TOPICAL REPORT T1-80

SACRAMENTO MUNICIPAL UTILITY DISTRICT

RANCHO SECO

NUCLEAR GENERATING STATION

OPERATOR TRAINING PROGRAM

FOR

NRC HOT LICENSE CANDIDATES

8008050423

The Hot License Training Program is divided into several phases. Each phase may contain one or more subphases to maximize utilization of facility operations and simulator time.

The following description briefly describes the training that will be accomplished during each phase.

I. ACADEMIC PHASE

The academic phases of the Rancho Seco Hot License Training Program consist of formal classroom presentation in mathematics, physics and related technologies. Evaluation of students is performed by direct instructor observation, daily quizzes and periodic examinations. Detailed reports are submitted to Rancho Seco management at the conclusion of each course. These reports include quiz and examination grades for student and constructive evaluations for the class and each student.

Mathematics Course — 160 Hours

This phase consists of four (4) weeks of classroom instruction in mathematics. The instruction encompasses mathematics ranging from basic numbers up to calculus. Additionally, instruction in calculator usage is included. Appendix "A" provides a basic outline of subject material.

Physics and Related Technologies — 320 Hours

This phase consists of an eight (8) week classroom period. This instruction will cover the areas of classical, atomic, nuclear and reactor physics; reactor operations and heat transfer and fluid flow. At the completion of this phase, each student should possess a sound knowledge level pertaining to the theoretical operation of the Rancho Seco reactor. Appendix "B" provides a basic outline of subject material.

Systems and Procedures — 320 Hours

This phase consists of an eight (8) week classroom period during which the major plant systems and evolutions will be taught. Classroom lessons will be supplemented with plant tours of applicable areas, equipment and controls. Appendix "C" provides an outline of subject material taught during this phase.

Chemistry, Radiological Controls and Fuel Handling — 120 Hours

This phase consists of a three (3) week period in which plant chemistry, radiological controls and fuel handling is taught. Appendix "D" outlines the material to be taught for the chemistry and radiological control subjects. The fuel handling course consists of instruction pertaining to fuel handling equipment and procedures.

II. IN PLANT TRAINING PHASE

The in-plant phases of the Rancho Seco Hot License Training Program utilize supervised hands-on-training and self study techniques to allow the students to gain an in-depth knowledge of plant systems, the procedures associated with these systems and to apply the theoretical concepts presented during the academic phases to actual plant operations. Evaluations of students are performed by means of oral examination and periodic written quizzes and examinations.

Systems, Procedures and Operations Training — 10 Weeks

The systems and operations training phase of the Hot License Training Program is designed to familiarize the hot license applicants with major plant systems and to provide the applicants the opportunity to participate in control room operations and other important plant evolutions. The emphasis during this phase is on obtaining system checkouts and studying for procedures. Priority during this phase of training is placed on control room operations. If no gainful evolutions are in progress, or if the applicant has obtained adequate experience in the current trend of operations, his efforts are then directed to systems training. Each student is issued a "Systems Training Workbook" which contains self-check checklists for the major plant systems. Study references instructions are also included. The student completes the checklists by studying the required information and initialing the appropriate checklist topic. When all topics on a particular checklist have been initialed, an oral examination is conducted by the Training Coordinator or Senior Licensed Operator. Upon satisfactory completion of the oral examination, the examiner signs the appropriate checklist. Satisfactory completion of all checklists is required of each student. The completed workbooks are maintained in each student's training records.

The following systems are included in the Systems Training Workbook:

Reactor Vessel and Internals
Reactor Coolant System
Safety Features
Auxiliary and Emergency Systems
Steam and Power Conversion System
Radioactive Waste Disposal System
Instrumentation and Control System
Electrical System
Radiation Monitoring System

Procedures and Operations Training

The procedures and operations training phase of the Hot License Training Program is designed to familiarize the hot license applicants with plant procedures and to allow the applicants to gain additional control room operating experience. The applicants are divided into operating shifts to maximize the control room availability for each applicant.

Approximately one-half of the shift period is used by each student to complete daily reading and study assignments and to complete a written quiz if assigned. The remaining shift time is devoted to control room operations.

Reading Assignments

Reading assignments are to be done during that phase of the training program in conjunction with systems, procedures and operations training. Reading and study assignments shall include the following:

Overall Plant Operating Procedures
System Operating Procedures
Fuel Handling Procedures
Casualty Procedures
Emergency Procedures
Radiation Control and Safety Precautions
  Rancho Seco Radiation Control Manual
  Rancho Seco Emergency Plan
Selected Administrative Procedures
Technical Specifications

Fuel Handling Training — 40 Hours

The fuel handling training phase of the Hot License Training Program is designed to familiarize the hot license applicants with the fuel handling equipment and to relate the fuel handling procedures to the equipment. Fuel handling training includes formal classroom presentations by experienced fuel handlers and, if practicable, actual demonstrations and hands-on manipulations by the students.

Scheduling the fuel handling training is maintained flexible in order to provide actual hands-on training by the applicants if possible. If no fuel handling evolutions occur during the conduct of the Hot License Training Program, supervised simulated operations of the fuel handling equipment are conducted.

On-Shift Operations Training — 12 Weeks

The on-shift operations training phase is designed to provide additional hands-on control room operations training. The license candidate will stand control room watches as a trainee so each candidate will become familiar with normal control room evolutions such as shift reliefs, log taking responsibilities equipment clearances, surveillance testing and other routine operations.

The Systems and Operations, Procedures and Operations and On-Shift Operations training will be divided into different phases to maximize utilization of plant operations, simulator and refueling time intervals. Each candidate will have, as a minimum, three (3) months training on shift as an extra person in the control room. Time devoted to systems and procedure training is in addition to time spent as extra person in the control room training.

III. SIMULATOR TRAINING PHASE

The simulator training phases of the Hot License Training Program are designed to provide each hot license applicant the opportunity to participate in control room operations which are not routinely performed at Rancho Seco. Such operations include equipment malfunctions, numerous startups and shutdowns and transient operations. An operating examination for startup certification is also administered to each applicant. The Simulator Training Program is divided into two (2) different phases.

Phase I is conducted about midway of the training program and consists of:

Pre-Simulator Review Course — 80 Hours

A forty (40) hour review course is conducted immediately prior to simulator training to aid the hot license applicants in obtaining maximum benefit from the simulator operations. The review course is conducted in a formal classroom atmosphere and will cover major systems and procedures. The following topics included in this review course are:

Reactor Theory
Nuclear Instrumentation
Major Non-Nuclear Instrumentation Systems
Integrated Control Systems
Control Rod Drive Systems
Start-up Procedures

Simulator Operations — 4 Weeks

Simulator operations are conducted at a simulator facility which closely parallels Rancho Seco with respect to operating characteristics and control room layout. The first two (2) week simulator course consists of approximately forty (40) hours of classroom presentations and forty (40) hours of simulator operations and an NRC-type operational examination. Reactor Startup Certification is obtained by each student who satisfactorily completes the operational examination. The following is the typical course content for simulator operations.

Introduction, Refamiliarization with Control Room
Control Rod Drive Operations
Reactor Startups
Power Operations to 100% Power
Plant Operations with Announced Malfunctions (including feedwater pump trips, reactor coolant pump trips, control rod drive malfunctions, load rejections and instrument malfunctions)
Reactor and Plant Startups (1% shutdown to full power)
Power Operations
Planned Shutdown (100% power to approximately 450°F)
Power Operations with Manual and Automatic Control (including casualties, steam line rupture and reactor coolant system leaks)
Reactor and Plant Startups
Operating Examination for Startup Certification

Phase II of the Simulator Training Program is designed to place emphasis on control room operations, especially emergency and casualty operations and consists of approximately forty (40) hours of formal classroom lectures and forty (40) hours of simulator operations. This phase will also be a period to address any weakness noted in previous simulator training.

IV. LICENSE TRAINING PHASE

The license preparation phases of the Rancho Seco Hot License Training Program is designed to provide each applicant the necessary final preparations to participate successfully in the NRC Licensing Examinations.

Control Room Operations — 2 Weeks

The control room operations phase of the Hot License Training Program is designed primarily for the hot license applicants to maintain an awareness of the Rancho Seco plant status and operating conditions. The applicants are assigned to operating shifts during this period to maximize the opportunities for each applicant to participate in control room operations. Emphasis is placed on each applicant relating concepts and techniques learned during simulator training to Rancho Seco control room operations.

Pre-License Review Course — 1 Week

The pre-license review course is designed to provide a timely review of the training topics most likely to appear on the NRC Examinations. The review course familiarizes the applicants with NRC Examination category topics and minimizes the possibility of a knowledgeable operator failing the NRC Examination due to a lack of familiarity with examination topics or examining techniques.

Pre-License Audit Examination — 2 Audits

Pre-license audit examinations are administered to all hot license candidates. A reactor operator examination consisting of questions in categories "A" through "H" is administered to all operator license applicants. The senior operator license applicant will also be administered an examination consisting of questions on categories "I" through "N." In addition, each applicant participates in an oral operating/demonstration examination. The contents of the written and oral examination closely parallel NRC examinations.

The written examinations are administered and graded using NRC examining and grading techniques. The corrected examinations are returned to the students for review purposes. The oral examinations are conducted using NRC examining techniques. At the conclusion of each oral examination, the examiner immediately reviews the results of the examination with the student. Following the completion of all examinations, a formal presentation covering NRC Examination philosophy is conducted.

The final results of the written and oral audit examinations are evaluated by the Rancho Seco management and training staffs to determine which applicants should participate in the NRC Licensing Examination.

In-Plant Briefing

The in-plant briefing phase of the Hot License Training Program is a period designed to reacquaint each hot license applicant with the current plant status and operating conditions. In addition, each applicant has the opportunity to correct the deficiencies noted during the audit examinations. The in-plant briefing phase is the final preparation for the NRC licensing examinations.

V. INSTRUCTORS

Instructors who provide instruction in systems, integrated response and transients related to the safety system shall be Licensed Senior Operators. For instruction where the instructors who have expertise in the above area are not licensed, a Licensed Senior Operator shall be present to audit and approve the training for consistency and accuracy.

APPENDIX "A"

1. Review of Introductory Math

   a) Number System
   b) Fractions
   c) Decimals and Percentage
   d) Arithmetic Operations
   e) TI-30 Instruction for above

2. Exponents and Logarithms

   a) Exponents, Powers, and Radicals
   b) Scientific Notation and Logarithms
   c) Natural Logs and Exponentials
   d) TI-30 Instruction

3. Algebra

   a) Basic Operation
   b) Equations
   c) Word Problems
   d) Systems of Equations
   e) Quadratics
   f) Exponential Equations
   g) Physical Relationships
   h) Graphing
   i) TI-30 Instruction

4. Geometry and Trigonometry

   a) Geometry

      1) Basic Elements
      2) Lines and Angles
      3) Triangles
      4) Area and Volume of Various Shapes
      5) Applications
      6) TI-30 Instruction

   b) Trigonometry

      1) Functions and Inverse Functions
      2) Tables
      3) Radian Measure
      4) Applications
      5) TI-30 Instruction

5. Dynamic Systems

a) Differentials

1) Limits
2) Differentials and Derivatives
3) Applications (Coefficients)
4) Graphical Understanding

b) Integrals and Summations

1) Introduction
2) Graphical Understanding
3) Applications

APPENDIX "B"

Physics and Related Technologies

1. Classical Physics

a) Units of measurement and unit conversion
b) Linear momentum
c) Work, energy, and power
d) Electrostatics

2. Atomic Physics

a) Chemical terms and chemical reaction laws
b) Periodic chart, electrons, and valence
c) Nuclear notation
d) Kinetic gas theory
e) GMW and avogadros
f) Atomic concentration
g) Electromagnetic radiation
h) Atomic structure and energy level analysis
i) Quantum mechanics
j) X-rays

3. Nuclear Physics

a) Structure and composition of the nucleus
b) Mass-energy equivalence
c) Binding energy and nuclear stability
d) Radioactivity
e) Nuclear reactions and decay diagrams
f) Chart of the nuclides
g) Interaction of radiation with matter

4. Reactor Physics

a) Neutron flux and reaction rates
b) Binding energy and fission and neutron travel
c) Neutron multiplication and Keff
d) Reactivity, shutdown margin and Kex
e) Prompt and delayed neutrons
f) Reactor period and SUR
g) Power distribution and control rod worth

5. Reactor Operations

a) Subcritical multiplication and neutron sources
b) Samarium and xenon
c) Reactivity coefficients and deficits
d) Time in life effects
e) Introductions to Technical Specifications, SFAR, procedures, etc.
f) Reactor vessel, internals and fuel
g) RCS
h) Makeup and letdown system and boron calculations
i) Mitigation and control of accidents involving a degraded core

6. Heat Transfer and Fluid Flow

a) Fundamentals of energy transfer
b) Properties of water and steam
c) PWR power plant cycle
d) Fluid flow
e) Basic heat transfer
f) OTSG theory
g) RCS heat transfer and reactor heat transfer
h) PWR response characteristics
i) Reactor protection analysis and introduction to ECCS
j) Transient response
k) Accident response
l) Thermodynamics

APPENDIX "C"

Systems and Procedures

1. Systems

- DHR System
- Core Flood
- Containment Spray
- OTSG's and Main Steam
- Electrical Distribution
- HPI, LPI
- RB Emergency Cooling, NSCW, NSRW
- Diesel Generator
- AC-DC Theory
- Process Instruments
- Nuclear Instruments
- Turbine Theory and Main Turbine
- Supervisory Instruments
- SFAS
- In Core Instruments
- Main Generator and Generator Theory
- Turbine Controls
- Feed and Condensate
- Cooling Water System
- Reactor Protection System
- Auxiliary Feed
- Control Rod Drive and System
- Fire Protection System
- Radwaste System
- Support System, Air and Water
- Integrated Control System

2. Procedures

- Startup
- Normal Operations
- Casualty
- Abnormal
- Emergency
- Shutdown and Cooldown
- Reactivity Balance

APPENDIX "D"

Chemistry and Radiological Controls

- Fundamentals of Chemistry
- Primary Chemistry
- Radioactivity, Sources of Radiation and Shielding
- Chemical Reactions
- Secondary Chemistry
- Dose Rates, Problems of Thumbrules
- Interaction of Radiation with Matter
- Biological Effects
- Radiation Protection Guides and 10 CFR 20
- Radiation Monitoring and Survey Instruments
- Area and Process Monitors
- RWPs and Respiratory Protection
- Radiation Emergencies