-A Reactors) Period: 1986-1987

Name	1986 Dates of Scheduled Requalification Exam and Grades				1987 Dates of Scheduled Requalification Exam and Grades			
	Feb.	May	Aug.	Nov.	Feb.	May	Aug.	Nov.
Supervising Senior Reactor Operators								
1.								
2.								
3.								
4.								
5.								
6.								
7.								
8.								
9.								
Reactor Operators								
1.								
2.								
3.								
4.								
5.								
6.								
7.								
8.								
9.								

Rev. ______
Date ______

D.16. SUMMARY OF REQUALIFICATION EXAMINATION GRADES
(continued)

Reactor: (Category-B Reactors) Period: 1986-1987

Name	Categories/Grades							
Senior Reactor Operators								
1.								
2.								
3.								
Reactor Operators								
1.								
2.								
3.								

Rev. ________
Date ________

D.17. RECORD OF REACTOR STARTUPS AND OTHER WORK

Reactor: ____________________ Period: 1986-1987

Name	Work in Which Individual Participated							
	Date	Item No.	Date	Item No.	Date	Item No.	Date	Item No.
Supervising Senior Reactor Operators								
1.								
2.								
3.								
4.								
5.								
6.								
7.								
8.								
9.								
Reactor Operators								
1.								
2.								
3.								
4.								
5.								
6.								
7.								
8.								
9.								

Instructions:

The shift supervisor should record the date and one or more of the following numbers, as applicable.

1. Participated in reactor startup (if the console operator, circle the "1").
2. Participated in control-rod scrams and insertion-time tests.
3. Participated in refueling of reactor.
4. Participated in reactor shutdown work (other than refueling).
5. Participated in reactor power change of greater than ten percent.
6. Participated in rod calibration or shutdown margin test.
7. Participated in rod-drop or scram-recovery training.

Rev. ________
Date ________

D.18. TRAINING PROGRAM APPROVAL/REVIEW CHECKLIST

1. This training program document for ORNL's reactor operating personnel has been reviewed and approved initially by the following people.

R V McCord	10/25/85	[signature]	10/25/85
Reactor Operations Section Head	Date	Operations Division Director	Date
D. A. Berry	10/25/85		
Office of Operational Safety	Date		

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2. On an annual basis thereafter, this document shall be reviewed by the Training Coordinator and approved by the Reactor Operations Section Head.

a. ________ Training Coordinator ________ Date ________ Reactor Operations Section Head ________ Date

b. ________ Training Coordinator ________ Date ________ Reactor Operations Section Head ________ Date

c. ________ Training Coordinator ________ Date ________ Reactor Operations Section Head ________ Date

d. ________ Training Coordinator ________ Date ________ Reactor Operations Section Head ________ Date

e. ________ Training Coordinator ________ Date ________ Reactor Operations Section Head ________ Date

f. ________ Training Coordinator ________ Date ________ Reactor Operations Section Head ________ Date

g. ________ Training Coordinator ________ Date ________ Reactor Operations Section Head ________ Date

D.19 LIST OF REVISIONS

Rev. No.	Page No.	Rev. Date	Approved By	Date
1.	____	____	____________	____
2.	____	____	____________	____
3.	____	____	____________	____
4.	____	____	____________	____
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