Evaluation of risk implications of changing SRV/LPS From "ALTERNATIVE" To "REDUNDANT"

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Objectives of Evaluation

- Identify characteristics of fire areas where relatively large increase or decrease in risk could occur
- Estimate relative change in risk for these fire areas
- Estimate change in risk

Change in CDF

	CCDP SRV/LPS is **Alternative**	CCDP SRV/LPS is **Redundant**
Areas with Increase	1E-3	1E-2
Areas with Decrease	2E-2	1E-2

Probability of Ignition about ~1E-3/area-year

Spatial Effects (location of fire and equipment) 0.10
Range is usually 0.50 to 0.05

Nominal Change in CDF for Fire-area with **increase**
= 1E-3/area-year * 0.1 * (1E-2 - 1E-3) = **+1E-6/area-year**

Nominal Change in CDF for area with **decrease**
= 1E-3/area-year * 0.1 * (1E-2 - 2E-2) = **-1E-6/area-year**

Relative number of fire areas with characteristics for relatively large increases versus decrease unclear

Conclusions

The conclusions assume that there is a request to change the designation of the SRV/LPS from an alternative to a redundant shutdown path **and** full implementation of the changes subsequently allowed under Appendix R.

Risk from fires is very dependent on specific fire area configurations

- Most fire areas will have small change in risk, well below +1E-6/yr CDF and +1E-7/yr LERF
- Some fires areas may have intermediate change in risk
- A few fire areas may have changes in risk greater than what would normally be acceptable, above +1E-5/yr CDF or +1E-6/yr LERF.

The total change in risk at a plant will probably be driven by a few fire areas

United States
Nuclear Regulatory Commission

Fire Risk Research Program: Status

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presentation to
ACRS Subcommittee on Fire Protection
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Outline

- Fire risk assessment (FRA) research program plan
- Plan implementation and notable results
  - Tools for circuit failure mode and likelihood analysis
  - Experience from major fires
- Research program plan update to meet evolving needs

Fire Risk Research Program Background

- FY 1998-2000 research program rationale, objectives, approach, and tasks discussed in last subcommittee briefing (January 21, 1999).
- Objectives addressed understanding of fire risk, support of ongoing fire protection activities, and fire risk assessment (FRA) methods/tools development (as needed)
- Involved evolutionary improvements, use of existing information, use of feasibility/scoping studies, use of results from other programs
- Initial research program plan issued in June 1999.

Fire Risk Research Program Background (cont.)

- **Tasks initiated in FY 1998**

Circuit failure mode and likelihood analysis

Fire detection and suppression analysis

IEEE-383 rated cable fire frequency

Fire modeling toolbox: input data and assessment

Experience from major fires

Industrial fire experience

Switchgear and transformer fires

Fire barrier reliability

Model and parameter uncertainty

Frequency of challenging fires

Fire model limitations and application guidance

Risk significance of turbine building fires

Penetration seals

Risk significance of multiple unit interactions

Advanced fire models in fire risk assessment

- **Plan is being revised**

Program Outputs

- Analyses:
  - circuit failure mode and likelihood analysis
  - experience from major fires
- Data: full-scale enclosure fire tests
- Methods: integrated treatment of model and parameter uncertainties
- Technical Support: IPEEE review questions, industry tests, NFPA 805

Results - Circuit Analysis and Events Review

Viewgraphs provided in separate package.

Revision of Fire Research Plan - Events Since Initial Plan

- Issuance of risk-informed, peformance-based fire protection rulemaking plan (SECY-00-0009)
- Preparation of NFPA 805
- Development of fire significance determination process
- Industry development of risk-informed approach to resolve circuit analysis issue
- ACRS reviews of fire risk research program
  - need for improved linkage to regulatory activities
  - need for tools to analyze fire-initiated core damage precursors
- Research results obtained (circuit analysis, major events)
- Potential research needs identified for reactor and non-reactor applications
- Cooperative activities established, e.g.,
  - EPRI MOU
  - fire modeling
  - WGRISK, COOPRA
- Establishment of Fire Research Coordinating Committee

Draft Revised FY 2001-2002 Research Plan Elements

- Overall objectives
- Background
  - Risk significance of NPP fires
  - Risk-informed regulatory initiatives
  - FRA state-of-the-art
  - Program history and status
- Program outputs and regulatory uses
- Relationship with other programs/activities
- Specific technical objectives
- Tasks and milestones
- Communications plan
  - Research planning
  - Research results

Draft Revised Research Plan Objectives

- **Improve qualitative and quantitative understanding of the risk contribution due to fires in nuclear power plants.**
  - Develop fire risk results and insights from the application of improved FRA methods, tools, and data to operating plants.
  - Develop insights regarding key FRA topics

- **Support ongoing or anticipated fire protection activities in the NRC program offices, including the development of risk-informed, performance-based approaches to fire protection.**
  - Support the development of a risk-informed, performance-based fire protection rule.
  - Support the improvement of the fire significance determination process.
  - Develop methods, tools, and data for analyzing the risk significance of fire-related operational experience.
  - Develop methods, tools, and insights for nuclear materials applications.

Draft Revised Research Plan Objectives (cont.)

- **Evaluate current FRA methods and tools and develop improved tools (as needed to support the preceding objectives).**
  - Complete the FRA development activities started in FY 1998.
  - Develop insights regarding the application of improved methods in practical studies.
  - Develop guidance concerning the practical application of these methods in plant-specific studies.
  - Support international activities involving the benchmarking of existing fire models, and the development of improved fire models for use in nuclear safety applications.

Draft Revised Research Plan Tasks

Task	Title
1	Fire risk assessment tool development
2	Fire risk requantification study
3	Fire model benchmarking and validation
4	Fire risk assessment guidance development
5	Fire protection rulemaking support
6	Fire protection for nuclear power plants
7	Fire protection for gaseous diffusion plants
8	Fire significance determination process support
9	Fire risk assessment tools for precursor analysis

Fire Risk Requantification Study

- **Objectives**
  - develop state-of-the art fire CDF estimates (including uncertainty)
  - determine impact of using improved methods, tools, and data
  - develop insights regarding results obtained using earlier tools
  - develop insights regarding key FRA topics
  - develop examples for practical use of research results
  - identify areas for further improvement

- **Potential Issues**
  - role of NRC and utilities
  - interaction with EPRI

Concluding Remarks

- Research results are supporting ongoing regulatory activities
- Staff is participating in cooperative efforts with industry and international organizations
- Needs for research support are evolving
- Research program plan is evolving to meet needs
- The fire risk requantification study is expected to be a significant milestone

NFPA 805 - PRA Approach

D. Henneke, Senior PRA Engineer
San Onofre Nuclear Generating Station
October 16th - 17th, 2000

General PRA Guidance

- Fire Risk Evaluations are performed using guidance in Section 2-3.3:
  - Analysis of Core Damage Frequency (CDF) & Large Early Release Frequency (LERF)
  - Includes all potentially risk-significant Fire Scenarios
  - Only use methods acceptable to AHJ - Appendix D provides general guidance on acceptable methods.
  - CDF and LERF Risk Acceptance Criteria for plant changes needs to be acceptable to the AHJ:
    - Plant Change Evaluations include Defense-in-Depth/ Safety Margin Evaluations and Evaluation of Uncertainty

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General PRA Guidance (Cont.)

- Risk-Informed Approach:
  - All changes using a performance based approach needs to include a PRA evaluation (Figure 2-2).
  - PRA evaluations include qualitative or quantitative evaluations of all modes of operation:
    - Shutdown evaluations are limited to High Risk Plant Operational States (Appendix B-6)
  - No Site Evaluation (Full Plant Fire PRA) is required.
  - Monitoring of availability, reliability and performance is required (Section 2-5) - validates PRA assumptions
  - Supporting documentation required.

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Conclusions

- PRA/RI methods discussed in NFPA 805 are simple and consistent with current Reg. Guides.
- Analysis of lower modes is new. There is little guidance on performance of Shutdown Fire PRA. New Requirement
- Some additional guidance or standard on acceptable Fire PRA methods would avoid NRC approval of PRA methods prior to application.
- PRA methods could be applied using risk-informed exemptions or deviations.

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Circuit Analysis Tools

Presented by:
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Task Co-Authors:
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Presented to:
ACRA Subcommittee on Fire Protection
October 16, 2000

Format for Presentation

- The circuit analysis task has five major objectives
- I plan to go through each of these objectives and summarize:
  - Insights and findings
  - Recommendations
  - Anticipated follow-on

Objective: Improve understanding of mechanisms linking cable damage to potentially risk significant failure modes of power, control, and instrument circuits

- Data review provided cable failure mechanism insights
  - For multi-conductor cables initial failures involving conductor-to-conductor shorts are relatively high likelihood
  - No experiment showed open circuit faults as initial fault mode
- Several circuit case examples studied and illustrated
  - Circuit faults for sample MOV, SOV, pump motor and relay circuits
  - Conductor failure modes and combinations explored for circuit impact
- Browns Ferry fire studied:
    - Spurious actuation of two RHR pumps and two CS pumps
    - ECCS indicating light behavior
    - Spurious ECCS alarms
  - Circuit analysis can explain most behaviors observed
  - Multiple hot shorts, spurious signals, and actual system actuation are most plausible explanation

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Objective: Improve methods and data for estimating the conditional probability of key circuit faults, given cable damage

- Preliminary input gained through:
  - Characterization of available data
  - Review of actual events
- Methods of circuit analysis demonstrated (FMECA)
- An overall PRA analysis framework has been proposed
  - Appropriate screening
  - FMECA for unscreened circuits
  - Quantify likelihood and impact
  - Fold into plant risk models - (may need to adapt models)
- Additional refinement of proposed methods anticipated as a part of the re-quantification studies
  - Combinatorial cable failure models and independence
  - NEI developing new data

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Objective: Develop sample estimates of the conditional probability of key circuit fault modes applicable to currently operating U.S. NPP's

- Substantial relevant data was identified
  - Multi-conductor cables (light power / control)
  - Cables with shield/drain arrangements (control / instrumentation)
  - Limited data for armored cables (light power / control)
- Data limitations remain a significant quantification obstacle
- Data says "hot short" cable failures are likely for some configurations (e.g., multi-conductor cables) but ...
  - Link between a hot short and a spurious actuation remains a point of uncertainty
  - Available data does not cover several potentially important influencing factors
  - Very little data on cable-to-cable interactions
- Discussions underway to supplement data
  - Coordinating with industry efforts
  - Potential future area for NRC program

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Objective: Gain risk insights concerning fire-induced circuit faults, especially those associated with cable hot shorts

- Data appear to indicate probability of hot shorts is higher for some common cases than assumed in past risk studies
  - If true, impact on fire risk estimates may be significant
  - May impact perception of both magnitude and sources of fire risk
- A quality Appendix R circuit analysis is a good PRA starting point
- FMECA flushes out potential circuit behaviors
  - Impact of multiple conductor interactions
  - Circuit features of importance (e.g., locking relays, double breaks)
- Re-quantification studies will strengthen insights
  - Impact on control cables/circuits may prove to be most significant concern
  - Importance of human factors interactions with instrument/control signal faults remains uncertain

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Objective: Identify areas where additional work needs to be done to improve understanding of the risk associated with fire-induced circuit faults

- Data needs to be strengthened
  - Basic cable failure mode probabilities
  - Influence factors
  - Quantification methods need to be "fleshed out"
- Cable failures -to- circuit faults link needs to be quantifiable
  - Combinatorial models
  - Independence
  - The fault "quality"
- Need to establish circuit analysis screening methods
- Need to assess plant risk models for suitability/adaptation

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Current and Future Task Status:

- Limited task follow-up is currently underway
  - Additional analysis of certain data sources
  - Publication of final report as NUREG/CR
- Interactions with industry on testing continue
- Re-quantification studies will be the test bed for proposed methods

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Fire PRA Insights from the Review of NPP Fire Events

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Presented to:
ACRS Subcommittee on Fire Protection
October 16, 2000

NPP Fire Events Review

- Task Objectives:
  - Identify fire risk/PRA insights from NPP fire events
  - Identify areas for improvement in fire PRA methods
- In effect we asked three questions:
  - How do fire incidents verify (or contradict) various elements of fire scenario models as developed in current fire PRAs?
  - Does the actual fire experience lend any insight into the current areas of methodological debate?
  - Do actual fire incidents indicate the existence of any new phenomena that have not been considered in past PRAs?

Event Selection Criteria

- Event set considered included fire events world-wide
  - EPRI and SNL fire event data bases
  - Public literature
  - Personal contacts
- Events were ultimately chosen for review based on one of three features:
  - "Severe" Fires - classical fire protection perspective
  - "Challenging" Fires - nuclear safety perspective
  - "Interesting" Fires - illustrates unique behavior

25 Nuclear Industry Fire Events Reviewed

- San Onofre, Mar. 12, 1968
- Mühleberg, July 21, 1971
- Browns Ferry, Mar. 22, 1975
- Greifswald, Dec. 7, 1975
- Beloyarsk, Dec. 31, 1978
- Fort St. Vrain, Oct. 3, 1987
- North Anna, July 3, 1981
- Armenia NPP, Oct. 15, 1982
- Rancho Seco, Mar. 19, 1984
- South Ukraine, Dec. 15, 1984
- Zaporozhye, Jan. 27, 1984
- Kalinin, Dec. 18, 1984
- Maanshan, July 1, 1985
- Waterford, July 14, 1985
- Ignalina, Sep. 5, 1988
- Oconee Jan. 3, 1989
- H. B. Robinson, Jan. 7, 1989
- Calvert Cliffs, Mar. 1, 1989
- Shearon Harris, Oct. 9, 1989
- Vandellos, Oct. 19, 1989
- Chernobyl 2, Oct. 11, 1991
- Salem, Nov. 9, 1991
- Narora, Mar. 31, 1993
- Waterford, June 10, 1995
- Palo Verde, Apr. 4, 1996

Insight Gained in Several Areas:

Fire Initiation

Fire Propagation

Fire Detection and Suppression

Equipment Damage

Impact on Plant Safety Functions

Recovery and Operator Actions

- Due to time constraints, I will cover a sample of the insights gained

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Overall Findings:

- Nothing we saw fundamentally challenged the overall framework of a quality fire PRA
  - Some elements of some events would not be captured in current full-scope fire PRA
  - Some aspects of PRA shown to be conservative
  - Importance of considering a range of fires highlighted (versus only the "most likely" fire)

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Insight: Six "Challenging" Fires

- Browns Ferry 1975: only such fire in the U.S.
- Narora: 9 hr. TB fire, 17 hr. SBO, loss of power to both MCR and remote shutdown station
- Greifswald: 92 min. cable/switchgear fire, SBO, loss of all active core cooling, stuck open PORV
- Armenia: 7 hr. fire in two cable galleries, loss of all active cooling systems
- Beloyarsk: TB oil fire, collapse of TB roof within minutes, propagation to and through most of the control bld. Including MCR
- Chernobyl 2: 6 hr. TB fire, loss of all high pressure flow sources, stuck dump valve brought coolant below top of active fuel for ~15 minutes

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Insight: Big vs. Challenging

- Events confirm the basic premise and findings of modern fire PRAs:
  - Not all big fires challenge nuclear safety
    - Ex: A number of severe turbine building fires have occurred without seriously challenging nuclear safety (e.g., Vandellos)
  - Not all challenging fires are big
    - Ex: Browns Ferry 1975 was not especially severe from a classical fire protection point of view
      - arguably largest cable fire to have occurred in a US NPP, but ..
      - relatively confined area impacted, no structural damage, quickly suppressed once water applied
  - Some fires are both big and challenging
    - Ex: At Narora a severe turbine hall fire led to a station blackout, loss of all power to main and emergency controls, loss of all normal core cooling functions

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Insight: Circuit Faults

A number of events did involve spurious actuations and other circuit effects

- Armenia:
  - Fire-induced cable fault spuriously re-connects generator set to grid, generator operates as a motor, causes a secondary fire
  - DG spuriously disconnects from loads due to control cable faults, could not be recovered
  - "Hot short" spuriously starts one feedwater pump
  - Various instrument readings skewed by fire damage to cables

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Insight: Circuit Faults (cont.)

- Ignalina:
  - Damage to oil pressure instrument cable causes one main coolant pump to trip - not recoverable
  - I&C cable faults led to spurious opening of two normal and two essential 6 kV supply buses
  - Another control cable fault trips a transformer designed to take up loads from lost 6 kV buses

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Insight: Circuit Faults

- Waterford 1995:
  - erratic indications recorded relating to an Aux. Transformer whose control cables were involved in the fire - no confirmation of actual spurious operations
- Browns Ferry:
  - Various spurious operations and signals reported
  - Task 1 study confirmed plausibility of two spurious operations investigated in detail (RHR and CS)
    - A simple conductor-to-conductor hot short in fire-damaged cables could have led to spurious operation of RHR and CS

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Insight: Circuit Faults

One unique case: cable fault causes spurious operation and this causes a fire

- Chernobyl 2:
  - plant tripped during startup due to steam leak
  - unrelated cond.-to-cond. fault on a multi-cond. cable spuriously connects generator back to grid
  - generator acts like motor
  - generator rotor fails
  - severe TB fire ensues

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Event Review Insights: Human Actions

- Review showed that fire PRAs typically make conservative human factors assumptions
- Actions not typically credited may be successful:
  - operators will "go the extra mile"
  - actions not in procedures (e.g., route new cables)
  - acting in areas with modest smoke, flooding
  - diagnosing a fire and not trusting bad readings
  - staying in the MCR despite smoke and/or fire
- But fire can prevent or degrade operator actions
  - smoke and heat can prevent actions
  - smoke and confusion may lead to errors
- Still some reluctance to apply water

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Insight: Multiple Fires

- Several events involved multiple concurrent fires
  - Simultaneous fires from a common cause
  - Secondary fires due to fire damage/demands
  - Often due to common electrical overloads or faults
- Current PRAs only treat one fire at a time
  - Risk significance remains indeterminate
    - How frequent are such events
    - Do they introduce any new risk scenarios
  - PRA framework could address multiple fires
    - No basis to say we should
    - No basis to establish when/where/why

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Insight: Multiple Initiators

- Some events involved multiple initiators:
  - Fire and flooding
  - Turbine blade ejection, explosion and fire
- PRAs assume fires as a lone initiator
  - Risk significance remains indeterminate
  - PRA framework could allow for additional effects such as flooding but:
    - No basis for saying this is important
    - Lack of basis for when/where/why
    - We don't trace all of the potentially important cables
      - (e.g., sump pumps may be lost due to fire (Vandellos))

Event Review Insights: Loss of FPS

- There were events where the fire damaged the fire suppression system before it operated
  - Power/control cables damaged
- Current U.S. standards are generally mute on routing of support cables
  - Fire pump standard may be exception
- In fire PRA, we do not trace FPS cables
  - Inherently assumes systems are independent of protected area

Summary

- Overall, the common structure of a quality fire PRA was not brought into question
- Some event elements are not considered in current PRAs, but importance is unclear:
  - multiple concurrent fires
  - multiple initiating events
- Some elements of fire PRA may deserve more attention, e.g.:
  - severe turbine hall fires
  - long duration fires in general
  - human factors in fire fighting

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ATTACHMENT 71111.05

INSPECTABLE AREA: Fire Protection

CORNERSTONES: Initiating Events (10%)
Mitigating Systems (90%)

INSPECTION BASES: Fire is generally a significant contributor to reactor plant risk. In many cases, the risk posed by fires is comparable to or exceeds the risk from internal events. The fire protection program shall extend the concept of defense in depth (DID) to fire protection in plant areas important to safety by (1) preventing fires from starting, (2) rapidly detecting, controlling, and extinguishing those fires that do occur, and (3) providing protection for structures, systems, and components important to safety so that a fire that is not promptly extinguished by fire suppression activities will not prevent the safe shutdown of the reactor plant. If DID is not maintained by an adequately implemented fire protection program, overall plant risk can increase.

This inspectable area verifies aspects of the Initiating Events and Mitigating Systems cornerstones for which there are no performance indicators to measure licensee performance.

The scope of this procedure has been reduced while criteria for review of fire-induced circuit failures of associated circuits is the subject of a voluntary industry initiative. Temporarily, the inspector is not required to address associated circuits issues as a direct line of inquiry nor develop associated circuits inspection findings (with certain exceptions contained in Section 02.03 of this procedure). However, in certain instances, associated circuits issues may arise unavoidably and indirectly during the inspector's review of safe shutdown system selection, redundant train separation, and the provision of independent alternative shutdown capabilities ("byproduct" associated circuits issues). These byproduct associated circuits issues shall be documented as unresolved items (URIs) awaiting generic resolution of the related associated circuits issues. The inspection report should reflect the temporary limitation in inspection scope, and the potential for "byproduct" associated service, degraded or inoperable fire protection equipment, systems or features, and ensures that procedures, equipment, fire barriers, and systems exist so that the post-fire capability to safely shut down the plant is ensured. The triennial team approaches this effort from a design point of view, as well as from the operational status and material condition points of view.

71111.05-02 INSPECTION REQUIREMENTS

02.01 Routine Inspection. The resident inspector will tour six to twelve plant areas important to safety (not necessarily limited to the top few contributors to overall plant fire risk) to assess the material condition of reactor plant active and passive fire protection systems and features, their operational lineup and operational effectiveness. For the areas selected, as applicable to the area of concern, conduct the following lines of inspection inquiry:

a. Control of Transient Combustibles and Ignition Sources

   1. Observe if any transient combustible materials are located in the area. If transient combustible materials are observed, verify that they are being controlled in accordance with the licensee's administrative control procedures.

   2. Observe if any welding or cutting (hot work) is being performed in the area. Verify that hot work is being done in accordance with the licensee's administrative control procedures.

b. Fire Detection Systems. Observe the physical condition of the fire detection devices and note any that show physical damage. Determine from licensee administrative controls the known material condition and operational status of the system, and verify that any observed conditions do not affect the operational effectiveness of the system (see compensatory measures section below).

c. Fire Suppression Systems

   1. Sprinkler Fire Suppression Systems. Observe that sprinkler heads are not obstructed by major overhead equipment (e.g., ventilation ducts). Verify through visual observation or surveillance record review that the water supply control valves to the system are open and that the fire water supply and pumping capability is operable and capable of supplying the water supply demand of the system. Observe any material conditions that may affect performance of the system, such as mechanical damage, painted sprinkler heads, corrosion, etc.

   2. Gaseous Suppression Systems. Observe that the gaseous suppression system (e.g. Halon or CO2) nozzles are not obstructed or blocked by

plant equipment such that gas dispersal would be significantly impeded. Observe and verify that the suppression agent charge pressure is within the normal band, extinguishing agent supply valves are open, and that the system is in the automatic mode. Observe and verify that the dampers/doors are unobstructed so that they will be permitted to close automatically upon actuation of the gaseous system. Observe and verify that the room penetration seals are sealed and in good condition. Observe and note any material conditions that may affect performance of the system, such as mechanical damage, corrosion, damage to doors or dampers, open penetrations, or nozzles blocked by plant equipment.

d. Manual Fire fighting Equipment and Capability

1. Fire Extinguishers. Ensure that portable fire extinguishes are provided at their designated locations in or near the area being inspected, and that access to the fire extinguishers is unobstructed by plant equipment or other work related activities. Observe and verify that the general condition of fire extinguishes is satisfactory (e.g., pressure gauge reads in the acceptable range, nozzles are clear and unobstructed, charge test records indicate testing within the normal periodicity).

2. Hose Stations and Standpipes. Observe that fire hoses are installed at their designated locations. Observe and verify that the general condition of hoses and hose stations is satisfactory (e.g., no holes in or chafing of the hose, nozzle not mechanically damaged and not obstructed, valve hand wheels in place). Observe and verify that the water supply control valves to the standpipe system are open and that the fire water supply and pumping capability is operable and capable of supplying the water flow and pressure demand. Ensure that access to the hose stations is unobstructed by plant equipment or work-related activities.

e. Passive Fire Protection Features

1. Electrical Raceway Fire Barrier Systems. Observe the material condition of electrical raceway fire barrier systems (e.g. cable tray fire wraps) and determine if there are any cracks, gouges, or holes in the barrier material, that there are no gaps in the material at joints or seams, and that banding, wire tie, and other fastener pattern and spacing appears appropriate. Where the fire barrier is a wrap or blanket-type material, observe that the material has no tears, rips, or holes in any of the visible layered material, that there are no gaps in the material at joint or seam locations, and that banding spacing is such that the material is held firmly in place. If plant modifications have recently been

conducted, establish that fire barriers removed as interference have been restored.

2. Fire Doors. Observe the material condition of the fire door in the area being inspected. Observe that selected fire doors close without gapping (e.g. due to fire door damage from previous obstructions), and that the door latching hardware functions securely.

3. Ventilation System Fire Dampers. To the extent practical and safe, directly observe the condition of the accessible ventilation fire dampers in the areas being inspected (to ensure fusible link fire dampers are not prematurely shut or obstructed). For those dampers which can not be readily observed in the selected plant areas, review the licensee's surveillance efforts directed towards verifying the continuing operability of ventilation fire dampers.

4. Structural Steel Fire Proofing. Observe the material condition of the structural steel fire-proofing (fibrous or concrete encapsulation) within the areas being inspected. Observe that this material is installed and that the structural steel is uniformly covered (no bare areas).

5. Fire Barrier and Fire Area/Room/Zone Electrical Penetration Seals. Tour plant areas being inspected and observe accessible electrical and piping penetrations. Observe whether any seals are missing from locations in which they appear to be needed to complete a fire barrier or area/room/zone wall, and determine that seals appear to be properly installed and in good condition.

6. Reactor Coolant Pump Oil Collection Systems. If applicable, verify that the licensee has installed a reactor coolant pump oil collection system which is designed to and does collect oil leakage and spray from all potential reactor coolant pump oil system leakage points.

f. Compensatory Measures. Verify that adequate compensatory measures are put in place by the licensee for out-of-service, degraded or inoperable fire protection equipment, systems or features (e.g. detection and suppression systems and equipment, passive fire barrier features, or safe shutdown functions or capabilities). Short term compensatory measures should be adequate to compensate for the degraded function or feature until appropriate corrective action can be taken. Review licensee effectiveness in returning the equipment to service in a reasonable period of time (typically days or weeks).

02.02 Annual Inspection. During the annual observation of a fire brigade drill in a plant area important to safety, evaluate the readiness of the licensee's personnel to prevent and fight fires, including the following aspects:

a. Protective clothing/turnout gear is properly donned.

b. Self-contained breather apparatus (SCBA) equipment is properly worn and used.

c. Fire hose lines are capable of reaching all necessary fire hazard locations, that the lines are laid out without flow constrictions, the hose is simulated being charged with water, and the nozzle is pattern (flow stream) tested prior to entering the fire area of concern.

d. The fire area of concern is entered in a controlled manner (e.g., fire brigade members stay low to the floor and feel the door for heat prior to entry into the fire area of concern).

e. Sufficient fire fighting equipment is brought to the scene by the fire brigade to properly perform their firefighting duties.

f. The fire brigade leader's fire fighting directions are thorough, clear, and effective.

g. Radio communications with the plant operators and between fire brigade members are efficient and effective.

h. Members of the fire brigade check for fire victims and propagation into other plant areas.

i. Effective smoke removal operations were simulated.

j. The fire fighting pre-plan strategies were utilized.

k. The licensee pre-planned the drill scenario was followed, and that the drill objectives acceptance criteria were met.

02.03 Triennial Inspection. Every three years, an inspection team will conduct risk-informed inspection of selected aspects of the licensee's fire protection program. The inspection will emphasize the review of post-fire safe shutdown capability, including the fire protection features provided to ensure that selected aspects the post-fire safe shutdown success path is maintained free of fire damage.

On a temporary basis, while certain associated circuits issues are the subject of an ongoing, voluntary industry initiative, the inspection team leader shall direct the triennial team inspectors, to NOT conduct direct and purposeful inspection of associated circuits issues. Associated circuits are defined in the

"Associated Circuits of Concern" section of the Generic Letter 81-12 Clarification Letter: Mattson to Eisenhut of March 22, 1982 "Fire Protection Rule - Appendix R." Certain exceptions to this temporary restriction are discussed in Section 02.03b.3 below.

a. Inspection Preparation. Select three to five fire areas (fire zones where applicable) important to risk for review. Obtain necessary information for determining post-fire safe shutdown capability and the fire protection features for maintaining post-fire safe shut down path free of fire damage.

b. Inspection Conduct. For the plant areas selected for review, conduct the following inspection efforts:

1. Systems Required to Achieve and Maintain Post-fire Safe Shutdown

Consider whether the licensee's shutdown methodology has properly identified the components and systems necessary to achieve and maintain safe shutdown conditions for each fire area, room and/or zone selected for review. Specifically determine the apparent adequacy of the systems selected for reactivity control, reactor coolant makeup, reactor heat removal, process monitoring and support system functions.

If the above high level performance criteria are not met, review the licensee's engineering and/or licensing justifications (e.g., NRC guidance documents, license amendments, technical specifications, SERs, exemptions, deviations).

To the extent that it is confirmed that a postulated fire in an area under consideration can cause the loss of offsite power, verify that hot and cold shutdown from outside the control room can be achieved and maintained with off-site power not available.

2. Fire Protection of Safe Shutdown Capability

Evaluate the separation of systems, including power, control and instrumentation cables necessary to achieve safe shutdown, and verify that fire protection features are in place to satisfy the separation and design requirements of Section III.G of Appendix R (or, for reactor plants reviewed under the Standard Review Plan, license specific separation requirements).

Verify that the fire detectors and automatic fire suppression systems, associated with 1-hour fire barriers and/or 20 foot areas free of intervening combustibles required by Section III.G.2 of Appendix R (or, for reactor plants reviewed under the Standard Review Plan, license specific requirements), have been adequately installed. Review licensee evaluations which confirm, and verify through observation in the reactor plant, that selected installed automatic detection and suppression systems are installed in accordance with the code of record and would adequately control and suppress fires associated with the hazards of each selected area.

For the plant areas selected, when applicable, verify that redundant trains of systems required for hot shutdown located in the same fire area are not subject to damage from fire suppression activities or from the rupture or inadvertent operation of fire suppression systems. Determine each of the following:

(a) How the licensee has addressed whether a fire in a single location may, indirectly, through the production of smoke, heat, or hot gases, cause activation of potentially damaging fire suppression for all redundant trains,

(b) How the licensee has addressed whether a fire in a single location (or inadvertent actuation or rupture of a fire suppression system) may, through local fire suppression activity, indirectly cause damage to all redundant trains (e.g., sprinkler-caused flooding of other than the locally affected train), and

(c) How the licensee has addressed whether a fire in a single location may cause damage to all redundant trains through the utilization of manually controlled fire suppression systems.

For the plant areas selected, review the adequacy of the design (fire rating) of fire area boundaries (i.e., able to contain the fire hazards of the area), raceway fire barriers, equipment fire barriers, and fixed fire detection and suppression systems.

Evaluate licensee operator recovery action capabilities, plans and timing estimates for smoke removal, dewatering of spaces, controlled re-energization, and return to service of equipment in fire-affected areas for fires in each plant area under consideration.

If a fire brigade drill is observed, consider the lines of inspection inquiry of Section 02.02 above.

3. <u>Post-fire Safe Shutdown Circuit Analysis</u>

Verify that safety-related and non-safety-related cables for selected post fire safe shutdown equipment in selected fire areas have been identified by the licensee and analyzed to show that they would not prevent safe shutdown because of hot shorts, open circuits, or shorts to ground.

The inspector is not precluded from developing findings related to purely deficient licensee performance in these areas. Thus for example, findings are not precluded where they are associated with mathematical errors or invalid plant configuration assumptions. Neither is the inspector precluded from developing findings in the specific associated circuits area of fuse/breaker coordination. However, the restriction does extend to IN 92-18 and multiple high impedance fault (MHIF) concerns (subjects of the current voluntary industry initiative).

Inspect the licensee's electrical systems and electrical circuit analyses with respect to the following:

(a) Common Power Supply/Bus Concern

(1) On a sample basis, for the safe shutdown equipment and cables located in the fire area, verify that circuit breaker coordination and fuse protection have been analyzed, provided and are acceptable as means of protecting the power source of the designated redundant or alternative safe shutdown equipment.

4. Alternative Shutdown Capability

Determine whether the licensee's alternative shutdown methodology has properly identified the components and systems necessary to achieve and maintain safe shutdown conditions for each fire area, room and/or zone selected for review. Specifically determine the apparent adequacy of the systems selected for reactivity control, reactor coolant makeup, reactor heat removal, process monitoring and support system functions.

If the above high level performance criteria are not met, review the licensee's engineering and/or licensing justifications (e.g., NRC guidance documents, license amendments, technical specifications, SERs, exemptions, deviations).

Verify that hot and cold shutdown from outside the control room can be achieved and maintained with off-site power available or not available.

Verify that the transfer of control from the control room to the alternative location has been demonstrated to not be affected by fire-induced circuit faults (e.g. by the provision of separate fuses and power supplies for alternative shutdown control circuits).

5. Operational Implementation of Alternative Shutdown Capability

Verify that the training program for licensed and non-licensed personnel has been expanded to include alternative or dedicated safe shutdown capability.

Verify that personnel required to achieve and maintain the plant in hot shutdown following a fire using the alternative shutdown system can be provided from normal onsite staff, exclusive of the fire brigade.

Verify that adequate procedures for use of the alternative shutdown system exist. Verify the implementation and human factors adequacy of the alternative shutdown procedures by independently "walking through" the procedural steps. Ensure that adequate communications are available for the personnel performing alternative or dedicated safe shutdown. Verify that the operators can reasonably be expected to perform the procedures within applicable shutdown time requirements.

Establish whether the licensee conducts periodic operational tests of the alternative shutdown transfer capability and instrumentation and control functions. In addition, establish whether these tests are adequate to show that if called upon, the alternative shutdown capability would be functional upon transfer.

6. Communications

Verify through inspection of the contents of designated emergency storage lockers and review of alternative shutdown procedures, that portable radio communications and/or fixed emergency communications systems are available, operable, and adequate for the performance of alternative safe shutdown functions. Assess the capability of the communication systems to support the operators in the conduct and coordination of their required actions (e.g., consider ambient noise levels, clarity of reception, reliability, coverage patterns, and survivability). If specific, risk-significant issues arise relating to alternative shutdown communications adequacy, then, on a not-to-interfere with operational safety basis, observe licensee conducted communications tests in the subject plant area or areas.

7. Emergency Lighting

Review emergency lighting provided, either in fixed or portable form, along access routes and egress routes, at control stations, plant parameter monitoring locations, and at manual operating stations:

(a) If emergency lights are powered from a central battery or batteries, verify that the distribution system contains protective devices so that a fire in the area will not cause loss of emergency lighting in any unaffected area needed for safe shutdown operations.

(b) Review the manufacturer's information to verify that battery power supplies are rated with at least an 8-hour capacity.

(c) Determine if the operability testing and maintenance of the lighting units follow licensee procedures and accepted industry practice.

(d) Verify that sufficient illumination is provided to permit access for the monitoring of safe shutdown indications and/or the proper operation of safe shutdown equipment.

(e) Verify that emergency lighting unit batteries are being properly maintained (observe the unit's lamp or meter charge rate indication, and specific gravity indication).

8. Cold Shutdown Repairs

Verify that the licensee has dedicated repair procedures, equipment, and materials to accomplish repairs of damaged components required for cold shutdown, that these components can be made operable, and that cold shutdown can be achieved within time frames specified by Appendix R to 10 CFR Part 50 (or, for reactor plants reviewed under the Standard Review Plan, license specific requirements). Verify that the repair equipment, components, tools, and materials (e.g., pre-cut cable connectors with prepared attachment lugs) are available on site.

9. Fire Barrier and Fire Area/Zone/Room Penetration Seals |

Selectively verify through review of installation records that material of an appropriate fire resistence rating (equal to the overall rating of the barrier itself) has been used to fill the opening/penetration .

10. Fire Protection Systems, Features and Equipment

In selected plant locations, review the material condition, operational lineup, operational effectiveness and design of fire detection systems, fire suppression systems, manual fire fighting equipment, fire brigade capabilities, and passive fire protection features. Establish that selected fire detection systems, sprinkler systems, gaseous suppression systems, portable fire extinguishers and hose stations are installed in accordance with their design, and that their design is adequate given the current equipment layout and plant configuration.

11. Compensatory Measures

Verify that adequate compensatory measures are put in place by the licensee for out-of-service, degraded or inoperable fire protection and post-fire safe shutdown equipment, systems or features (e.g. detection and suppression systems and equipment, passive fire barrier features, or pumps, valves or electrical devices providing safe shutdown functions or capabilities). Short term compensatory measures should be adequate to compensate for the degraded function or feature until appropriate corrective action can be taken. Review licensee effectiveness in returning the equipment to service in a reasonable period of time (typically days or weeks).

02.04 Identification and Resolution of Problems. During routine (quarterly and annual) resident inspection and triennial team inspection, verify that the licensee is identifying issues related to this inspection area at an appropriate threshold and entering them in the corrective action program. For a sample of selected issues documented in the corrective action program, verify that the corrective actions are appropriate. See Inspection Procedure 71152, "Identification and Resolution of Problems," for additional guidance.

71111.05-03 INSPECTION GUIDANCE

General Guidance

Routine Inspection. See Attachment 1.

The main focus of the resident inspector's activities is on the material condition and operational status of fire detection and suppression systems and equipment, and fire barriers used to prevent fire damage or fire propagation. The six to twelve plant areas to be inspected should be selected on the basis of site-specific risk worksheets.

Triennial Inspection

Objective. The triennial inspection is primarily a risk-informed look at the mitigation elements of fire protection defense in depth (DID) (i.e., detection, suppression, and confinement of fires through passive barriers, and the fire protection features and procedures which establish the licensee's ability to achieve and maintain post-fire safe shutdown conditions during and after a fire). The triennial inspection is that portion of the baseline inspection program that focuses on the design of reactor plant fire protection and post-fire safe shutdown systems, features, and procedures. The inspection team leader will manage and coordinate the conduct of an inspection emphasizing post-fire safe shutdown. The team will use plant-specific risk, event, and technical information (including the results of licensee self-assessments) to confirm that selected aspects of one train of safe shutdown equipment (capable of providing reactivity control, reactor coolant makeup, reactor heat removal, and process monitoring and support functions) is free of potential fire damage.

Inspection Team and Responsibilities. The team assigned to conduct the multi-disciplinary triennial fire protection inspection would include a fire protection inspector, an electrical inspector, and a reactor systems/mechanical systems inspector.

1. Reactor Systems/Mechanical Systems Inspector (RSI). The reactor systems/mechanical systems inspector (RSI) will assess the capability of reactor and balance-of-plant systems, equipment, operating personnel, and procedures to achieve and maintain post-fire safe shutdown and minimize the release of radioactivity to the environment in the event of fire. Therefore, the inspection team leader will ensure that he is knowledgeable regarding integrated plant operations, maintenance, testing, surveillance and quality assurance, reactor normal and off-normal operating procedures, and BWR and/or PWR nuclear and balance-of-plant systems design.

2. Electrical Inspector (EI). The EI will identify electrical separation requirements for redundant train power, control, and instrumentation cables. He will review alternative shutdown panel electrical isolation design to establish the panels' electrical independence from postulated fire areas. Therefore, the inspection team leader will ensure that he is knowledgeable regarding reactor plant electrical and instrumentation and control (I&C) design and is familiar with industry ampacity derating standards.

3. Fire Protection Inspector (FPI). The FPI will work with other team members in determining the effectiveness of the fire barriers and systems that establish the reactor plant's post-fire safe shutdown configuration and maintain it free of fire damage. He will determine whether suitable fire protection features (suppression, separation distance, fire barriers, etc.) are provided for the separation of equipment and cables required to ensure plant safety. Therefore, the inspection team leader will ensure he is knowledgeable regarding reactor plant fire protection systems, features and procedures.

Regulatory Requirements and Licensing Bases. The regulatory requirements and licensing bases against which post-fire safe shutdown capability is assessed are as follows:

1. Plants licensed before January 1, 1979. Effective February 17, 1981, the NRC amended its regulations by adding Section 50.48 and Appendix R to 10

CFR Part 50 to require certain provisions for fire protection in nuclear power plants licensed to operate before January 1, 1979. This action was taken to resolve certain contested generic issues in fire protection safety evaluation reports (SERs), and (1) to require all applicable licensees to upgrade their plants to a level of fire protection equivalent to the technical requirements in Sections III.G, J, L, and O of 10 CFR Part 50, Appendix R, and (2) to require all applicable licensees to meet all other requirements of Appendix R to the extent that comparable items had not been closed out in pre-Appendix R SERs (under Appendix A of the Branch Technical Position). Licensees were required to meet the separation requirements of Section III.G.2, the alternative or dedicated shutdown capability requirements of Sections III.G.3 and III.L, or to request an exemption in accordance with 10 CFR 50.48. Alternative or dedicated safe shutdown capabilities were required to be submitted to the Office of Nuclear Reactor Regulation (NRR) for review. NRR approvals are documented in SERs.

2. <u>Plants licensed after January 1, 1979</u>. These plants are subject to requirements similar to those in 10 CFR part 50, Appendix R, as specified in the conditions of their facility operating license, commitments made to the NRC, or deviations granted by the NRC. These reactor plants licensed after January 1, 1979, are subject to 10 CFR 50.48 (a) and (e) only.

   The fire hazards analysis (FHA) ("Fire Protection Review, Fire Protection Evaluation") document of the reactor plants licensed after January 1, 1979, may have been reviewed under Appendix A to Branch Technical Position APCSB 9.5-1, "Guidelines for Fire Protection for Nuclear power Plants Docketed Prior to July 1, 1976," of August 23, 1976 (in which case, the licensee conducted an Appendix R comparison and justified final safety analysis report (FSAR) or FHA differences from the specific provisions of Appendix R). It is possible also that licensee submittals for plants licensed after January 1, 1979, were reviewed under the Standard Review Plan, NUREG-0800, and Branch Technical Position (BTP) CMEB 9.5-1 (formerly BTP ASB 9.5-1), "Guidelines for Fire Protection for Nuclear Power Plants," Rev. 2 (July 1981) (in which case, licensee submittals were reviewed according to requirements that closely paralleled the provisions of Appendix R).

   The actual fire protection requirements applicable to a given reactor plant licensed after January 1, 1979, arise from the specific license conditions in the facility operating license. These license conditions possibly refer to SERs and their supplements. Section 9.5 of such an SER delineates which licensee submittals were reviewed (e.g., a fire hazards analysis would be such a submittal).

3. All changes to fire protection license conditions which have been placed in the reactor plant's FSAR/USAR may be conducted under 10 CFR 50.59.

Inspection Process

1. Licensee Notification Letter. The licensee should be notified of the triennial inspection in writing at least three months in advance of the onsite week. The information gathering visit shall be conducted no fewer than three weeks in advance of the onsite inspection week. The letter should discuss the scope of the inspection, request an information-gathering visit to the licensee reactor site/engineering offices, discuss documentation and licensee personnel availability needs during the onsite inspection week, and request a pre-inspection conference call to discuss administrative matters and finalize inspection activity plans and schedules. A template for an NRC to licensee triennial fire protection baseline inspection notification letter is provided as Attachment 2.

2. Information-gathering Site Visit. The inspection team leader should conduct a two to three day information gathering site visit. The purposes of the information gathering site visit are to (1) gather site-specific information important to inspection planning, and (2) conduct initial discussions with licensee representatives regarding administrative items and inspection activity plans and schedules. In advance of the information-gathering site visit, the team leader should provide the licensee with a list of information and documents that may be needed for the team to prepare for and conduct the triennial inspection, as well as a list of any planned requests for licensee conducted evolutions (e.g., emergency lighting tests, communication tests, fire drills, shutdown walkthroughs, etc.).

2. Information Required/Preparation. The team members should gather sufficient information to become familiar with the following during preparation period:

   (a) The reactor plant's design, layout, and equipment configuration.

   (b) The reactor plant's current post-fire safe shutdown licensing basis through review of 10 CFR 50.48, 10 CFR Part 50 Appendix R (if applicable), NRC safety evaluation reports (SERs) on fire protection, the plant's operating license, updated final safety analysis report (UFSAR), and approved exemptions or deviations.

   (c) The licensee's strategy and methodology, and derivative procedures, for accomplishing post-fire safe shutdown conditions. Among the sources of information are the updated final safety analysis report (UFSAR), the latest version of the fire hazards analysis (FHA), the latest version of the post-fire safe shutdown analysis (SSA), fire protection/post-fire safe-shutdown related 10 CFR 50.59 and Generic Letter 86-10 review documentation and modification packages, plant drawings, emergency/abnormal operating procedures, and the results of licensee internal audits (e.g., self assessments and quality assurance (QA) audits in the fire protection and post-fire safe shutdown areas).

(d) The historical record of plant-specific fire protection issues through review of plant-specific documents such as previous NRC inspection results, internal audits performed by the reactor licensee (e.g., self-assessments and quality assurance audits), corrective action system records, event notifications submitted in accordance with 10 CFR 50.72, and licensee event reports (LERs) submitted in accordance with 10 CFR 50.73.

(e) The safe shutdown systems and support systems credited by the licensee's analysis for each fire area, room, or zone for accomplishing of the required shutdown functions (e.g., reactivity control, reactor coolant makeup, reactor heat removal, and process monitoring and support functions) as necessary to comply with the safe shutdown requirements of 10 CFR 50.48(a) and plant-specific licensing requirements. The shutdown logic for each area, room, or zone to be inspected must be thoroughly understood by the team members.

(f) The licensee's analytical approach for electrical circuits separation analyses, and the licensee's methodology for identification and resolution of associated circuits of concern. The team's electrical review should include addressing the assumptions and boundary conditions used in the performance of the licensee's analyses.

Specific Guidance

03.01 Routine Inspection. The resident inspector should not attempt to address all plant areas each inspection. The routine plant tour should focus on six to twelve plant areas important to risk. The resident inspector should note transient combustibles and ignition sources (and compare these with the limits provided in licensee administrative procedures). The resident inspector should also note the material condition and operational status (rather than the design) of fire detection and suppression systems, and fire barriers used to prevent fire damage or fire propagation.

03.02 No specific guidance provided

03.03 Triennial Inspection

1. Prior to the inspection information gathering trip, the team leader should contact the regional senior reactor analyst (SRA) to obtain summary of plant specific fire risk insights (e.g., fire risk ranking of the rooms/plant fire areas, conditional core damage probabilities (CCDPs) for those rooms and areas, and transient

sequences for these rooms). After considering the focus of past fire protection and post-fire safe shutdown inspections, the team leader should select three to five fire areas important to risk for inspection

2. The fire protection and post-fire safe shutdown information.gathered should focus on the samples selected.

3. After the information gathering site visit, the team leader should use the SRA developed fire risk insights, as well as technical input from the other team members, to develop an inspection plan addressing (for the selected three to five fire areas, zones, as applicable) post-fire safe shutdown capability and the fire protection features for maintaining one success path of this capability free of fire damage.

Inspection Requirement 02.03b2 Short term compensatory measures should be adequate to compensate for the degraded function or feature until appropriate corrective action can be taken.

03.04 Identification and Resolution of Problems. No specific guidance is provided.

71111.05-04 RESOURCE ESTIMATE

The resource to perform this inspection procedure is estimated to be, on average, 33 hours per year for routine inspection including approximately 2 hours for annual observation of a fire drill and 200 hours every 3 years for the triennial inspection regardless of the number of reactor units at the site.

71111.05-05 REFERENCES

The SDP Guideline "Appendix 4 - Determining Potential Risk Significance of Fire Protection and Post-fire Safe Shutdown Inspection Findings."

Appendix H of the Fire Protection Supplemental Inspection Procedure (FPSI) "Guidance for Making a Qualitative Assessment of Fire Protection Inspection Findings, Fire Protection Risk Significance Screening Methodology" [FPRSSM])

Inspection Procedure 71152, "Identification and Resolution of Problems."

Generic Letter 91-18 "Information to Licensees Regarding Two NRC Inspection Manual Sections on Resolution of Degraded and Non-conforming Conditions and on Operability."

Information Notice 97-48 "Inadequate or Inappropriate Interim Fire Protection Compensatory Measures," July 9, 1997

NRC Internal Memorandum dated August 17, 1998, from John N. Hannon to Arthur T. Howell titled "Response to Region IV Task Interface Agreement (TIA) (96TIA008) - Evaluation of Definition of Continuous Fire Watch (TAC No. M96550).

Individual Plant Examination of Externally Initiated Events(IPEEE)

END

ATTACHMENT 1
ROUTINE INSPECTION GUIDANCE TABLE

CORNERSTONE	RISK PRIORITY	EXAMPLES
INITIATING EVENTS	Equipment or actions that could cause or contribute to initiation of fires in plant areas important to safety or near equipment required for safe shutdown.	Transient combustibles (rags, wood, ion exchange resin, lubricating oil, or Anti-Cs) are not in areas where transient combustibles are prohibited. Transient combustible amounts in other areas do not exceed administrative controls. Ignition sources (welding, grinding, brazing, flame cutting) have a fire watch. Planning includes precautions and additional fire prevention measures where these activities are near combustibles.

MITIGATING SYSTEMS	Functionality of fire barriers in plant areas important to safety. Functionality of detection systems in plant area important to safety. Functionality of automatic suppression systems in plant areas important to safety. Fire brigade manual suppression effectiveness. Compensatory measures for degraded fire detection systems, fire suppression features, and barriers to fire propagation.	Doors and dampers that prevent the spread of fires to/or between plant areas important to safety remain in place and are functional. Electrical raceway fire barriers and penetration seals that protect the post-fire safe-shutdown train are not damaged. Fire detection and alarm system is functional for plant areas important to safety. Automatic suppression system sprinklers are functional and their sprinkler head patterns are not blocked by plant equipment. Fire brigade performance indicates a prompt response with proper fire fighting techniques for the type of fire encountered. Manual fire suppression equipment is of the proper type and has been tested. Degraded fire detection equipment, suppression features and fire propagation barriers are adequately compensated for on reasonably short-term bases.

ATTACHMENT 2

Mr. , President
Licensee Nuclear Department
Licensee Corporation or Company
Address

SUBJECT: SELECTED NUCLEAR POWER STATION, UNITS 1 AND 2 - NOTIFICATION OF CONDUCT OF A TRIENNIAL FIRE PROTECTION BASELINE INSPECTION

Dear Mr. :

The purpose of this letter is to notify you that the U.S. Nuclear Regulatory Commission (NRC) Region # staff will conduct a triennial fire protection baseline inspection at Selected Nuclear Power Station, Units 1 and 2 in Month, 20##. The inspection team will be lead by First Last, a fire protection specialist from the NRC Region # Office. The team will be composed of personnel from NRC Region #, and Contracted National Laboratory. The inspection will be conducted in accordance with IP 71111.05, the NRC's baseline fire protection inspection procedure.

The schedule for the inspection is as follows:

- Information gathering visit - Month ##-##, 20## [Note - this date is pre-coordinated with the licensee]
- Week of onsite inspection - Month ##, 20##.

The purposes of the information gathering visit are to obtain information and documentation needed to support the inspection, to become familiar with the Selected Nuclear Power Station, Units 1 and 2 fire protection programs, fire protection features, and post-fire safe shutdown capabilities and plant layout, and, as necessary, obtain plant specific site access training and badging for unescorted site access. A list of the types of documents the team may be interested in reviewing, and possibly obtaining, are listed in Enclosure 1.

During the information gathering visit, the team will also discuss the following inspection support administrative details: office space size and location; specific documents requested to be made available to the team in their office spaces; arrangements for reactor site access (including radiation protection training, security, safety and fitness for duty requirements); and the availability of knowledgeable plant engineering and licensing organization personnel to serve as points of contact during the inspection.

We request that during the onsite inspection week you ensure that copies of analyses, evaluations or documentation regarding the implementation and maintenance of the Selected Nuclear Generating Station, Units 1 and 2 fire protection program, including post-fire safe shutdown capability, be readily accessible to the team for their review. Of specific interest are those documents which establish that your fire protection program satisfies NRC regulatory requirements and conforms to applicable NRC and industry fire protection guidance. Also, personnel should be available at the site during the inspection who are knowledgeable regarding those plant systems required to achieve and maintain safe shutdown conditions from inside and outside the control room (including the electrical aspects of the relevant post-fire safe shutdown analyses), reactor plant fire protection systems and features, and the Selected Nuclear Power Station fire protection program and its implementation.

Your cooperation and support during this inspection will be appreciated. If you have questions concerning this inspection, or the inspection team's information or logistical needs, please contact First Last, the team leader, in the Region # Office at ###-###-####.

Sincerely,

Docket Nos.: 50-###
and 50-###

Enclosure: As stated (1)

Reactor Fire Protection Program Supporting Documentation

[Note: This is a broad list of the documents the NRC inspection team may be interested in reviewing, and possibly obtaining, during the information gathering site visit.]

1. The current version of the Fire Protection Program and Fire Hazards Analysis.

2. Current versions of the fire protection program implementing procedures (e.g., administrative controls, surveillance testing, fire brigade).

3. Fire brigade training program and pre-fire plans.

4. Post-fire safe shutdown systems and separation analysis.

5. Post-fire alternative shutdown analysis.

6. Piping and instrumentation (flow) diagrams showing the components used to achieve and maintain hot standby and cold shutdown for fires outside the control room and those components used for those areas requiring alternative shutdown capability.

7. Plant layout and equipment drawings which identify the physical plant locations of hot standby and cold shutdown equipment.

8. Plant layout drawings which identify plant fire area delineation, areas protected by automatic fire suppression and detection, and the locations of fire protection equipment.

9. Plant layout drawings which identify the general location of the post-fire emergency lighting units.

10. Plant operating procedures which would be used and describe shutdown from inside the control room with a postulated fire occurring in any plant area outside the control room, procedures which would be used to implement alternative shutdown capability in the event of a fire in either the control or cable spreading room.

11. Maintenance and surveillance testing procedures for alternative shutdown capability and fire barriers, detectors, pumps and suppression systems.

12. Maintenance procedures which routinely verify fuse breaker coordination in accordance with the post-fire safe shutdown coordination analysis.

13. A sample of significant fire protection and post-fire safe shutdown related design change packages (including their associated 10 CFR 50.59 evaluations) and Generic Letter 86-10 evaluations.

14. The reactor plant's IPEEE, results of any post-IPEEE reviews, and listings of actions taken/plant modifications conducted in response to IPEEE information.

15. Temporary modification procedures.

16. Organization charts of site personnel down to the level of fire protection staff personnel.

17. If applicable, layout/arrangement drawings of potential reactor coolant/recirculation pump lube oil system leakage points and associated lube oil collection systems.

18. A listing of the SERs and actual copies of the 50.59 reviews which form the licensing basis for the reactor plant's post-fire safe shutdown configuration.

19. Procedures/instructions that control the configuration of the reactor plant's fire protection program, features, and post-fire safe shutdown methodology and system design.

22. A list of applicable codes and standards related to the design of plant fire protection features and evaluations of code deviations.

23. Procedures/instructions that govern the implementation of plant modifications, maintenance, and special operations, and their impact on fire protection.

24. The three most recent fire protection QA audits and/or fire protection self-assessments.

25. Recent QA surveillances of fire protection activities.

26. A listing of open and closed fire protection condition reports (problem reports/NCRs/EARs/problem identification and resolution reports).

27. Listing of plant fire protection licensing basis documents.

28. A listing of the NFPA code versions committed to (NFPA codes of record).

29. A listing of plant deviations from code commitments.

30. Actual copies of Generic Letter 86-10 evaluations.

END

Performance-Based Deterministic Safe Shutdown Analysis

Robert Kalantari and Mark Schairer

EPM

Engineering Planning and Management, Inc.

Introduction

- A unique approach to safe shutdown analysis
- Utilizes in part NPFA 805 techniques and guidelines
- It is deterministic
- <u>But</u> it is Performance-Based
- Does not deal with probabilities
- But addresses real fires with realistic engineering evaluation
- It is Performance-Based, Risk Informed (but, It is Not PRA)

Definition

- Performance Based:[1]

An engineering approach based on:

1. Fire safety goals, loss and design objectives
2. Evaluation of fire initiation and growth
3. Physical and chemical properties of fire
4. Quantitative assessment of design alternatives

[1]Introduction to Performance-Based Fire Safety, Custer and Meacham

Performance-Based

- No preconceived "rules" related to separation between redundant safety systems

Instead of saying:	Stated as:
Redundant systems shall be separated by at least 6 meters	Redundant systems shall be separated sufficiently

Nothing is New

- The more things change the more they stay the same
- 19 years of Appendix R Utilities have always been able to use deterministic, non-quantitative Risk Informed techniques
- The NRC staff has always reluctantly accepted the same
- NFPA 805 refines and specifies long standing industry techniques

The Pain Will Probably Remain

- NRC historically was concerned with "Loss of control"
- Worried about excessive NRC (or contractor) manpower for review of more sophisticated approaches
- Discouraged the licensees to use this approach
- Relegated to a research project

Process Overview

- Is based on NRC requirements/expectations
  - Assumes multiple shorts (i.e., Hot shorts, shorts to ground, etc)
  - Doesn't limit the number of failures
- Doesn't limit the number of spurious operations
- Utilizes NFPA 805 guidelines

Comparison

- Difference Between this approach and 10CFR 50 Appendix R
  - Appendix R requires evaluating the impact of total loss of SSD equipment in the area
  - Appendix R requires evaluating the consequences of random fire in any fire area
  - This approach evaluates only real fires based on real hazards
  - Does not postulate fires if there are no fire hazards or fire initiators

Benefits

- Realistic Approach to Fire Hazards and Safe Shutdown Analysis
- More Focus on Hazard
- Flexible use (i.e. Canadian Plants)
- Allows for more realistic resolutions
- Requires more engineering time for analysis, calculations, and documentation, however, results are focused resolutions and less modifications

Methodology

- Determine Plant Performance Goals
- Select SSD Systems, Cables, Components
- Locate SSD Cables, Components
- Identify Hazards
- Evaluate Potential Impact of Hazards
- Identify Issues, problem areas
- Propose Resolutions

Assumptions/Requirements

- Plant needs to have a solid electrical protection system (i.e. adequate fuse/breaker and coordination)
- Good Administrative Control Programs
  - Transient combustible control
  - Cutting and Welding
  - Good housekeeping
- Capable Fire Brigade (Fire Emergency Response Team)

Performance Goals

- Demonstrate capability of the plant to achieve fire safe shutdown
  - Reactor Shutdown
  - Decay Heat Removal
  - Monitoring of Plant Parameters
  - Barrier to Fission Product Release
  - Supporting Functions

SSD System Selection

- Identify a minimum set of plant systems, functions and equipment that can be used to satisfy the performance goals
- Safe Shutdown System Components, and Cable Selection is based on strict requirements (Similar to the NFPA 805 Appendix B Guidelines)

SSD Model

- Computerized model is developed that maintains information on performance goals, systems, functions, equipment, cables, and their associated fire zone locations within the plant.
- Logical relationships are established in the FSSA database used to develop a cable to fire zone location based on cable raceway routes

Engineering Evaluation

- Divide Plant into smaller Fire Zones
- Locate SSD cables and/or equipment and assign to a specific Fire Zone
- Input data into computer software
- Screen Fire Zones based on results of computer-assisted analysis

Fire Zone Screening

- Screen 1:
  - No credited equipment and/or cable
- Screen 2:
  - Performance goals can still be met, even with loss of all credited equipment and/or cable
- Screen 3:
  - One or more performance goals cannot be met, due to loss of all credited equipment and/or cable

Screen 1 Fire Zone Analysis

- No credited equipment and/or cable
- Identify fire sources and hazards
  - Postulate potential impact of fires on adjacent Screen 2 or Screen 3 Fire Zones
  - Evaluate Screen 1 Fire Zone boundaries
- No further analysis for Screen 1 fire zones with no hazards necessary
- Walkdowns and/or plant drawings

Screen 2 Fire Zone Analysis

- Identify fire sources and hazards
- Evaluate potential to spread to adjacent Screen 2 or Screen 3 Fire Zones
- Assure that no single fire could impact redundant shutdown systems
- Combine Screen 2 Fire Zones where applicable
- Walkdowns and/or plant drawings

Screen 3 Fire Zone Analysis

- Combination of Walkdowns and/or plant drawings
- Identify fire sources and hazards
  - Postulate potential impact of fires on targets
- Evaluate potential to spread to adjacent Screen 2 or Screen 3 Fire Zones
- Assure that no single fire could impact redundant shutdown systems

Walkdowns

- Building construction type
- General plant layout
- Type and quantity of combustible materials and ignition sources
- Location of major plant equipment
- Installed fire protection features
- Credited cables and equipment

Locating Targets

- Locate targets
  - Architectural/Plant Layout Drawings
  - FHA/ Pre-fire plan drawings
  - Cable Information Database
  - System Engineers
  - Verify via Walkdown

Fire Protection Features

- Any of the following may be credited:
  - Water Supply System
  - Fire Detection and Alarm Systems
  - Automatic Fire Suppression Systems
  - Manual Fire Suppression Systems
  - Fire Barriers

Identification of Hazards

- Via plant walkdowns
- Documentation of potential fire sources
  - Pumps (Lubricating oil)
  - Electrical Motors
  - Ventilated Electrical Cabinets
  - Storage and Laydown Areas
  - Transients (i.e. trash collection areas)

Fire Modeling

- Evaluate plant hazards using fire model
- Calculate Critical Distance Range
- Calculate Hot Gas Layer if applicable
- Determine which targets fall within range
- Fire Models are conservative

Fire Model

- EPRI FIVE Methodology
- Input Parameters
  - Damage Threshold for Target
  - Ambient Room Temperature
  - Peak Heat Release Rate of Fuel
  - Total Heat Release of Fuel
  - Room Dimensions
  - Location Factor
  - Configuration of target

Types of Failure

- Direct Plume Impingement
- Ceiling Jet Impingement
- Thermal Radiant Exposure
- Hot Gas Layer
- Target is Hazard
- Propagation along cable trays

Identification of Issues

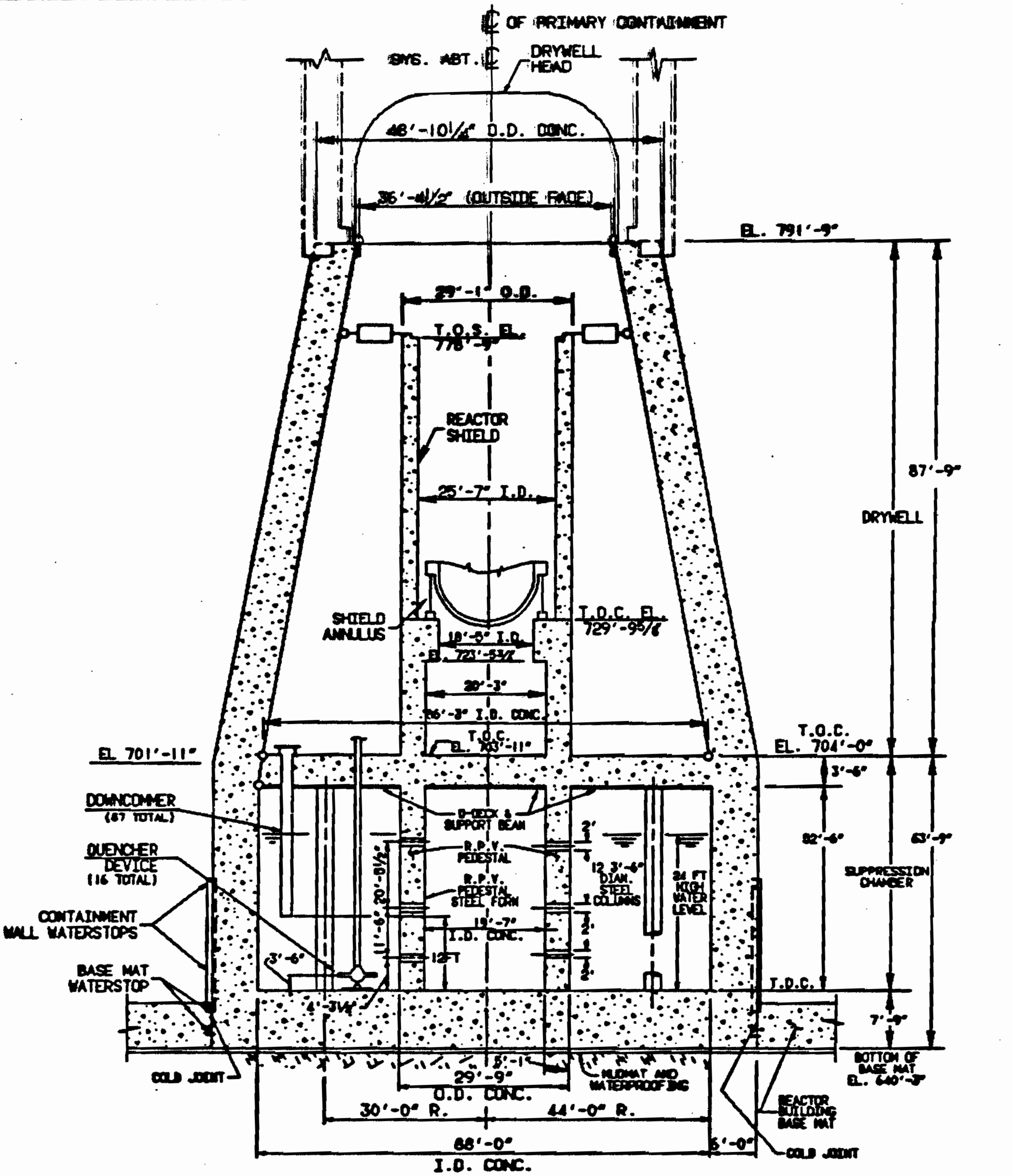
- Document the failure of specific targets with each potential fire scenario
- Using Computer-assisted analysis, re-run scenarios
- Issues arise only from fire scenarios where performance goals are not met
- Resolve issues

Example Resolutions

- Remove Hazard
- Reduce Hazard (i.e. dike around pump)
- Provide Protection to Cable Tray
- Install/Upgrade Detection Systems
- Install/Upgrade Suppression Systems
- Provide Barrier Protection
- Operator Actions

Conclusion

- Performance-Based
- Deterministic
- Realistic Fire Scenarios
- Realistic Issues
- Realistic Resolutions
- Assures that no single fire could compromise safe shutdown performance goals



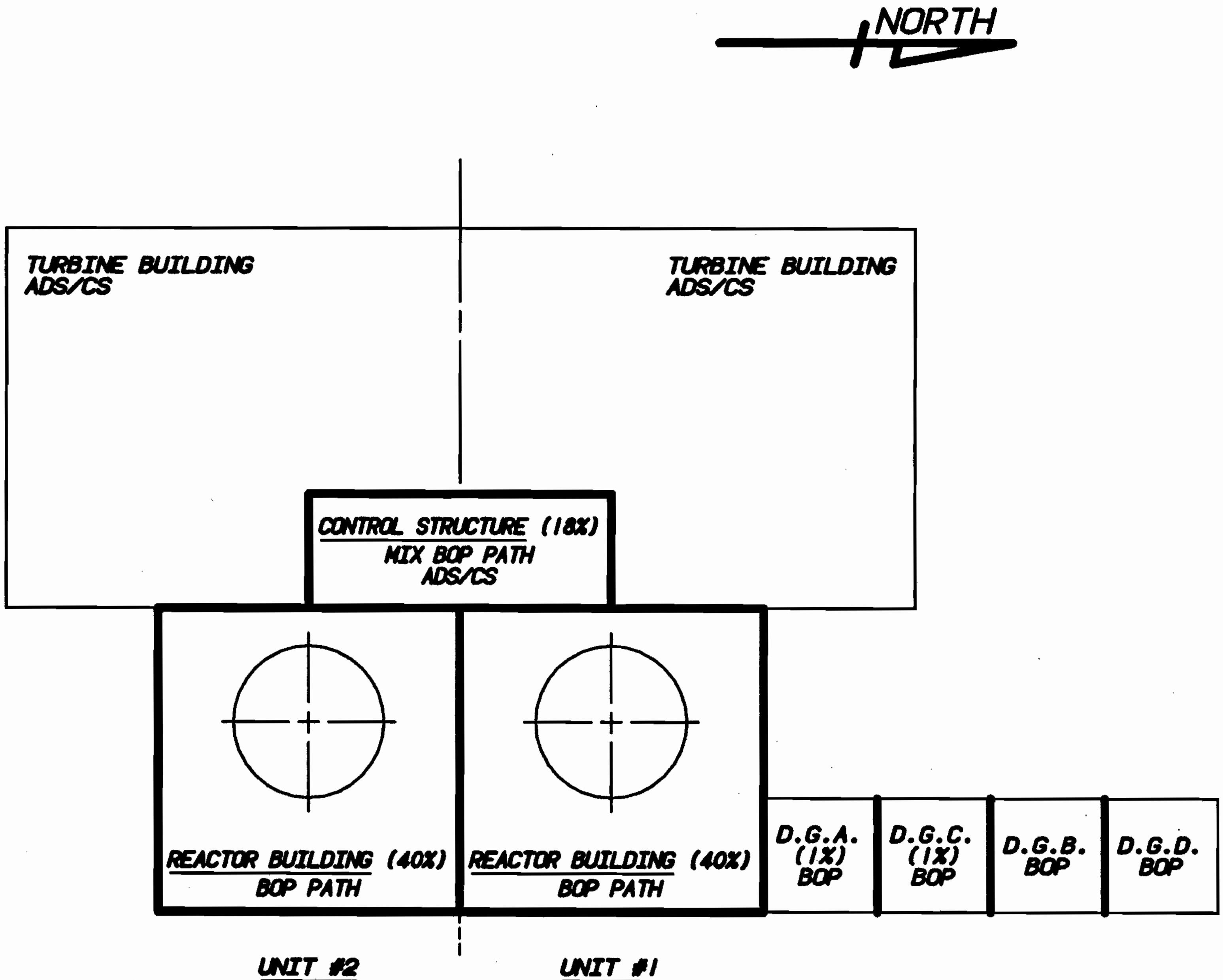
PE023. .A219725.001.000.A 2/91

SUSQUEHANNA STEAM ELECTRIC STATION
BERWICK, PENNSYLVANIA

INDIVIDUAL PLANT EVALUATION

THE PRIMARY CONTAINMENT

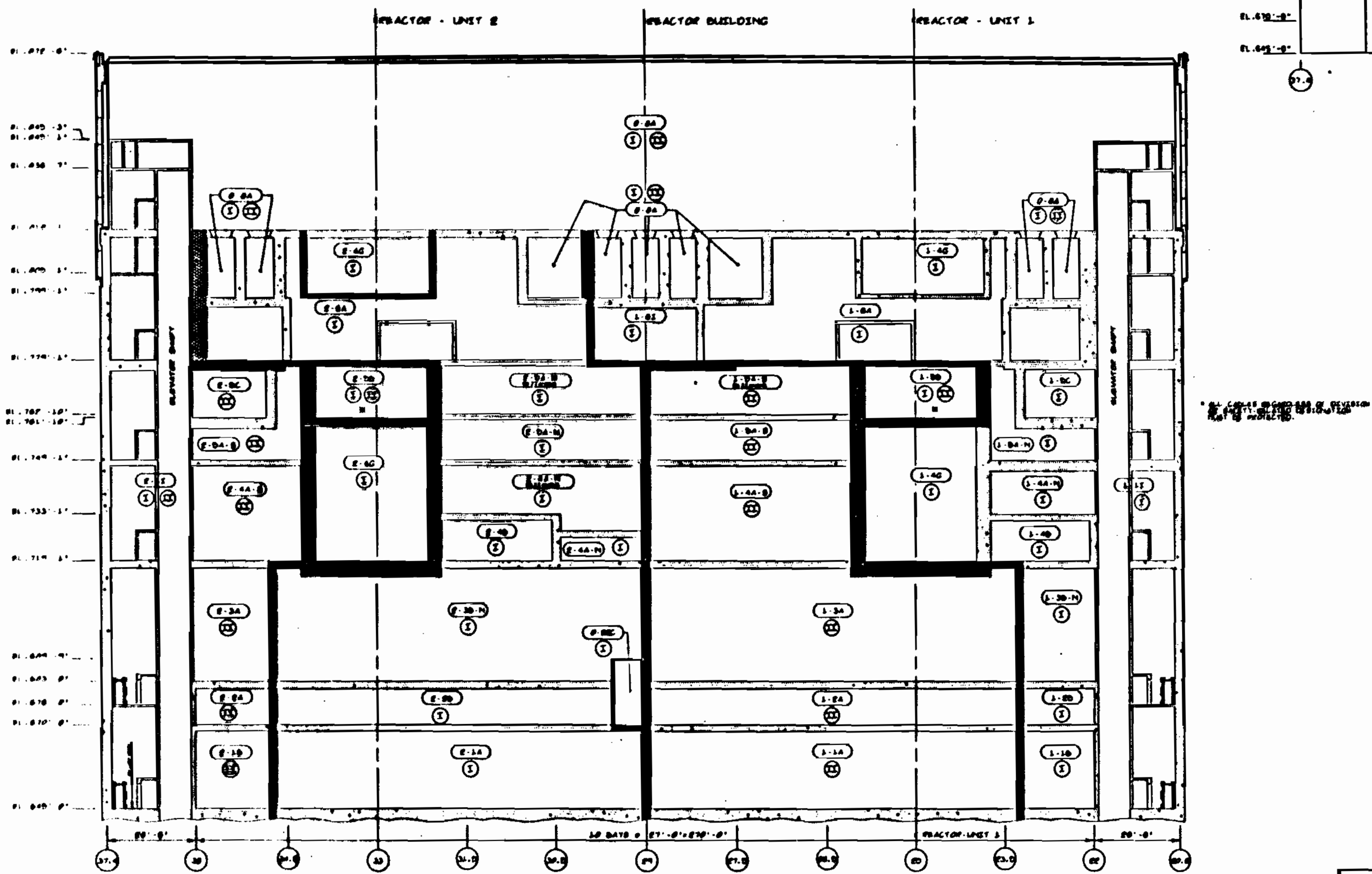
FIGURE A.2.6



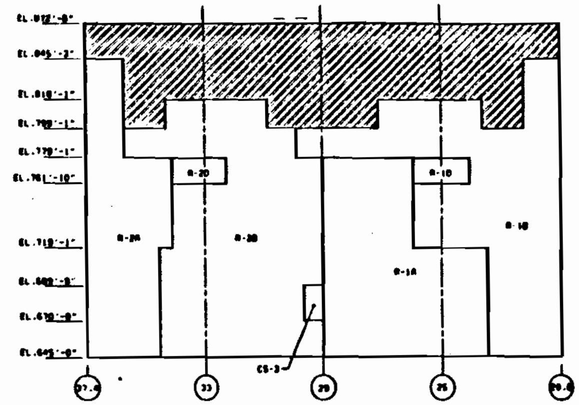
PLAN VIEW

SSES
APPENDIX R
SHUTDOWN PATHS

APDXR. .SHTDWN .PAT.HS .*



SECTION C-C



FIRE AREA KEY PLAN

BUFFER ZONE

NOTES

1) PROTECTED SAFE SHUTDOWN PATH (I.E. DIVISION) IS DEFINED AS THOSE SAFE SHUTDOWN CABLES AND COMPONENTS WHICH MUST BE PROTECTED FROM FIRE DAMAGE WITHIN THE DESIGNATED FIRE ZONE. WHERE BOTH DIVISIONS ARE SHOWN, BOTH DIVISIONS MUST BE PROTECTED.

LEGEND

(oval)	FIRE ZONE
(I)	DIVISION I PROTECTED SAFE SHUTDOWN PATH
(II)	DIVISION II PROTECTED SAFE SHUTDOWN PATH
(line)	FIRE ZONE BOUNDARY
(hatched)	3 HR. FIRE-RATED WALLS

A-11 THRU A-17 AE DRAWING NO.		E-105004, SHTS. 1 THRU 7 PP&L DRAWING NO.			
REFERENCE DRAWINGS					
3	ADDED FIRE AREAS				
2	PER ENGINEERING INFO. AND DCN 11 (87-3520)			TAC	
1	PER ENGINEERING INFO. AND DCN 87-0707			TAC	
0	INITIAL ISSUE			TAC	
REV	DESCRIPTION	BY	CH	APPROVED	DATE

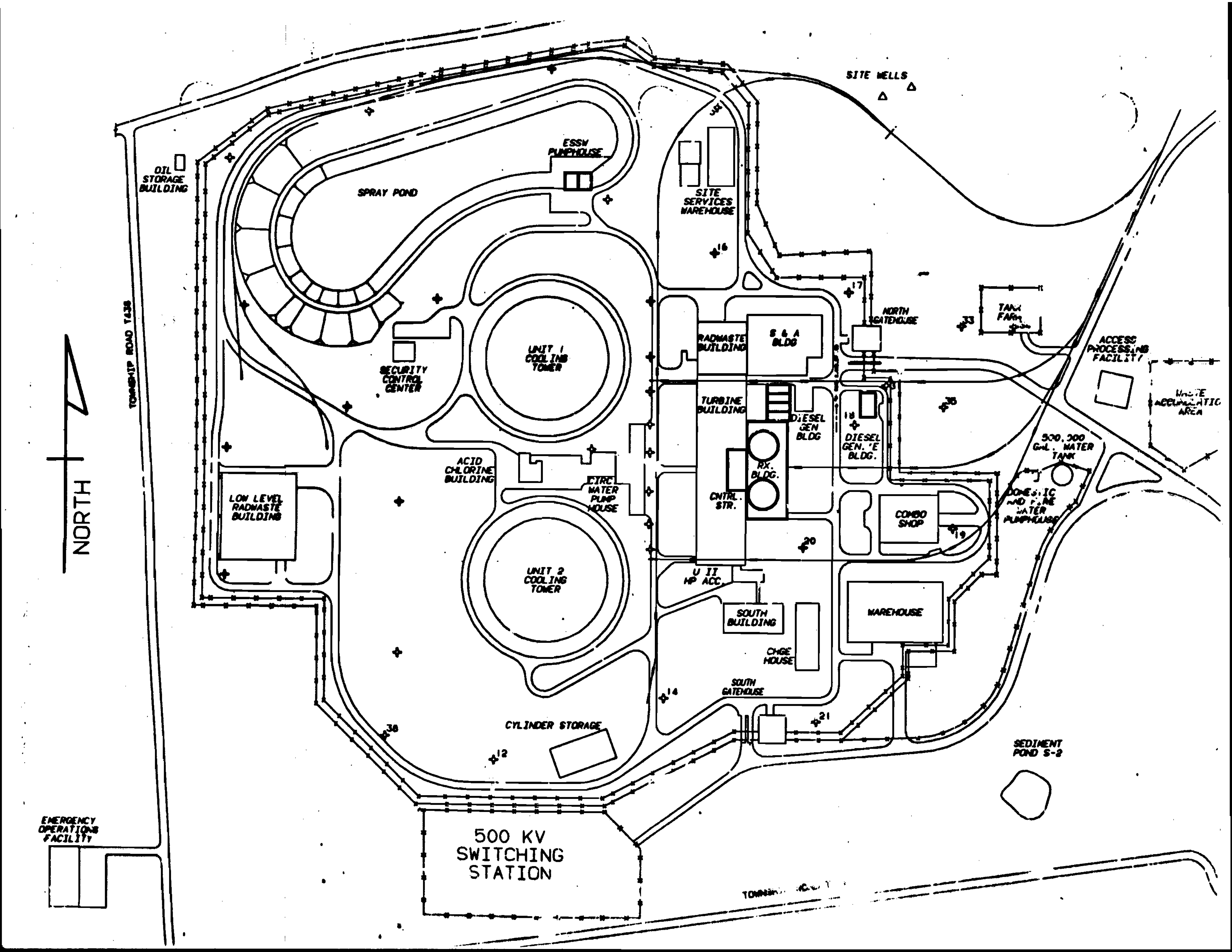
NON QUALITY RELATED

SUSQUEHANNA S.E.S.
UNITS 1&2
SECTION C-C

AREA 25,27,30,32 | ELEV. ALL | SCALE-NONE

PENNSYLVANIA POWER & LIGHT COMPANY
ALLENTOWN PA.

PP&L DRAWING NO. E205967 — SHEET NO. 1 — REV. NO. 3
AE DRAWING NO. C-1738 — SHEET NO. 1


NORTH
TOWNSHIP ROAD T436
OIL STORAGE BUILDING
SPRAY POND
ESSW PUMPHOUSE
SITE SERVICES WAREHOUSE
SITE WELLS
SECURITY CONTROL CENTER
UNIT 1 COOLING TOWER
UNIT 2 COOLING TOWER
RADWASTE BUILDING
S & A BLDG
NORTH GATEHOUSE
TANK FARM
ACCESS PROCESSING FACILITY
TURBINE BUILDING
DIESEL GEN BLDG
DIESEL GEN. E BLDG.
RX. BLDG.
CNTRL. STR.
ACID CHLORINE BUILDING
CIRC WATER PUMP HOUSE
LOW LEVEL RADWASTE BUILDING
COMBO SHOP
500,000 GAL. WATER TANK
U II HP ACC.
SOUTH BUILDING
CHGE HOUSE
WAREHOUSE
SOUTH GATEHOUSE
SEDIMENT POND S-2
CYLINDER STORAGE
500 KV SWITCHING STATION
EMERGENCY OPERATIONS FACILITY
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NFPA 805 Performance-Based Standard for Fire Protection for Light Water Reactor Electric Generating Plants

Edward A. Connell
Office of Nuclear Reactor Regulation
301-415-2838

Advisory Committee on Reactor Safeguards
Subcommittee on Fire Protection
October 2000

NFPA 805

Background

- Purpose - Comprehensive FP Std to Protect Safety of the Public, Environment and Plant Personnel, as Well as Limit the Potential for Economic Loss During All Phases of Plant Ops
- June 1998 - Commission Approved Staff Proposal (SECY 98-058) to Work w/ Industry to Develop a PB/RI Consensus Std for NPPs
- Previously Briefed ACRS FP Subcommittee Jan 199[illegible]

NFPA 805

Update Since Jan 1999 Mtg

- Second Draft Issued for Public Comment
- Limited Scope Pilot of Draft Standard
- Rulemaking Plan (SECY 00-0009) Approved by the Commission
- TC Affirmative Ballot for NFPA Membership Vote

NFPA 805

Overview

- Combination Deterministic, PB, RI Fire Prot Std for Existing LWRs
- Deterministic Requirements for Admin Controls, Fire Brigade, FP System Design, Fire Barrier Testing and Water Supply
- Perf Criteria Can Be Satisfied w/ Deterministic or PB/RI Approach
- PB/RI Approach Can Be Qualitative or Quantitative
- Guidance on Performing Nuclear Safety Analysis, Use of Fire Models, and Fire PRA
- [illegible] Required for Changes *
- Mo[illegible]rogram Required X

There are not part of the Standard

NFPA 805

Changes From Appendix R

- Performance Criteria for NS Allows Use of ADS/LPS for BWRs and Feed & Bleed for PWRs as Only SD Method
- PB/RI Allows "Recovery" of SSCs vs. Free of Fire Damage
- 72 Hour CSD Requirement Eliminated
- Alt/Dedicated SD Requirements Eliminated
- 8 Hour Emergency Lighting Requirement Eliminated
- RCP Lube Oil Collection System Eliminated
- Specific Criteria for Rad Release Added

conflict with Appendix R

NFPA 805

Outstanding Technical Issues

- NS Performance Criteria
- Circuit Analysis Methodology Conflicts w/ BWROG/NEI Approach
- Recovery of SSD Capability
- FP Capability Following SSE
- SFP Circuits Not Required to be Identified
- "Bundl[illegible] [illegible]hanges for Risk Impact
- "Gr[illegible] of Existing Plant Confi[illegible]ration

These issues needs to be resolved through the Rulemaking Process

NFPA 805

Implementation Issues

- Partial Adoption by Licensees
- Reactive Adoption by Licensees
- NEI Implementing Guidance
- Oversight by Regions
- Change Control
- NRR Oversight of Licensee Implementation

NFPA 805

Path Forward

- Nov 2000 - NFPA Membership Vote on Std
- Dec 2000 - Commission Update
- Mar 2001 - Std Published for Use*
- Apr 2001 - Public Meeting on Rulemaking*
- Oct 2001 - Publish Proposed Rule*
- Sep 2002 - Publish Final Rule*

*Tentative

NRR FIRE PROTECTION INSPECTION ACTIVITIES

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ADVISORY COMMITTEE ON REACTOR SAFEGUARDS
SUBCOMMITTEE ON FIRE PROTECTION
OCTOBER 2000

BASELINE FIRE PROTECTION INSPECTION PROGRAM

- COMMENCED APRIL 2000 IAW SECY 99-140 (FPFI FINAL REPORT) AFTER 3 PILOTS
- FIRE RISK COMPARABLE TO TOTAL RISK FROM INTERNAL EVENTS
- BASELINE INSPECTION TECHNIQUES DERIVED FROM FPFI PROGRAM

FIRE PROTECTION
SIGNFICANCE DETERMINATION PROCESS

- BASED ON FP DEFENSE-IN-DEPTH
- FIRE SCENARIO MUST BE DEVELOPED (NO MORE "WALL TO WALL" FIRE ASSUMPTIONS)
- RISK SIGNIFICANCE OF FP FEATURE DEGRADATIONS ASSESSED
- DELTA CDF COMPUTED

BASELINE PROCEDURE CONTENT

- MONTHLY/ANNUAL RESIDENT INSPECTION
  - COMBUSTIBLES AND IGNITION SOURCES
  - DETECTION AND SUPPRESSION
  - MANUAL FIRE FIGHTING
  - PASSIVE FP FEATURES/FIRE BARRIERS
  - FIRE BRIGADE CAPABILITY AND PERFORMANCE
  - COMPENSATORY MEASURE ADEQUACY
  - RCP OIL COLLECTION

BASELINE PROCEDURE CONTENT (CONTINUED)

- TRIENNIAL TEAM INSPECTION OF POST-FIRE SAFE SHUTDOWN CAPABILITY
  - ELECTRICAL, RX/MECHANICAL SYSTEMS, AND FP INSPECTORS
  - 2-3 DAY INFORMATION GATHERING VISIT
  - 1-2 WEEKS OF ONSITE INSPECTION WITHIN DESIGN AND LICENSING BASES

BASELINE PROCEDURE CONTENT (CONTINUED)

- TRIENNIAL TEAM LINES OF INQUIRY:
  - FIRE AREA BOUNDARY DESIGN
  - SS/D SYSTEMS SELECTION ADEQUACY
  - HOT S/D SYSTEMS SEPARATION
  - SS/D CIRCUIT PROTECTION ANALYSIS
  - ALTERNATIVE SHUTDOWN

BASELINE PROCEDURE CONTENT (CONTINUED)

- TRIENNIAL TEAM LINES OF INQUIRY (CONTINUED):
  - COMMUNICATIONS
  - EMERGENCY LIGHTING
  - FIRE PROTECTION SYSTEMS, EQUIPMENT AND FEATURES
  - FIRE SUPPRESSION DAMAGE ASSESSMENT

BASELINE PROCEDURE CONTENT (CONTINUED)

- TRIENNIAL TEAM LINES OF INQUIRY (CONTINUED):

- OPERATOR RECOVERY ACTIONS
    - SMOKE REMOVAL
    - DEWATERING
    - CONTROLLED RE-ENERGIZATION
    - RETURN TO SERVICE

BASELINE PROCEDURE CONTENT (CONTINUED)

- TRIENNIAL TEAM LINES OF INQUIRY (CONTINUED):

  - ASSOCIATED CIRCUITS OF CONCERN (INTERFERING CIRCUITS AS OPPOSED TO INTEGRAL SS/D CIRCUITS) [NOTE: CIRCUIT ANALYSIS ENFORCEMENT SUSPENDED INDEFINITELY BY EGM 98-002 REV 2 OF 2/2/00 AWAITING INDUSTRY RESOLUTION EFFORTS]

BASELINE PROCEDURE CONTENT (CONTINUED)

- TRIENNIAL TEAM ASSOCIATED CIRCUITS LINES OF INQUIRY (CONTINUED):
  - COMMON POWER SUPPLY CONCERN (MULTIPLE HIGH IMPEDANCE FAULTS AND FUSE/BREAKER COORDINATION)
  - COMMON ENCLOSURE CONCERN (ELECTRICAL FAULT PROTECTION FROM NON-ESSENTIAL CIRCUITS)

BASELINE PROCEDURE CONTENT (CONTINUED)

- TRIENNIAL TEAM ASSOCIATED CIRCUITS LINES OF INQUIRY (CONTINUED):
  - SPURIOUS SIGNAL CONCERN
    - HOT SHORTS
    - SHORTS TO GROUND
    - OPEN CIRCUITS

BASELINE PROCEDURE CONTENT (CONTINUED)

- TRIENNIAL TEAM LINES OF INQUIRY (CONTINUED):
  - SS/D SYSTEM SELECTION ADEQUACY
  - INDEPENDENCE OF REMOTE S/D PANEL FROM THE MAIN CONTROL ROOM
  - S/D CAPABILITY WITH AND W/O OFFSITE POWER
  - EFFECT OF FIRE-INDUCED CIRCUIT FAULTS ON TRANSFER OF CONTROL

BASELINE PROCEDURE CONTENT (CONTINUED)

- TRIENNIAL TEAM LINES OF INQUIRY (CONTINUED):

  - OPER. TRNG (OBSERVE ASD SIMULATOR)
  - SHUTDOWN STAFFING (ONSITE STAFF EXCLUSIVE OF FIRE BRIGADE)
  - PERIODIC OPERATIONAL TESTS OF ALTERNATIVE TRANSFER CAPABILITY
  - PROCEDURES

BASELINE PROCEDURE CONTENT (CONTINUED)

- TRIENNIAL TEAM LINES OF INQUIRY (CONTINUED):
  - TIMELINE (THERMO-HYDRAULIC ANALYSIS)
  - COMMUNICATION PLANS
  - HUMAN FACTORS
    - NUMBER OF MANUAL ACTIONS
    - FEASABILITY
    - HABITABILITY
    - ACCESS ROUTES INDEPENDENCE

BASELINE PROCEDURE CONTENT (CONTINUED)

- TRIENNIAL TEAM LINES OF INQUIRY (CONTINUED):
- PERIODIC OPERATIONAL TESTS OF REMOTE SHUTDOWN PANEL INSTRUMENTATION AND CONTROL FEATURES
- PORTABLE AND FIXED COMMUNICATIONS:
  - OPERABLE/AVAILABLE/RELIABLE
  - CLEAR WITH FULL COVERAGE

BASELINE PROCEDURE CONTENT (CONTINUED)

- TRIENNIAL TEAM LINES OF INQUIRY (CONTINUED):
  - COLD SHUTDOWN REPAIRS
    - DAMAGE SPECIFIC REPAIR PROCEDURES
    - DEDICATED ONSITE REPAIR EQUIPMENT AND MATERIALS
    - REPAIRS FEASIBLE WITHIN APPLICABLE TIME REQUIREMENTS

TRIENNIAL INSPECTION TRAINING

- ONE WEEK BNL/NRR CONDUCTED REGIONAL INSPECTOR TRAINING CLASSES CONDUCTED IN MARCH AND JUNE, 2000

- ONE DAY REGIONAL INSPECTOR REFRESHER TRAINING CONDUCTED IN EACH REGION SEPTEMBER, 2000

TRIENNIAL INSPECTION RESULTS

- NINE TRIENNIAL INSPECTION RESULTS SETS STUDIED
  - OVERALL RESULTS: 19 ISSUES, NO ISSUES AT TWO PLANTS

TRIENNIAL INSPECTION RESULTS OF INTEREST

- IN 92-18 "MECHANISTIC" (VERSUS FUNCTIONAL) DAMAGE PHENOMENON CONTESTED, AND NO LICENSEE ANALYSIS CONDUCTED

- "SINGLE SPURIOUS ACTUATION" ASSUMPTION MADE, BUT APPARENTLY NOT ACTUALLY APPLIED IN THE LICENSEE ANALYSIS (THEREFORE NO ISSUES DURING INSPECTION)

TRIENNIAL INSPECTION RESULTS OF INTEREST (CONTINUED)

- VARIOUS INCOMPLETE CIRCUIT ANALYSES, AND INCOMPLETE TRANSLATIONS OF SAFE SHUTDOWN ANALYSIS INTO PROCEDURES

- ALT. S/D CAPABILITY NOT INDEPENDENT OF FIRE AREA (VCT AND RWST VALVE CONTROL CABLES PLUS CHARGING PUMP POWER CABLES) - THREE PLANT AREAS

TRIENNIAL INSPECTION RESULTS OF INTEREST (CONTINUED)

- ALT. S/D CAPABILITY DID NOT ENSURE PRIMARY COOLANT INTEGRITY (LOSS OF RCP SEAL INJECTION W/O TEMPERATURE INDICATION FOR OPERATOR RCP TRIP) - THREE PLANT AREAS

RECENT CHANGE IN FP BASELINE INSPECTION SCOPE

- DIRECT ASSOCIATED CIRCUITS INSPECTION SUSPENDED UNTIL COMPLETION OF VOLUNTARY INDUSTRY CIRCUIT ANALYSIS INITIATIVE (FY 2001)

  - GENERAL ASSOCIATED CIRCUITS, IN 92 - 18, AND MHIF REVIEWS NOT TO BE CONDUCTED

RECENT CHANGE IN FP BASELINE INSPECTION SCOPE (CONTINUED)

- UNAVOIDABLE (“BYPRODUCT) ASSOC. CKTS ISSUES TEMPORARILY URIs

- INSPECTOR CAN STILL REVIEW:

  - ASSOCIATED CIRCUITS CALCULATIONS
  - PLANT CONFIGURATION ASSUMPTIONS
  - FUSE/BREAKER COORDINATION (NON-CONTROVERSIAL ISSUE)

RECENT CHANGE IN FP BASELINE INSPECTION SCOPE (CONTINUED)

- CHANGE RATIONALE:
  - RECENT UNDERSTANDING OF WIDE VARIABILITY IN LICENSING BASES, SOME AT VARIANCE WITH GL 86-10 ASSOCIATED CIRCUIT ANALYSIS CRITERIA
  - THEREFORE, ASSOC. CKTS ISSUES UNRESOLVABLE BY INSPECTION TEAM

NRR FP CIRCUIT FAILURE ANALYSIS ISSUE RESOLUTION

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OCTOBER 2000

FIRE-INDUCED CIRCUIT FAILURE ANALYSIS

- APP. R DEFINES CKT FAULTS AS HOT SHORTS, OPEN CKTS, SHORTS TO GROUND

- LONG-TERM INSPECTION POLICY AND GL 86-10 ASSOCIATED CIRCUITS POSITION IS THAT ALL POSSIBLE SETS OF SPURIOUS ACTUATIONS MUST BE IDENTIFIED, ASSESSED, AND MITIGATED SO AS NOT TO PREVENT SAFE SHUTDOWN ("HOT SHORT CONDITIONS EXIST UNTIL ISOLATED")

- BASIC CKT ANALYSIS ISSUES TO BE RESOLVED BETWEEN NRR AND INDUSTRY:

  - HOW MANY SIMULTANEOUS CIRCUIT FAULTS SHOULD BE ASSUMED PER FIRE WHICH CAN COOPERATIVELY CAUSE SPURIOUS EQUIPMENT ACTUATIONS?

AND

  - HOW MANY SIMULTANEOUS SPURIOUS EQUIPMENT ACTUATIONS NEED TO BE ASSUMED PER FIRE EVENT?

- IN SUPPORT OF A VOLUNTARY INDUSTRY INITIATIVE, IN NOVEMBER OF 1999 THE BWROG SUBMITTED A DETERMINISTIC SAFE SHUTDOWN ANALYSIS METHODOLOGY

- IN APRIL, 2000 THE STAFF'S EXTENSIVE "DRAFT" RAI HAD A REPETITIVE QUESTION: "PROVIDE TECHNICAL BASES FOR YOUR POSITIONS"

- IN A JULY, 2000, RAI CLARIFICATION MEETING, THE BWROG STATED:

- THE BWROG SAW NO SAFETY SIGNIFICANT CIRCUIT ANALYSIS ISSUES OUTSIDE OF THE CURRENT LICENSING BASES

- THEREFORE, THE BWROG DOCUMENT WAS A COLLECTION OF SELECTED CIRCUIT ANALYSIS LICENSING BASES.

- THE STAFF ACCEPTS THE BWROG DOCUMENT AS A "FIRST STEP" IN THE ISSUE RESOLUTION PROCESS.

- NEI CONTINUES DEVELOPMENT OF A RISK-INFORMED SAFE SHUTDOWN ANALYSIS METHODOLOGY NEI 00-01 (WHICH IT HAS INTEGRATED WITH THE BWROG DOCUMENT)

- DURING RECENT BWROG CIRCUIT ANALYSIS INTERACTIONS THE STAFF LEARNED OF:

  - A WIDE VARIABILITY IN CIRCUIT ANALYSIS LICENSING BASES, SOME AT VARIANCE WITH GL 86-10 ASSOCIATED CIRCUITS ANALYSIS CRITERIA

- THEREFORE, IN AUGUST 2000, NRR TEMPORARILY SUSPENDED ASSOCIATED CIRCUIT REVIEWS FROM FP BASELINE INSPECTIONS (IDENTIFIED SAFETY ISSUES WILL STILL BE ADDRESSED)

- NEI/EPRI FIRE TESTING TO BE CONDUCTED TO OBTAIN "CIRCUIT FAILURE CHARACTERIZATION" DATA

    - TESTING INTENDED TO SUPPORT INDUSTRY CIRCUIT ANALYSIS CRITERIA OF NEI 00-01

- NEI 00-01 METHODOLOGY PILOT TRIALS TO BE CONDUCTED AT U.S. REACTOR SITES IN JANUARY/FEBRUARY 2001.

- NEI 00-01 TO BE SUBMITTED FOR STAFF REVIEW BY THIRD QUARTER CY 2001

NRR REDUNDANT SRV/LPS SHUTDOWN ACTIVITIES

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SUBCOMMITTEE ON FIRE PROTECTION
OCTOBER 2000

REDUNDANT USE OF SRV/LPS

- IN SEPTEMBER, 1999, BWROG SUBMITTED A DOCUMENT ON THE USE OF SAFETY RELIEF VALVES AND LOW PRESSURE SYSTEMS (SRV/LPS) AS A MEANS OF REDUNDANT POST-FIRE SAFE SHUTDOWN

- REGULATORY BACKGROUND

  - SRV/LPS IN BWR DESIGN BASIS ACCIDENT LICENSING BASIS

- SRV/LPS IN BWR NORMAL S/D GDC 34 SINGLE FAILURE LIC. BASIS SINCE 1975

- SRV/LPS WIDELY APPROVED BY THE STAFF AS A MEANS OF ALTERNATIVE SHUTDOWN (WITH DETECTION AND SUPPRESSION IN THE FIRE AFFECTED AREA IAW APPENDIX R SECTION III.G.3)

- THE STAFF'S REGULATORY AND CORE THERMO-HYDRAULIC ANALYSES SUPPORT USE OF SRV/LPS AS A REDUNDANT SAFE SHUTDOWN METHOD

change in the requirement

- ON 4/25/00 THE STAFF MET WITH THE BWROG TO PROVIDE TECHNICAL, REGULATORY, RISK AND LEGAL FEEDBACK

- SEVEN MAJOR SUB-ISSUES WERE ADDRESED BY THE STAFF DURING AND SUBSEQUENT TO THAT MEETING:

  - THE EXISTENCE OF PLANT SPECIFIC LIC. BASES IN WHICH THE STAFF HAS APPROVED SRV/LPS AS A <u>REDUNDANT</u> MEANS OF POST-FIRE SAFE SHUTDOWN (5 EXAMPLES IDENTIFIED TO DATE)

- WHETHER AN SRV/LPS "HOT SHUTDOWN" PROCEDURE EXISTED. THE BWROG PROVIDED A HOT SHUTDOWN PROCEDURE NARRATIVE BASED ON EPG 4 / EOP
  - INCLUDED LIKELY DEPRESSURIZATION AT TOP OF ACTIVE FUEL
  - HOT S/D MAINTENANCE CAPABILITY FROM 200 TO 212 DEGREES F
- NON-APPLICABILITY OF APPENDIX R SECTION III.L PERFORMANCE CRITERIA

- NON-APPLICABILITY OF SINGLE FAILURE CRITERIA

- POTENTIAL RISK INCREASE FROM REMOVAL OR ABANDONMENT OF DETECTION AND SUPPRESSION GENERALLY SMALL AS DEFINED IN RG 1.174 (FIRE AREA OUTLIERS MAY EXIST AT AT SOME PLANTS)

- NUMBER OF PROTECTED SRVS FOR CORE THERMO-HYDRAULIC SAFETY DURING DE-PRESSURIZATION (BASED ON PLANT SPECIFIC ANALYSES), AND

- VESSEL MATERIAL CONCERNS RELATED TO COOLDOWN RATE >100 DEGREES F/HR (DEPRESSURIZATION COUNTERACTS THERMAL STRESSES, AND VESSEL FATIGUE ADDRESSED BY LIMITING THE NUMBER OF STRESS CYCLES)

- UPON FINAL CONSIDERATION OF THE ISSUES, THE STAFF EXPECTS TO ISSUE AN SER ON THE BWROG SRV/LPS TOPICAL DURING OCTOBER, 2000.