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ARTHUR E. LUNDVALL, JR.
VICE PRESIDENT
SUPPLY

May 28, 1982

U.S. Nuclear Regulatory Commission
Office of Nuclear Reactor Regulation
Washington, DC 20555

ATTENTION: Mr. Robert A. Clark, Chief
Operating Reactors Branch #3
Division of Licensing

SUBJECT: Calvert Cliffs Nuclear Power Plant
Unit Nos. 1 & 2, Docket Nos. 50-317 & 50-318
NUREG-0737, Items I.A.2.1 & II.B.4

REFERENCE: (a) NRC Letter to A. E. Lundvall, Jr., from R. A. Clark dated 4/26/82, Request for Additional Information

Gentlemen:

The additional information requested by reference (a) is enclosed. Should you have any questions regarding this matter, please contact us. Specific questions concerning the information provided should be directed to Mr. S. E. Jones, Jr., at (301) 269-4798.

Very truly yours,

A. E. Lundvall, Jr.

Vice President - Supply

AEL/SEJ/gla

Enclosures

cc: J. A. Biddison, Esquire
G. F. Trowbridge, Esquire
D. H. Jaffe, NRC
R. E. Architzel, NRC
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ENCLOSURE (1)

Responses are numbered to coincide with questions asked in Enclosure (1) to Mr. R. A. Clark's letter dated April 26, 1982.

1. Yes, our June 18, 1980, response does apply to both Unit 1 and 2.

2. Yes, our courses do involve 80-contact hours. In fact, the course for our license operator candidates presently includes 288 contact hours, as detailed below. In June 1980 the courses involved 248-contact hours. However, in July 1981 the Heat Transfer and Thermodynamics section was expanded from 40 to 80-contact hours.

   The previously licensed operators at Calvert Cliffs have also been given considerable training in this area. Their training presently totals 142 contact hours as detailed below:

Licensed Operator Candidate Training	Contact Hours
Heat Transfer/Thermodynamics	80
Plant Chemistry	48
Radiation Protection	40
Transient Analysis	40
Procedures	24
Instrumentation	32
Degraded Core	24
TOTAL	288

Licensed Opertor Requalification Training	Contact Hours
1981	
Heat Transfer/Thermodynamics	20
Transient Analysis (Classroom)	12
Transient Analysis/Procedures (Simulator)	20
Mitigation of Core Damage	40
TOTAL	92
1982	
Heat Transfer/Thermodynamics	14
Transient Analysis/Procedures (Simulator)	20
Pressurized Thermal Shock	8
Procedures for Accident Conditions (Classroom)	8
TOTAL	50

3. The lectures and associated quizzes on accident mitigation listed above and described later were administered to all NRC licensed individuals at the plant. This

includes both alternates for the Plant Superintendent (Plant Manager), but not the Plant Superintendent himself. The Plant Superintendent particiapted in an 8-hour course on Core Damage Mitigation conducted by Combustion Engineering on November 11, 1981. Additionally, the Plant Superintendent, who previously held an SRO license received training similar to that listed above as a part of his license training program and as an officer in the Navy's Nuclear Training Program.

The organization structure showing training status is as follows:

Plant Superintendent - 8 hours

General Supervisor - Operations (1)

Shift Supervisor (1)

Senior Control Room Operator (1) (2) | Shift Supervisors Assistant (1) (2)

Unit 1 | Unit 2

Control Room Operators (1) | Control Room Operators (1)

NOTES

(1) Trained as per program listed in response to question 2.

(2) Serves as STA-Transient Analysis.

4. Yes, accelerated requalification is required for < 80% overall or < 70% in any category on the licensed operator requalification examination.

5. Yes, the control manipulations required as a part of licensed operator requalificaiton has been modified to conform with enclosure 4 of Mr. H. Denton's letter of March 28, 1980.

6. In July 1981 the Heat Transfer/Thermodynamics course was revised and expanded from 40 to 80 hours. The emphasis is placed not only on basic theoretical concepts but also on their application to a nuclear power plant. Enclosure (2) is an outline of the course as it exists today.

7. Mitigation of Core Damage Training at Calvert Cliffs no longer follows the exact outline listed in Mr. Denton's March 28, 1980, letter. The course has been rearranged for more effective presentation. Enclosure (3) is an outline of all mitigating core damage related training which was also asked for in Mr. Clark's letter of April 26, 1982.

ENCLOSURE (2)

TRAINING IN HEAT TRANSFER, FLUID FLOW, & THERMODYNAMICS

80 HOURS

I. STEAM POWER CYCLE

A. Basic Cycle

1. Purpose & Principle Components of Steam Cycle
2. System & Component Boundaries

B. Pressure, Temperature, & Volume

1. Define Temperature & Pressure
2. Temperature & Pressure Scales
3. Specific Volume & Weight
4. Gas Laws

C. Heat & Its Effects

1. Heat, Specific Heat, BTU, Latent Heat of Vaporization, Latent Heat of Fusion, Sensible Heat, Change of Phase
2. Effects of Pressure on Latent Heat & Boiling
3. Problem Solving for Specific Heat & Latent Heat

D. Enthalpy & Entropy

1. Work, Energy, Enthalpy, & Entropy
2. Problem Solving Involving Work & Enthalpy

E. Cycle Diagrams

1. Plotting T-S Diagrams
2. Explanation of Diagrams

F. Steam Tables

1. Mollier Diagram
2. Quality
3. Sat. Pressure, Temperature, & Subcooling
4. Superheat

II. THERMODYNAMICS

A. First Law

1. Potential & Kinetic Energy
2. Velocity
3. Water Hammer

B. Heat at Work

1. Internal Energy
2. Flow Work
3. Mechanical Work
4. Heat
5. Bernoulli's Equation

C. Energy Conversions

1. Conversion Units
2. Flow Processes
3. Nozzles & Orifices

D. Second Law

1. Second Law
2. Efficiency

III. BASIC HEAT TRANSFER

A. Basic Heat Transfer Principles

1. Conduction
2. Convention
3. Radiation

B. Physical Parameters of Basic Heat Transfer

1. Conduction Heat Transfer
2. Effects of Flow on Heat Transfer

C. Boiling Heat Transfer

1. Critical Heat Flux, DNB
2. Nucleate & Film Boiling
3. Heat Transfer Curve

D. Physical Parameters of Boiling Heat Transfer

1. Pressure
2. Flow
3. Temperature
4. Boiling Heat Transfer

E. Steam Boiler Characteristics

1. Natural Circulation
2. Moisture Separators
3. Quality & Carryover
4. Shrink & Swell

IV. TURBINE GENERATOR

A. Turbine Cycle

1. Moisture Separator Reheaters
2. Turbine Arrangement
3. Turbine Efficiency

B. Energy Conversion

1. Critical Pressure Ratio
2. Flow Measurement
3. Energy Conversion

C. Superheat & Reheat Cycles

1. T-S Diagram
2. Advantages & Disadvantages

V. CONDENSERS

A. Condenser Theory

1. Condenser Operation
2. T-S Diagram

B. Condenser & Cycle Efficiency

C. Turbine Extraction & Feedwater Heating

1. Feedwater Heating & Heat Exchanger Operation
2. Extraction Steam

VI. HYDRAULIC SYSTEMS

A. Hydraulic Systems

1. Pump Head
2. Laminar & Turbulant Flow
3. T-S Diagram
4. Pump Operation
5. Head Loss & Flow
6. Pressure vs. Flow Diagrams
7. Density
8. Viscosity
9. Friction Losses

B. Positive Displacement Pumps

1. Operation
2. Pump Laws
3. Pump Curves

C. Eductors & Jet Pumps

1. Pump Operation
2. Nozzle & Fluid Movement

D. Centrifugal Pumps

1. Pump Operation
2. Series & Parallel Pump Operation
3. Pump Curves

E. Net Positive Suction Head

1. Define NPSH
2. Cavitation

VII. STEAM PLANT CALCULATIONS

A. Efficiency

B. Heat Balance

1. Calorimetric
2. Reactor & Electrical Power

VIII. REACTOR THERMAL & HYDRAULIC PERFORMANCE

A. Fuel & Clad Performance

1. Clad Failure
2. Fuel Failure
3. Heat Transfer Across the Fuel Rod
4. Atomic Action

B. Thermal Limits & Fuel Channel Flow

1. Thermal Limits
2. Coolant Flow & Instabilities
3. Heat Transfer in Fuel Channel
4. Factors Effecting Heat Transfer
5. DNBR
6. Steam & Non-condensible Gases
7. Critical Power
8. Hot Channel Factors, Axial & Radial Power Limits

C. Temperature & Pressure Limits

1. Temperature Limits, Heat-up & Cooldown
2. Brittle Fracture, NDTT
3. Operators Curve

ENCLOSURE (3)

MITIGATING CORE DAMAGE

I. NSFER, FLUID FLOW & THERMODYNAMICS - 80 Hours

Enclosure (2) to this letter)

II. LANT CHEMISTRY - 40 Hours

A. Basic Concepts

1. Chemical Reactions
2. Solutions
3. pH
4. Conductivity

B. Corrosion of Plant Materials

1. Effects of Corrosion
2. Methods of Corrosion
3. Carbon Steel
4. Stainless Steel
5. Nickle & Copper Based Alloys
6. Zircalloy

C. Effects of Nuclear Operation

1. Activation of Corrosion Products
2. Crud
3. Activation of Water and Water Impurities
4. Fission Products
5. Tritium
6. Radiolytic Decomposition

D. Chemistry Control Equipment

1. Filters
2. Ion Exchangers
3. Evaporators

E. Primary Chemistry

1. Water Specifications

F. Secondary Water Chemistry

1. Water Specifications
2. Make-up Water

III. RADIATION PROTECTION - 40 Hours

A. Theory of Radiation Exposure

1. Type of Radiation
2. Interaction with Matter
3. Contamination

B. Exposure Limits

1. Federal
2. Administrative

C. ALARA Concepts

1. Time, Distance, & Shielding
2. Job Planning
3. CCNPP Program

D. Radiation Work Practices

1. Work Permits
2. Contamination Control

E. Radiation Detection Equipment

IV. TRANSIENT ANALYSIS - 40 Hours

A. CEN-128, "Transient and Accident Analysis"

B. FSAR Accident Analysis

C. Normal Plant Transients

V. PROCEDURES - 24 Hours

A. Operating Procedures

B. Abnormal Operating Procedures

C. Emergency Operating Procedures

D. Emergency Response Plan Implementing Procedures

VI. INSTRUMENTATION - 32 Hours

A. Reactor Coolant System Instrumentation

1. Function & Control
2. Power Supply
3. Modes of Failure

B. Reactor Protective System

1. Function & Control
2. Power Supply
3. Modes of Failure

C. Nuclear Instrumentation

1. Function & Control
2. Power Supply
3. Modes of Failure

D. Engineered Safety Features Actuation System Instrumentation

1. Function & Control
2. Power Supply
3. Modes of Failure

E. Radiation Monitoring System

1. Function & Control
2. Power Supply
3. Modes of Failure

F. Reactor Regulating System

1. Function & Control
2. Power Supply
3. Modes of Failure

G. Feedwater Control

1. Function & Control
2. Power Supply
3. Modes of Failure

VII. DEGRADED CORE TRAINING - 24 Hours

A. Incore Instrumentation

1. Purpose of Incore & Thermocouples
2. Location
3. Principles of Operation - Normal Plant
4. Principles of Operation - Accident Conditions

    a. Self-Powered Neutron Detectors

        1. TMI Response
        2. Heating Effects
        3. Determination of Geometry Changes
        4. Determination of Core Damage

b. Thermocouples

1. Range
2. How to Extend Range
3. Effects of Overranging
4. Direct Reading Techniques

5. Plant Computer

a. Neutron Detectors

1. INCA Programs
2. Print Values
3. Alarms
4. Demand Log

b. Thermocouples

1. Trend Blocks
2. INCA Programs
3. Print Value
4. Expansion of Range

6. Computer Failure

a. Reading Neutron Detector Voltages
b. Reading Thermocouple Voltages

B. Excore Nuclear Instrumentation (NIS)

1. Purpose

2. Location

3. Principles of Operation

a. Proportional Counters
b. Fission Chambers

4. Response

a. TMI

1. Void Effects on Readings
2. Geometry Changes
3. Reactor Water Level Determination
4. Extent of Core Damage
5. Sources of Neutrons

b. CCNPP

1. Location Differences from TMI
2. Comparison to TMI Instruments
3. Water Level Determination

5. Comparison of INCORE, EXCORE, & Thermocouples

   a. Response of Fission Chambers
   b. Response of Proportional Counters
   c. Response of Incores
   d. Response of Thermocouples
   e. Determinaton of Core Uncovery

C. <u>Vital Instrumentation</u> - 4 Hours

1. Normal Operation

   a. Pressure Instrument
   b. Level Instruments
   c. Flow Instruments

      1. Δ p
      2. Acoustic

   d. Temperature

      1. RTD's
      2. Thermocouples

2. Effects of Accident Environment on Transmitters

   a. Temperature

      1. Transmitter Failures

   b. Pressure

      1. Transmitter Failures

   c. Humidity

      1. Transmitter Failures

   d. Radiation

      1. Indications on High Range Monitors

3. Accident Process

   a. RCS - Actual vs. Indicated Parameters

      1. Temperature
      2. Pressure
      3. Pressurizer Level

         a. Conversion tables in EOP's

   b. Containment - Expected Response

1. Pressure
2. Temperature

4. Failure Mechanism

   a. Level

      1. Dry Leg
      2. Wet Leg

   b. Pressure

   c. Temperature

      1. RTD
      2. Thermocouples

   d. Flow

5. Alternate Methods of Determining Parameters

   a. Pressure Level

      1. Reasons Why This is not Available

   b. Letdown Flow

      1. Heat Balance

   c. RCS

      1. Temperature - Loops RTD's

         a. Thermocouples

      2. Flow

         a. Δ T across Core

      3. Pressure

         a. Saturation Conditions for Large Break
         b. Superheat Conditions for Small Break with Core Uncovery

D. <u>Primary Chemistry</u>

1. Basic Chemistry (Review)

   a. Polarity
   b. Ionization
   c. Electrolytes
   d. pH

e. Conductivity
f. Oxidation

2. Corrosion (Review)

   a. Oxidation
   b. Precore Hot Functional Testing
   c. General Corrosion
   d. Effects of:

      1. pH
      2. Oxygen

   e. Control of General Corrosion
   f. Localized Corrosion
   g. Stress Corrosion
   h. Corrosion Products

3. Chemistry Control (Review)

   a. Volital Control
   b. Impurity Removal
   c. Lithium
   d. Boron
   e. Ammonia
   f. Hydrogen Overpresssure
   g. Tritium Production

4. Materials

   a. ZircIV
   b. Inconel
   c. 304 S.S.

5. Concerns & Objectives

   a. Prevention of Equipment Damage
   b. Exposure Control
   c. Waste Control

6. Core

   a. Fission Reactions
   b. Fission Product Release
   c. Dose Equivalent I^{131}
   d. Technical Specification Limits
   e. Clad Contamination
   f. Fuel Defects

7. Degraded Core Considerations

   a. Fuel Swelling
   b. Fuel Bursting
   c. Clad Oxidation
   d. Candling
   e. Core Slump
   f. Core Melt
   g. Hydrogen Gas Generation
   h. Radiolysis
   i. TMI
   j. Hydrogen Combustion
   k. Rod Burst - TMI
   l. Fission Gas Release
   m. Iodine Release
   n. Fission Product Release
   o. Sources of Oxygen in Containment

E. <u>Radiation Monitoring</u>

1. Fission Fragment Release Characteristics

   a. Fission Fragment Release Mechanisms

      1. Recoil
      2. Knockout
      3. Thermally Activated Migration

         a. Bubble Formation & Channels

   b. Clad Failure

      1. Means of Detection - Normally Sample
      2. Causes of Failures - Zr Hydriding

         a. Core Uncovery

      3. Thermal Cycling - Breathing

2. Inventory of Fission Fragments

   a. Gap Activity

      1. Clad Failure

   b. RCS Activity

      1. Equilibrium Activity
      2. Activated Corrosion

   c. Fuel Inventory

      1. Pellet Release

3. RMS System

   a. Pre-TMI Equipment

      1. Range of Detectors
      2. Effects of Accident

   b. Post-TMI Equipment

      1. High Range RMS
      2. Use of Detector in Determining Core Damage

   c. Hand Held Meters

      1. Expected Readings
      2. Determining Core Damage
      3. Determining Dose Rates Inside Containment

   d. ERPIP

      1. Determination of Core Damage