"COLD" LICENSE TRAINING PROGRAM

PURPOSE

This program is intended to prepare a power plant operator to become a licensed reactor operator or senior reactor operator under the provision of Section 55.25(b) of 10 CFR, Part 55.

APPLICABILITY

The cold license training program is required for all candidates for reactor operator or senior reactor operator license for each new nuclear power plant. Depending upon the qualifications of individual candidates who have had previous nuclear power plant operating experience, portions of this program may be waived by the USAEC on a case by case bases for specific individuals.

PROGRAM

The "cold" license training program consists of five (5) phases, and they are normally completed in order. The specific phases are:

Phase I	Basic Nuclear Theory
Phase II	Nuclear Power Plant Operation Observation
Phase III	PWR Technology
Phase IV	Nuclear Power Plant Simulator Operation Experience
Phase V	On The Job Experience

Phase I

A course of classroom study comprised of basic physics, mathematics, heat transfer, fluid flow, and plant operations.

Phase II & IV

Operational experience gained in actually being involved with operation of a power plant and operating a nuclear power plant simulator. For those trainees who do not gain sufficient actual reactor operating experience during the Phase II portion of the program, an operational period on the B&W Training Reactor will be required in order to be eligible for examination as a "cold" license candidate.

Phase III

The presentation of the design details of how the specific nuclear steam supply is constructed and how operating systems accomplish their functions.

Phase V

On the job experience, gained while operating their own plant during the test programs and writing operating and test procedures.

The specific details of each of these programs are contained in the following sections.

PHASE I - NUCLEAR THEOR.

(Program 0 -)

COURSE DURATION - 13 weeks, 30 hours/week classroom time.

TRAINING LOCATION - Customer's discretion.

PURPOSE - To provide the prospective nuclear power plant operators with a basic foundation in nuclear engineering, reactor theory, and nuclear physics so that he can successfully pursue later phases of instruction covering operations, construction, technical specifications and operating and casualty procedures of a nuclear power plant.

APPLICABILITY - High school graduates, with demonstrated aptitude in mathematics, chemistry and physics.

COURSE CONTENT - Covers basic subjects in areas of mathematics, atomic physics, reactor physics, heat transfer, introductory nuclear instrumentation, shielding and health physics, as outlined below:

Subject Matter	Estimated Time, Hr.
Arithmetic Computations, exponentials, roots, logarithms, math tables, slide rule usage, curve plotting.	1.
Algebra Notation, addition and subtraction, factoring, fractions, squares, cubes, solution of equations, simultaneous equations.	30
Trigonometry Definitions of functions, angles, plane triangles, trigonometric tables.	15
Introduction to Calculus Derivatives and differentials, integration, series, tables of derivatives and integrals, approximate methods of integration, ordinary differential equations, graphical representation of variables.	10
Atomic Physics Atomic nature of matter, nuclear characteristics of the elements, fundamental particles and rays, radioactivity and decay, induced nuclear reactions.	60
Reactor Physics Terminology, fission process and chain reactions, properties of neutrons, multiplication factors, criticality, flux and power, reactor operation and control, reactivity, reactivity coefficients, safety.	90

Subject Matter	Estimated Time, Hr.
Heat Transfer and Fluid Flow	
Thermal properties of bodies, gases, vapors, transmission of heat by conduction and convection, viscosity, pressure, liquids in motion, steam and compressed liquid tables, expansion of gases and vapors, application to reactor design.	75
Introduction to Nuclear Instrumentation	
Radiation detectors, principles of operation, radiation detector types, pulse-type neutron detectors, integrating detectors, detector design factors, ion current measurement, scales and counters, typical systems.	30
Shielding	
Functional requirements, sources of radiation, materials and shielding types of various radiations, shielding geometry, principles of shield design.	30
Health Physics and Radiation Safety	
Health physics practices, biological effects of radiation, radiation units and dosages, exposure levels, review of federal regulations.	30

PHASE II - PRACTICAL OPERATING EXPERIENCE

(Program 0 -)

COURSE DURATION - Trainees/Class - 8 Weeks/40 Hour per Week

APPLICABILITY - Personnel without previous nuclear control room experience

PROGRAM - Preplanned program of system tracing and evolution observation of the operation of a commercial nuclear power plant under supervision of full time B&W coordinator.

TRAINING LOCATION - At an operating PWR utility power plant, preferably with B&W supplied NSS.

DESCRIPTION

This program is a familiarization phase designed to satisfy U.S. Atomic Energy Commission requirements concerning practical experience and to provide the trainee with an insight into actual operations and procedures in an operating utility type nuclear power plant.

The full time B&W coordinator will schedule classes, designate instructors, validate and sign off preplanned program check-lists, generate necessary documentation and generally ensure that the trainees become familiar with operations within and outside of the control room.

It has been the policy of the USAEC to give credit for previous nuclear experience. If in their opinion the trainee's background meets the intent of this program, the requirement to complete this phase may be waived by the USAEC.

The choice of plant is at the customers discretion; however, we will assist the customer in making the necessary arrangements if desired.

PHASE III - PWR TECHNOLOGY

(Program 0 -)

COURSE DURATION - 6 weeks, 30 hours/week classroom time, 28 men/class.

TRAINING LOCATION - Nuclear Training Center

DESCRIPTION - This phase of operator training is designed to provide an in-depth series of lectures covering design and operation of the particular B&W plant the trainees will operate. This program is normally presented at the Nuclear Training Center in Lynchburg, Virginia.

A Training Supervisor is assigned to your group of operators when they arrive at the training center in Lynchburg for the beginning of Phase III. The supervisor's duties include preparation of course material, arrangements for instructors and classes, setting up special tutoring sessions, and generally assisting the trainees, singly and as a group.

The heavy investment in and concentration of unique facilities and staff, such as the PWR simulator, Lynchburg Pool Reactor, modern classrooms, and instructors with design and service experience, make the training center at Lynchburg, Virginia, an ideal location for this phase of their training. However, we can negotiate to provide this program at any location desired by the customer.

The trainees will apply their experience as power station operators and begin to use the knowledge gained in earlier phases of the training program. They learn how reactor physics, heat transfer, and fluid flow principles are factored into the design of the nuclear plant. They are given an insight into the safety requirements for and descriptions of potential plant accidents and hazards. After studying applicable codes and regulations, they will better understand the need for the administrative and design limitations on the operation of the plant. Generally, they learn the similarities and differences in nuclear and fossil-fired power stations.

Operating personnel are instructed in the detailed design and characteristics of the major components of the nuclear steam supply system. All facets of the instrumentation and control systems are studied to ensure complete knowledge of the various

features of these systems. Instruction is provided in water chemistry, radiochemistry, and health physics, as applied to the operation and maintenance of a nuclear plant. The refueling procedure and the operator's role in this operation are discussed. Fundamentals of operating the plant are taught, and operators are informed of the normal and emergency operating characteristics, response, and capabilities and limitations of the nuclear system. Finally, the precritical and postcritical test programs are studied in detail.

Subject Matter	Estimated Time, Hr.
Reactor Physics	
Review of reactor physics as applied to the specific plant design.	15
Heat Transfer and Fluid Flow	
Review of the nuclear plant design, design objectives, reactor design considerations and limitations.	15
Reactor Vessel and Internals	
1. Reactor vessel design, materials, fabrication, inspection, NDTT.	
2. Reactor internals description, design, materials, purposes.	
3. Design and fabrication of fuel elements and control rods.	7 - 1/2
Primary Loop Components	
1. Simplified two-loop heat transport system.	
2. Description of piping, pumps, and pressurizer.	
3. Design considerations, analysis performed, materials.	15
Once-Through Steam Generators	
Description, peculiarities, heat transfer characteristics, mechanical design considerations, materials, chemistry necessities, maintenance.	15
Reactor Auxiliary Systems	
1. Functional requirements (normal and emergency).	
2. Design objectives and criteria.	
3. Design approach and analysis.	

Subject Matter	Estimated Time, Hr.
4. System-by-system description, equipment description, arrangement, parameters.	
5. Equipment access and maintenance	30
Control Rod Drives	
1. Description of drives.	
2. Description of controls.	7 - 1/2
Instrumentation and Control	
1. Functional requirements and description.	
2. Integrated plant control system.	
3. Nuclear instrumentation and reactor protection system.	
4. Primary loop non-nuclear instrumentation.	
5. Reactor auxiliaries non-nuclear instrumentation.	
6. Incore monitoring system description and function.	
7. Automatic data logging and on-line computer requirements.	30
Normal and Emergency Power Requirements	
1. Description of functional needs.	
2. Procedures.	7 - 1/2
Chemistry	
1. Water chemistry application to the nuclear plant.	
2. Radiochemistry measurements.	
3. Sampling and chemical analysis.	7 - 1/2
Health Physics	
1. Radiation monitoring systems.	
2. Decontamination methods and precautions.	
3. Administrative procedures and controls.	7 - 1/2
Safety Analysis	
1. Potential plant accidents and hazards.	
2. General public protection and acceptance.	
3. Administrative safeguards.	
4. Accident analysis (MHA, MCA, reactivity accidents, equipment failures such as loss of coolant flow).	15
Examination and Review	7 - 1/2
Total	180

PHASE IV - PWR OPERATION

(Program 0 -)

GENERAL DESCRIPTION:

This phase is an operational period in which classroom lectures and the B&W PWR simulator are used to provide a coordinated training effort in nuclear power station operation. This program when combined with Phase II training provides operational experience required to meet the requirements expressed in USAEC Regulations Title 10, Part 55, Paragraph 55.25b. This period of training is directed toward the understanding and actual completion of operational procedures as they would be accomplished at a nuclear power station. The training consists of five weeks of instruction, split between classroom and operation of the PWR simulator and two weeks of shift operation, followed by an AEC type written and operational examination.

This program will thoroughly indoctrinate each man in the duties of his watch station. After first learning the details of plant design and construction and the theory of operation in Phases I - III, the trainee is now schooled in the practical conduct of plant operations. During the two week period of shift operations, the actual shift crews will operate the PWR simulator control room as if it were a unit in commercial operation. They will complete all shift functions and make all decisions on plant operation, as they will be required to do in the actual plant. Operational responsibility will be greater than that experienced at any power reactor.

Training in malfunction and emergency procedures is possible on the PWR simulator to an extent impractical on an operating reactor. The instructor will carefully probe the level of knowledge of each operator by interjecting various system and component failures into plant operation. Major malfunctions that cannot be conducted on an operating reactor will be possible on the PWR simulator in complete detail. Completion of this training program permits the operator to observe the responses of a PWR nuclear steam supply system to both normal and abnormal conditions. This program demands response of an operational nature from each operator, for it is the operator who must make the necessary decisions and initiate the required actions under actual plant conditions.

DETAIL COURSE DESCRIPTION

Course Duration: 8 Weeks

Class Size: 6 Men Per Class

Training Location: Nuclear Training Center

Simulator Operation: 100 Hours (Minimum)

During this portion of the program, the trainees will be broken into groups of three for duty in the control room where each trainee will operate the simulator at each of the three operating positions. Approximately one third of the time will be spent as Shift Supervisor, Control Operator and Assistant Control Operator.

During the first five weeks the emphasis will be on operational orientation where the trainee will concentrate on learning the basic operations of the plant including casualty procedures.

The second part will consist of two weeks of shift operation where the trainees will operate the plant with minimal instructor assistance. They will perform assigned evolutions and handle imposed casualties to develop confidence in their ability to handle a plant under all conditions. During this phase, day to day progress of each trainee will be documented and evaluated with group and individual guidance provided by the training staff.

CLASSROOM INSTRUCTION - 170 Hours

An essential supplement to simulator operation is the related classroom instruction provided in this phase. Lectures will be given to review plant systems from an operational and functional view point rather than plant design. Areas covered will include:

Fluid Systems

Control Rod Drives

Nuclear Physics Review

Plant Instrumentation and Controls

Reactor Protective System

Reactivity Balance

Soluable Poison Calculations

Plant Operating procedures will be presented in a planned sequence along with actual operations on the simulator. The following operations will be presented:

Start Up

Reactivity Control

Power Operations

Transient Control

Loss Of Load

Reactor Trip

Casualty Procedures

As with simulator operations, progress and study in this portion of the program will be documented and appropriate assistance and counseling will be provided to the trainees.

SIMULATED AEC TYPE EXAMINATION AND REVIEW - 40 Hours

This portion of the program will consist of a complete examination by an experienced audit team of B&W staff members who have not been previously involved with training of the group. These examinations will closely simulate USAEC operator

examinations and the results of these examinations will constitute an audit of individual and group competence.

This audit will be reviewed with plant management to appraise them of strengths and weaknesses in their operating staff.

TOTAL COURSE:

Lectures, Observation, Study and Counseling	170 Hours
Simulator Operation	100 Hours
Examination, Reviews and Examination Preparation	40 Hours
Total	310 Hours

PHASE IVA - PWR OPERATION

(B&W NUCLEAR TRAINING REACTOR OPERATION)

(Program O - Optional)

COURSE DURATION - 2 Weeks

CLASS SIZE - 6 Men Per Class

TRAINING LOCATION - B&W Nuclear Training Reactor - Lynchburg Research Center

PURPOSE

This program is intended to supplement the eight week Phase IV - Simulator Program O - for those trainees without prior nuclear experience, and who have not had actual start up experience on a real reactor.

Trainees will operate the B&W Nuclear Training Reactor in at least three different core configurations, and will get a minimum of ten start ups each. Areas covered will include:

Control Rod Calibration

Increase Multiplication With Rods

Increase Multiplication With Fuel

Power Distribution Measurements

Detection Systems

Basic Health Physics

Reactivity Effects

It is recommended that this program be included in the simulator training program as it will serve as an excellent review of reactor theory in a laboratory environment. Experienced operators will find the course stimulating and very worthwhile. If the course is selected it will be integrated into the customers Phase IV simulator program, making the entire program ten (10) weeks in duration.

PHASE V - ON-THE-JOB TRAINING

(Program 0 -)

COURSE - Approximately ten months

TRAINING LOCATION - Job Site

DESCRIPTION

A resident on-site B&W Training Coordinator knowledgeable in design and operation of the nuclear plant will assist the plant superintendent in establishing an effective program during this final phase of operating staff training.

The B&W Training Coordinator will tailor our complete preplanned package to suit the requirements of your particular plant. His responsibilities will include:

1. Scheduling
2. Training Records
3. Evaluations
4. Assistance in development of lesson plans
5. Assistance in locating outside resources when required
6. Evaluation of instructor presentations
7. Reports
8. Reviews and preparation for USAEC "cold" license examinations
9. Development of a plant training program

During this phase of the program as fuel loading is approached a "mock" AEC written examination and walk-through oral examination for each license applicant by a team of B&W examiners will be conducted. The results of this examination will be used to advise the trainees and their management of possible areas of weakness that should be corrected before taking the USAEC "cold" license examinations.