D.C. COOK NUCLEAR PLANT
TRAINING PROGRAMS
REVIEW AND APPROVAL SHEET

OPERATOR REPLACEMENT TRAINING
(Program Name)

DATE PREPARED OR REVISED: 2-4-80

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REVIEWED BY: (Applicable Dept. Head Minimum)

David M Nelson — TRAINING COORDINATOR — 2-5-80 Date

R S Lease — 2-9-80 Date

B A Lukmann — 3/27/80 Date

_____ — Date

_____ — Date

APPROVED: D C Chilton — Plant Manager — 3/27/80 Date

ENCLOSURE TO AEP:NRC:0395B

OPERATOR REPLACEMENT TRAINING PROGRAM

The Operator Replacement Training Program supplies selected operating personnel with the background and experience necessary for safe and reliable operation of the plant controls and prepares them for the NRC Reactor Operator licensing examinations.

Prior to selection to the program, the license candidates shall have been working in the control room under the direction of qualified licensed operators. All control room instruction, including control manipulations, shall be documented on form OHI-2070 Attachment 5 (attached) until the trainee is licensed by the NRC.

Formal classroom instruction will be given in the areas and subjects listed in the Non-licensed Operator Training Program as necessary to ensure thorough trainee comprehension. In addition, formal classroom instruction will be given in the following subjects:

A. Neutron Behavior

1. Microscopic Cross Section.
2. Neutron Energy vs. Cross Section.
3. Doppler Broadening.
4. Macroscopic Cross Section.
5. Neutron Density.
6. Neutron Flux.

7. Reaction Rate Calculations.

8. Energy Dependence of Reaction Rate.

9. Neutron Reactions:

   a. Control Materials.

   b. Water.

   c. Density Effects.

   d. Structural Materials.

10. Power and Power Density.

11. Neutron Scattering.

12. Moderator Properties.

   a. Slowing Down Power.

   b. Moderating Ratio.

   c. Non-Nuclear Factors.

13. Neutron Density Energy Spectrum.

14. Neutron Flux Energy Spectrum.

15. Neutron Diffusion.

16. Neutron Reflection.

B. Reactor Theory

1. Neutron Balance Equations.

2. Multiplication Factors.

3. The Neutron Cycle.

4. Fast Neutrons.

5. Epithermal Neutrons.

6. Neutron Leakage.

7. Thermal Absorption - Fuel.
8. Fast Fission.
9. Epithermal Resonance Capture.
10. Thermal Absorption - Not Fuel.
11. Neutron Cycle Calculations.
12. Calculating the Reproduction Factor.
13. The Fast Fission Factor.
14. The Resonance Escape Probability.
15. Calculating the Thermal Utilization Factor.
16. The Four Factor Formula - The Infinite Multiplication Factor.
17. Enrichment Effects on the Four Factors.
18. Poison Effects on the Four Factors.
19. Moderator-to-Fuel Ratio Effects on the Four Factors.
20. Core Life Effects on the Four Factors.
21. Thermal Neutron Leakage Calculations.
22. Fast Neutron Leakage Calculations.
23. Moderator-to-Fuel Ratio Effects on Leakage.
24. Enrichment Effects on Leakage.
25. Poison Effects on Leakage.
26. Core Life Effects on Leakage.
27. The Six Factor Formula - The Effective Multiplication Factor.
28. Neutron Flux Distribution.
29. Neutron Reflection.
30. Core Zoning.
31. Power-Flux Relationship.

32. Power Distribution.

33. Peaking Factors.

34. Radial Nuclear Factor.

35. Axial Nuclear Factor.

36. Local Nuclear Factor.

37. Total Nuclear Factor.

38. Neutron Production.

39. Prompt Neutrons.

40. Delayed Neutrons.

41. Delayed Neutron Emissions.

42. The Delayed Neutron Fraction.

43. The Delayed Neutron Fraction Change Over Core Life.

44. The Effective Delayed Neutron Fraction.

45. Neutron Lifetime and Generation Time.

46. Delayed Neutron Effects.

47. Reactivity.

48. Reactor Period.

49. The Power Law.

50. Startup Rate.

51. Doubling Time.

52. The Inhour Equation.

53. Reactor Control System Effects.

    a. Short-Term.

    b. Intermediate-Term.

    c. Long-Term.

54. Typical Absorber Materials.

55. Effect of Control Poisons on the Effective Multiplication Factor.

56. Control Poison Forms.

57. Black and Gray Poisons.

58. Effects of Control Systems on Flux Shape.

    a. Control Rods.

    b. Soluble Poison.

    c. Burnable Poisons.

59. Differential Rod Worth.

60. Integral Rod Worth.

61. Differential Boron Worth.

62. The Doppler Coefficient.

63. The Moderator Temperature Corefficient.

64. Undermoderation.

65. Overmoderation.

66. The Pressure Coefficient.

67. The Void Coefficient.

68. The Isothermal Moderator Temperature Coefficient.

69. The Power Coefficient.

70. Calculations of Reactivity Changes.

71. Variations in the Doppler Coefficient.

72. Variations in the Moderator Temperatur Coefficient.

    a. Effect of Fuel Temperature Changes.

    b. Effect of Changes in Moderator Density.

    c. Effect of Poison Density.

    d. Effect of Core Age.

73. Reactivity Defects.

74. The Power Defect.

75. Neutron Competition and Shadowing.

76. Conditions Affecting Control Rod Worth.

77. Coefficients and Control in a Pressurized Water Reactor.

78. Fission Product Formation.

79. Xenon Production and Removal.

80. Equilibrium Xenon.

81. Startup Xenon Transients.

82. Shutdown Xenon Transients.

83. Restart Xenon Transients.

84. Power Change Xenon Transients.

85. Xenon Oscillations.

86. Equilibrium Samarium.

87. Samarium Transients.

88. Core Reactivity Requirements - Excess Reactivity.

89. Core Nuclear Reactions.

90. Fuel Depletion Effects on Reactivity.

    a. U-235 Burnout.

    b. Fission Product Poison Buildup.

    c. Pu-239 Buildup.

    d. Burnable Poisons Depletion.

    e. Total Core Life Effect.

    f. Refueling.

91. Other Fuel Depletion Effects.

a. Effects on Flux.

b. Effects on the Six Factors.

c. Effects on the Effective Delayed Neutron Fraction.

d. Effects on the Reactivity Coefficients.

92. Neutron Sources.

94. 1/M Plots.

95. Fuel Loading.

96. The Approach to the Critical Condition.

97. Predictions of Criticality.

98. Physics Testing.

a. Rod Worth Measurement.

b. Coefficient Worth Measurement.

c. Reactivity Follow.

99. Power Changes.

100. End of Core Life.

101. Reactor Coastdown.

102. Turbine Runback.

103. Planned Shutdown.

104. Reactor Trip.

105. Shutdown Cooling Requirements.

106. Fuel Management.

107. Refueling.

To enhance the theory phase of instruction, the trainees will participate in a training program at a research reactor. During this

program they will perform experiments to exhibit and measure reactivity effects. The trainees will gain hands-on experience by performing startups and shutdowns of the reactor.

Plant systems will be taught in depth through formal classroom instruction and in-plant study. Normal, Abnormal, and Emergency Operating Procedures will be emphasized. Controls, instrumentation, setpoints, automatic actions, differences between the units, system interfaces, and Technical Specifications limitations will be stressed. The systems covered are:

1. Reactor Core.
2. Reactor Coolant System.
3. Pressurizer and Pressure Relief System.
4. Rod Control System.
5. Chemical and Volume Control System.
6. Residual Heat Removal System.
7. Excore Nuclear Instrumentation System.
8. Incore Nuclear Instrumentation System.
9. Reactor Protection System.
10. Emergency Core Cooling System.
11. Containment System.
12. Ice Condenser System.
13. Containment Spray and Hydrogen Recombiner System.
14. Fuel Handling System.
15. Primary Sampling System.
16. Component Cooling Water System.
17. Essential Service Water System.

18. Non-Essential Service Water System.
19. Demineralized Water System.
20. Spent Fuel Pit Systems.
21. Waste Disposal Vent and Drain System.
22. Liquid Waste Disposal System.
23. Gaseous Waste Disposal System.
24. Solid Waste Disposal System.
25. Containment Ventilation System.
26. Auxiliary Building Ventilation System.
27. Control Room Ventilation System.
28. Emergency Diesel Generator Systems.
29. Auxiliary Feedwater System.
30. Compressed Air System.
31. Lube Oil Cleanup System.
32. Secondary Sampling System.
33. Secondary Chemical Feed Systems.
34. Primary Water System.
35. Primary Gas System.
36. Water Fire Protection System.
37. Carbon Dioxide and Halon Fire Protection System.
38. Miscellaneous Fire Protection Systems.
39. Plant Computer.
40. Radiation Monitoring System.
41. Portable Radiation Instruments.
42. Steam Generator and Steam Generator Blowdown System.
43. Main Steam System.

45. Auxiliary Steam System.
46. Plant Heating Boiler.
47. Main Turbine and Control System.
48. Steam Seal Supply and Exhaust System.
49. Main Turbine Lube Oil System.
50. Bleed Steam System.
51. Moisture Separator/Reheater and Feedwater Heater Drains.
52. Circulating Water System.
53. Chlorination System.
54. Miscellaneous Sealing and Cooling Water System.
55. Vacuum Priming System.
56. Condensate System.
57. Feedwater System.
58. Steam Generator Level Control System.
59. Steam Dump System.
60. Main Generator and Auxiliary Systems.
61. 4160 KV Electrical Distribution.
62. 600V AC Electrical Distribution.
63. 120V AC Electrical Distribution.
64. 250V DC Electrical Distribution.

The trainees will be instructed in the Plant Technical Specifications Safety Limits, Limiting Safety System Settings, Limiting Conditions for Operation and Bases for these limits. They will be held responsible for knowing all Action Statements of one hour or less.

Further intensive training in Instrumentation and Control systems and in Radiation Control and Protection will be given.

Periodic written and oral examinations will be given throughout the program to evaluate trainee performance and to prepare them for taking the NRC written and oral examinations.

Plant operating characteristics and responses to transients will be taught. Accident diagnosis and corrective actions will be emphasized.

The trainees will attend a simulator training program where they will perform plant evolutions and casualties. An NRC approved simulator certification program will be utilized for the demonstration portion of the Reactor Operator licensing examination at this time.

Simulated NRC written and oral examinations will be administered to the license candidates to audit their preparation for the NRC Reactor Operator licensing examinations. This audit will be an input in determining which candidates will be recommended for the NRC examination and will be used to identify weak areas needing further study.

After the audit examination, a minimum two week review series will be conducted in final preparation for the NRC examination. Weak areas and overall plant operation will be stressed.

HI-2070
Attachment #5

No. of Hours _____
(to the nearest 1/10 hour)

Date _____

Shift _____

REACTIVITY MANIPULATION

Control Board Time

To be completed by Hot License candidates (Replacement Reactor Operator Students) working under instruction in the Control Room, or by any individual Auxiliary Equipment Operator that is working under instruction in the Control Room.

_____ / _____
Name - Print Signature

Control Manipulations, Oral Exams (Walkthrough), etc.

Be Specific:

_____ / _____
Name - Print (RO,SRO) Signature

Forward immediately to the Training Department each and every time a student works in the Control Room.