



*Regulatory Conference*

*NRC Triennial Fire Protection  
Inspection Findings*

*Surry Power Station Units 1 and 2*

*April 1, 2004*



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# *Introduction*

*Richard Blount*  
*Site Vice President*



## *Agenda*

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- Introduction
  - NRC & Dominion
  - NRC Findings
- Background
  - Fire Strategy
  - Overview of ESGR and Local FP Features
- Assessment of NRC Phase 3 SDP Analysis
- Summary
- Management Perspective



## *NRC Findings*

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- Apparent violation of 10 CFR 50, Appendix R, Sections III.L.2.b and III.L.3
  - Fire response procedures were not effective in assuring a safe shutdown of the Unit 1 reactor for a severe fire in the Unit 1 Emergency Switchgear Room
  - Specifically, procedures may not preclude an extended loss of reactor coolant pump seal injection flow and may initiate a RCP seal LOCA which could result in pressurizer level failing to be maintained within the indicating range
- A similar issue was noted for Unit 2



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# *Background*

*Mike G. Gaffney*  
*Station Director*  
*Nuclear Safety and Licensing*



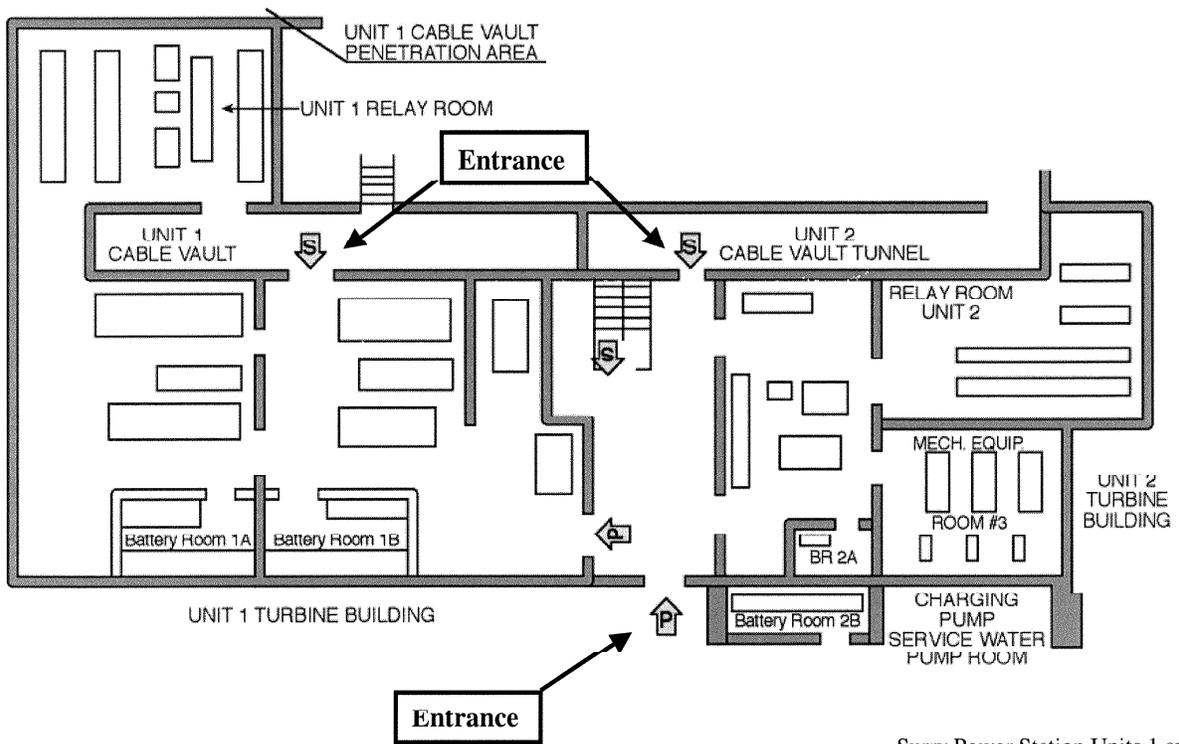
## *Fire Strategy - ESGR*

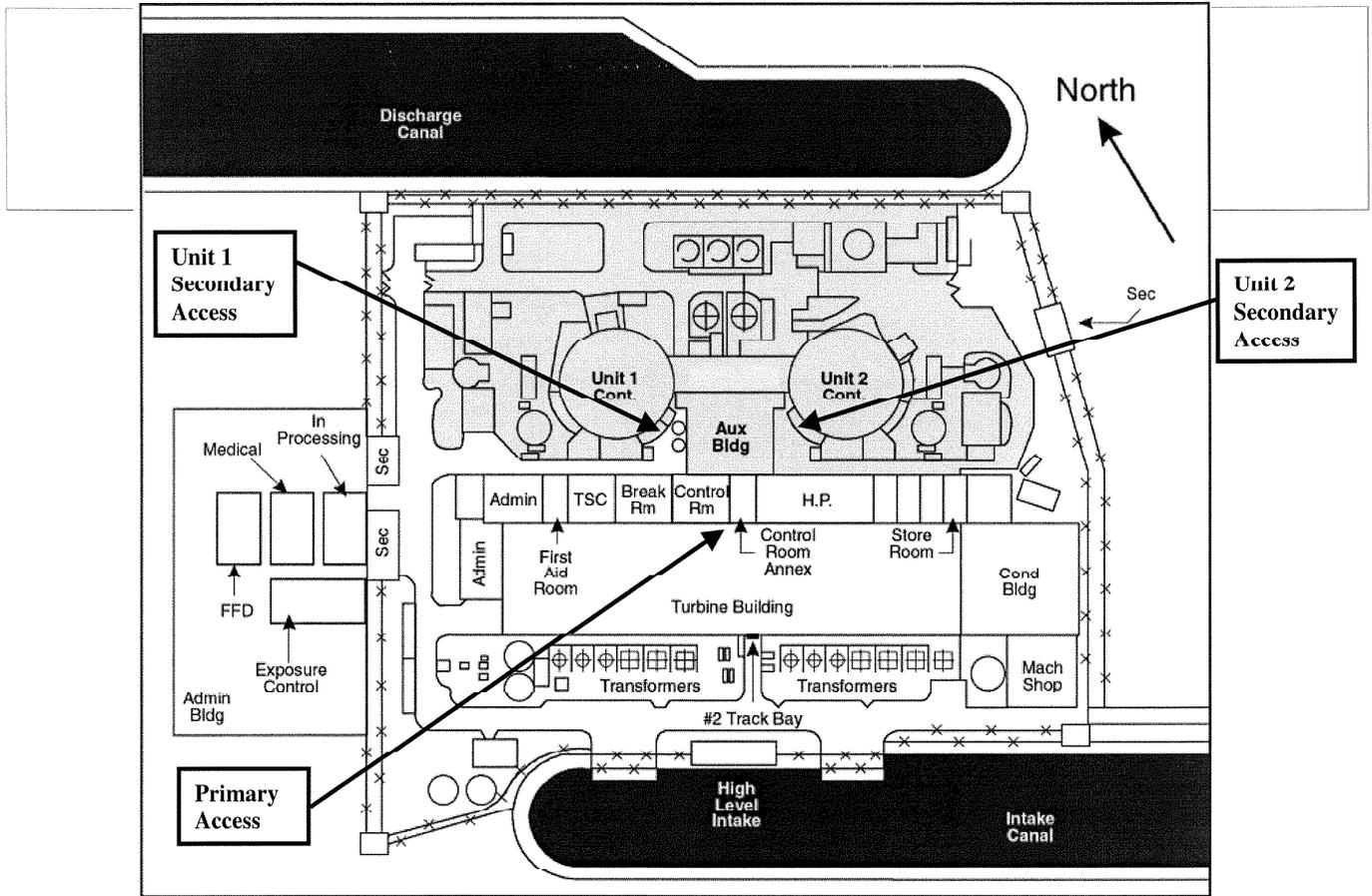
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- Annunciator Response Procedure
  - Smoke Alarm actuates
  - Caution – prompt response (within 5 minutes) necessary
  - Dispatch operator to status within 5 minutes
  - If fire, discharge Halon
  - If no communication within 5 minutes, discharge Halon
- Fire Strategy ESGR #1
  - Primary Access Unit 1 Turbine Building 9’6”
  - Secondary Access Unit 1 Cable Vault
  - Establish Command Post Unit 2 ESGR



# ESGR Floor Plan

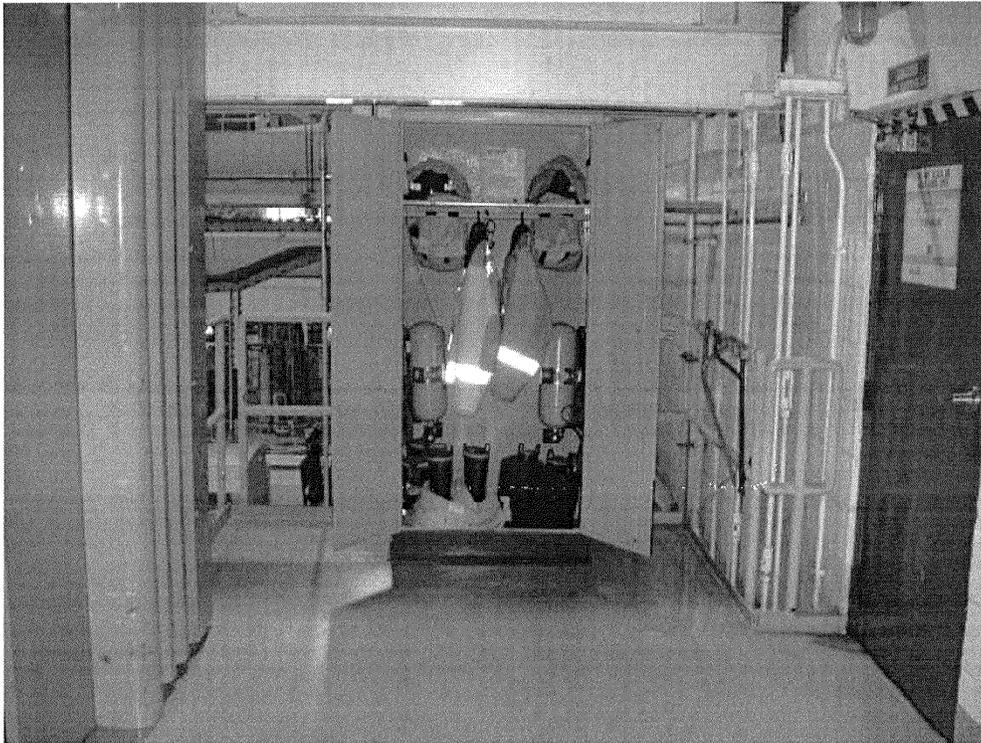




NET 02

Surry Power Station

## *MCR to ESGR*





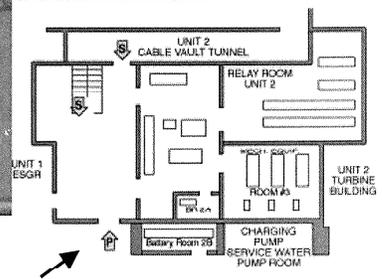
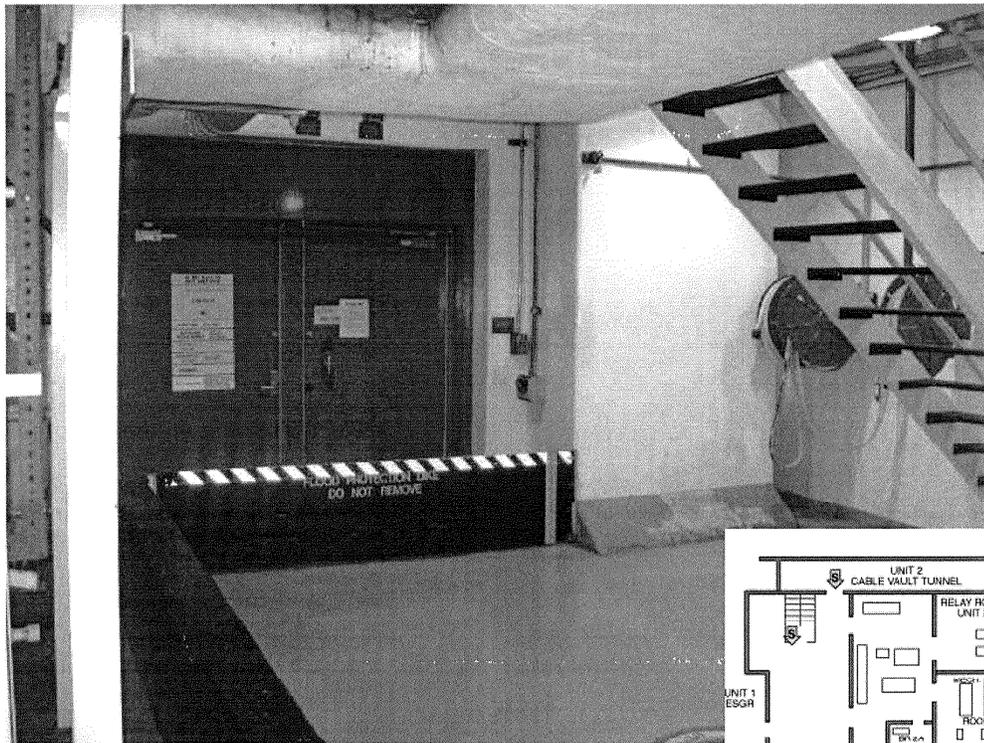
## *ESGR Entrance*



Door Outside  
MCR

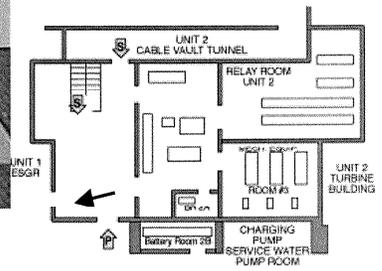
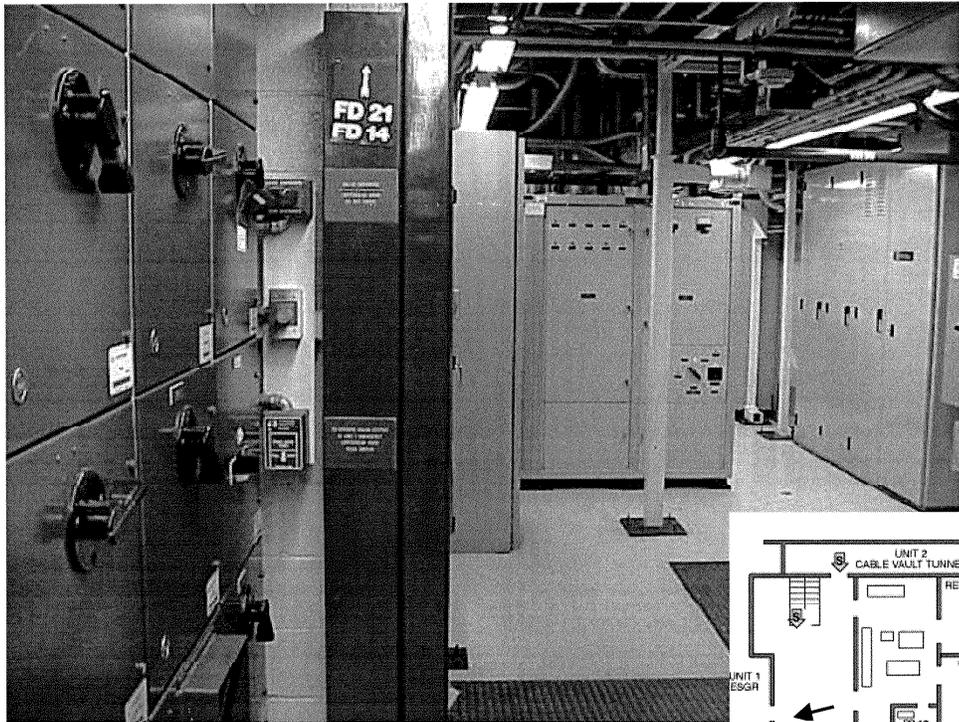
ESGR  
Entrance

# *ESGR Entrance*





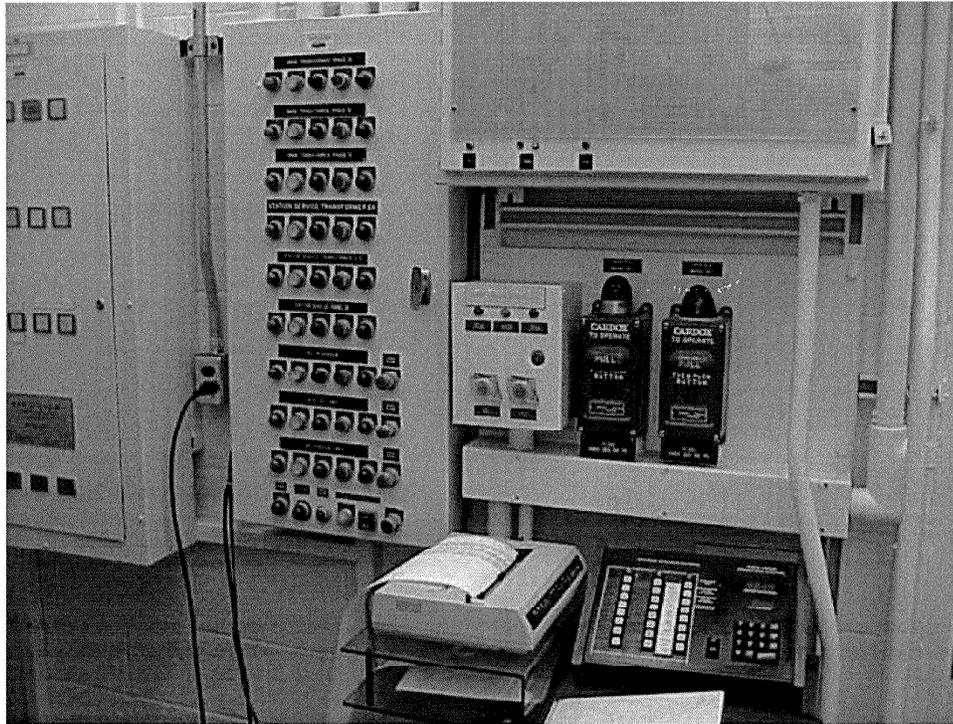
# *Halon Activation System*





# *Halon Activation System*

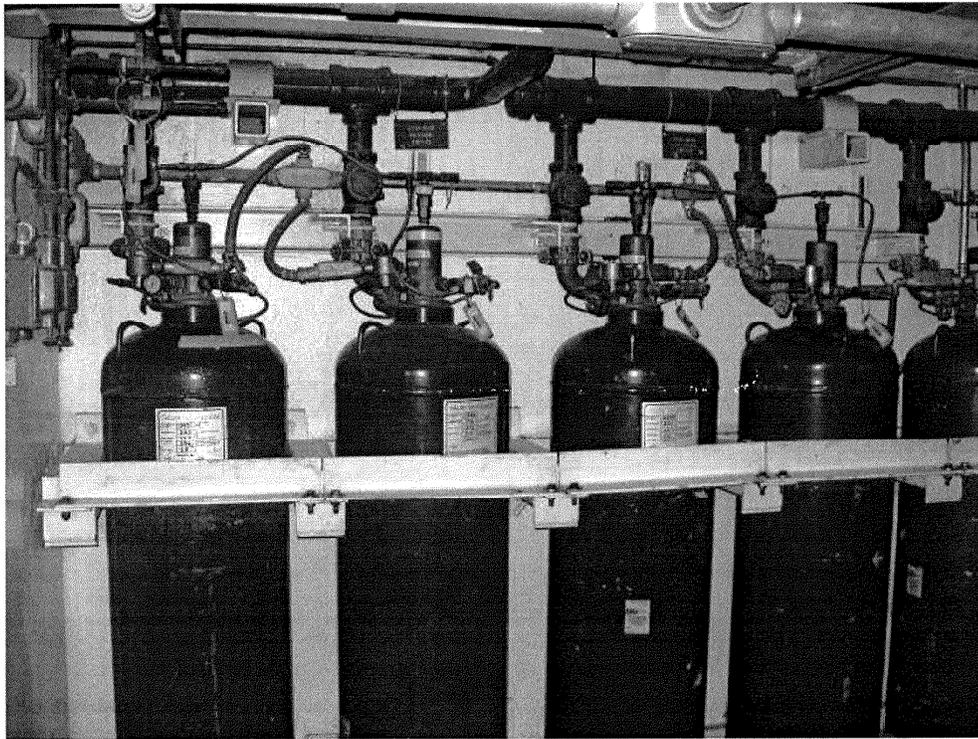
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# *Halon Activation System*

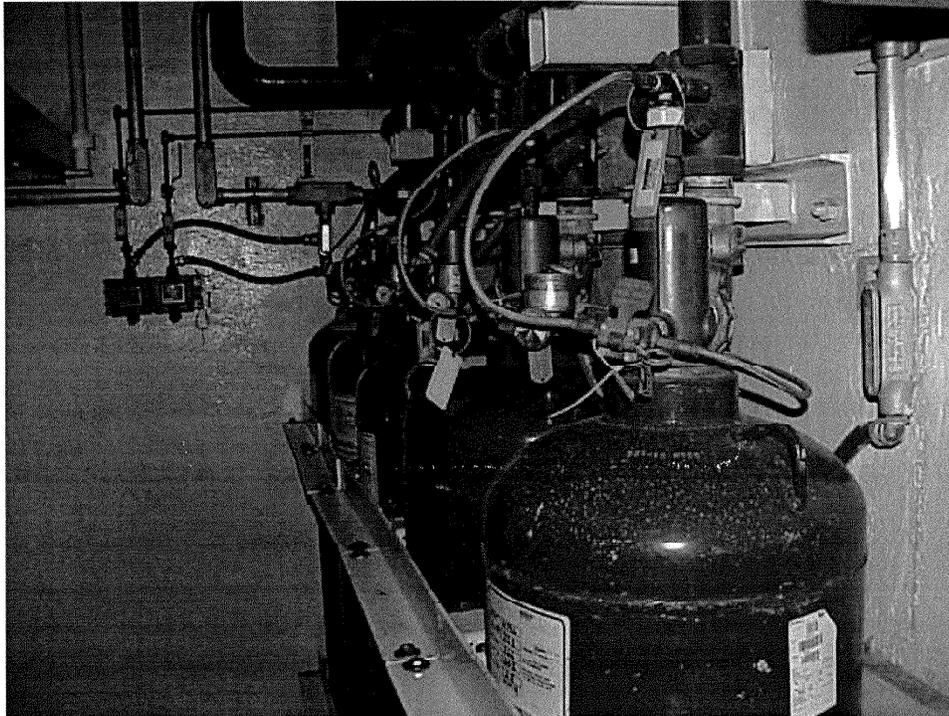
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# *Halon Activation System*

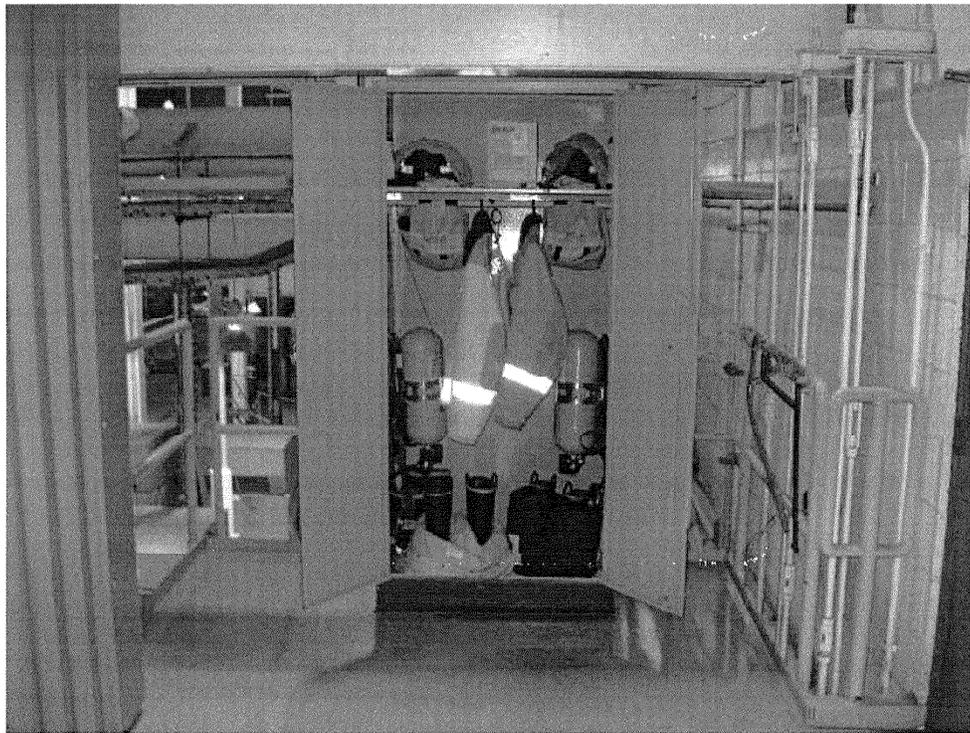
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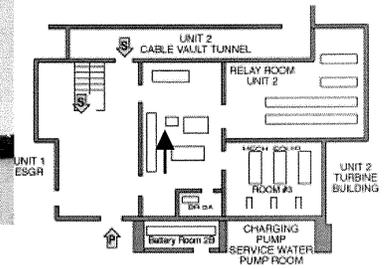
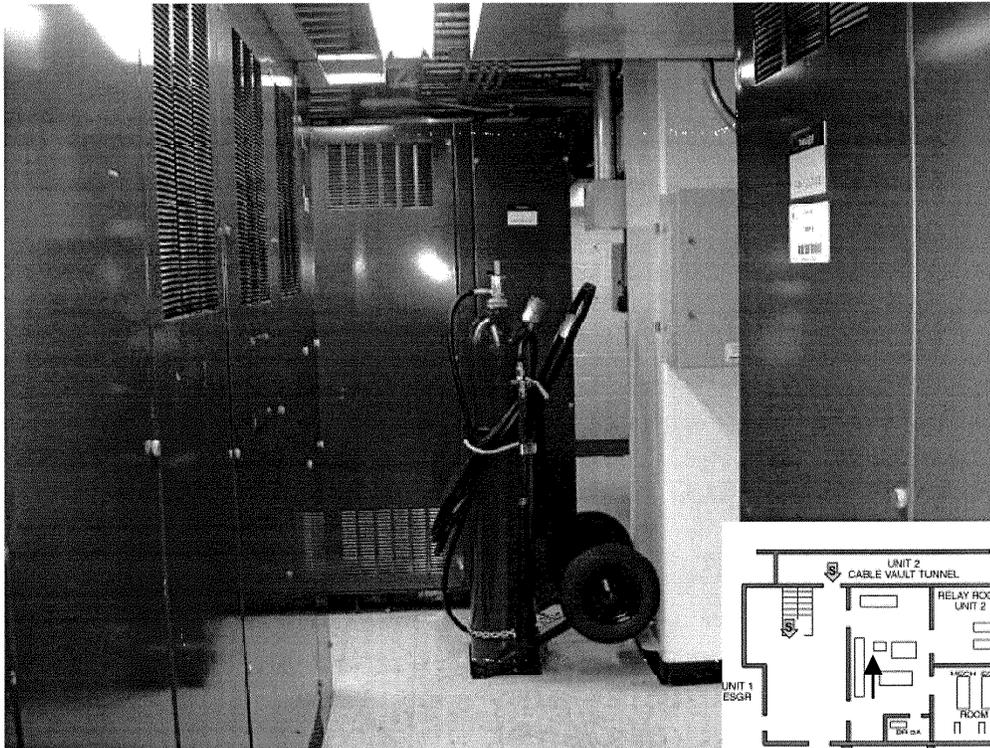
## *Fire Brigade Equipment*

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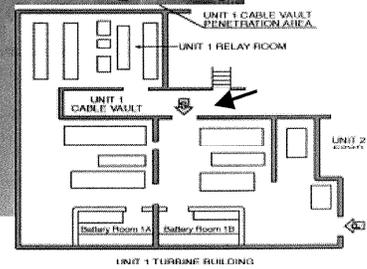
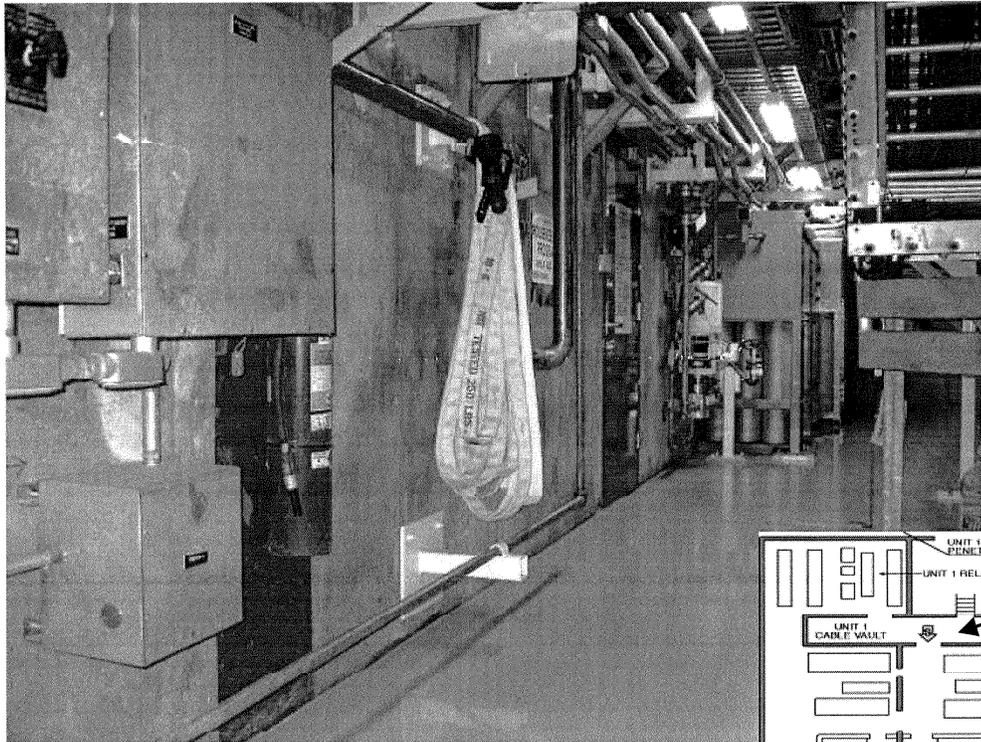


# Fire Brigade Equipment

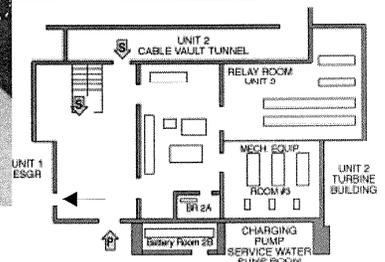
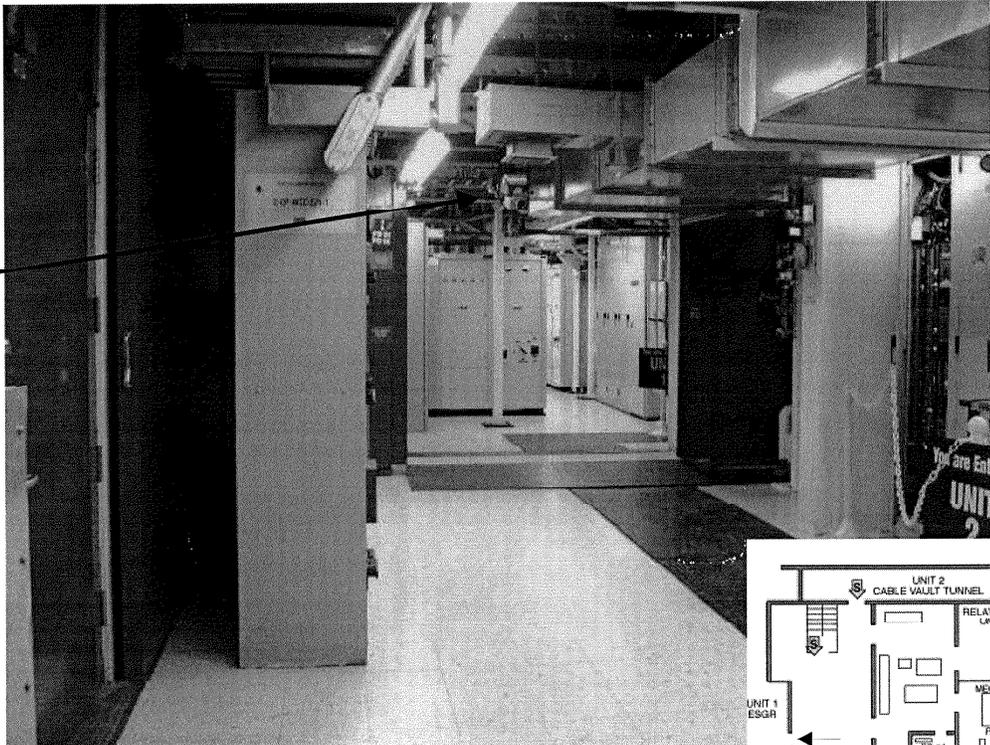


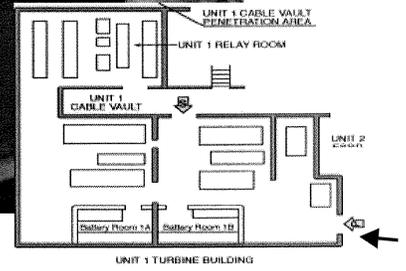
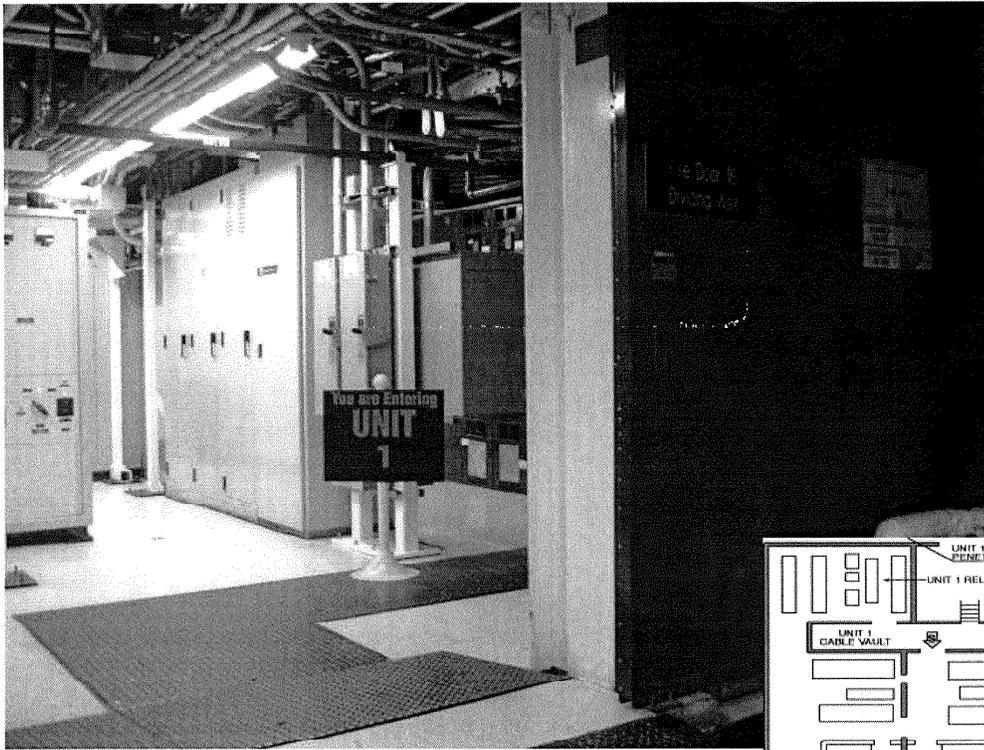


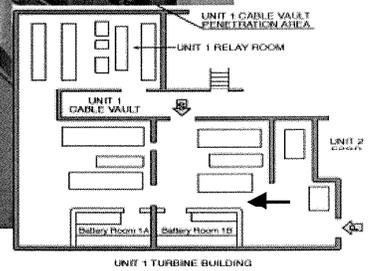
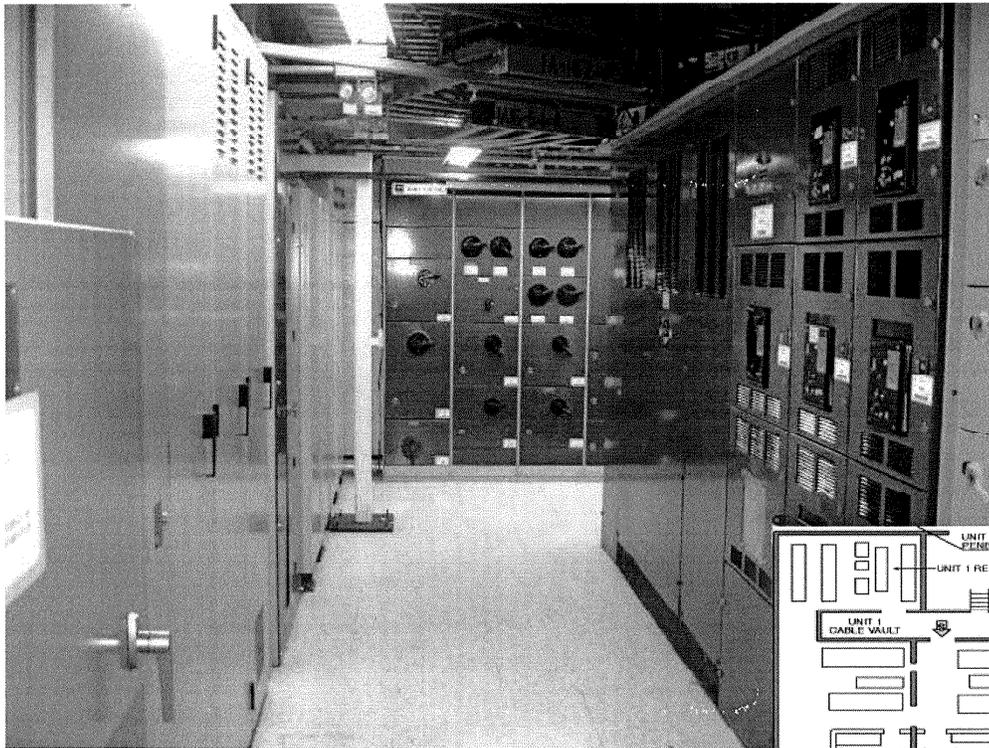
# Fire Brigade Equipment

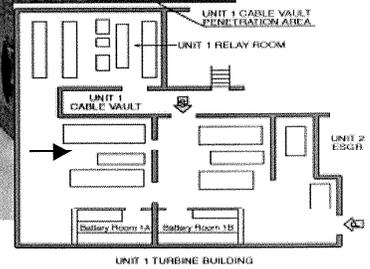


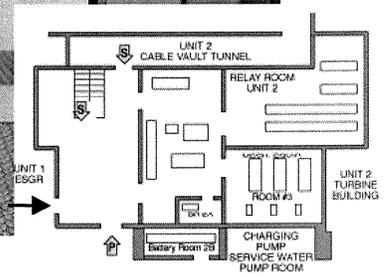
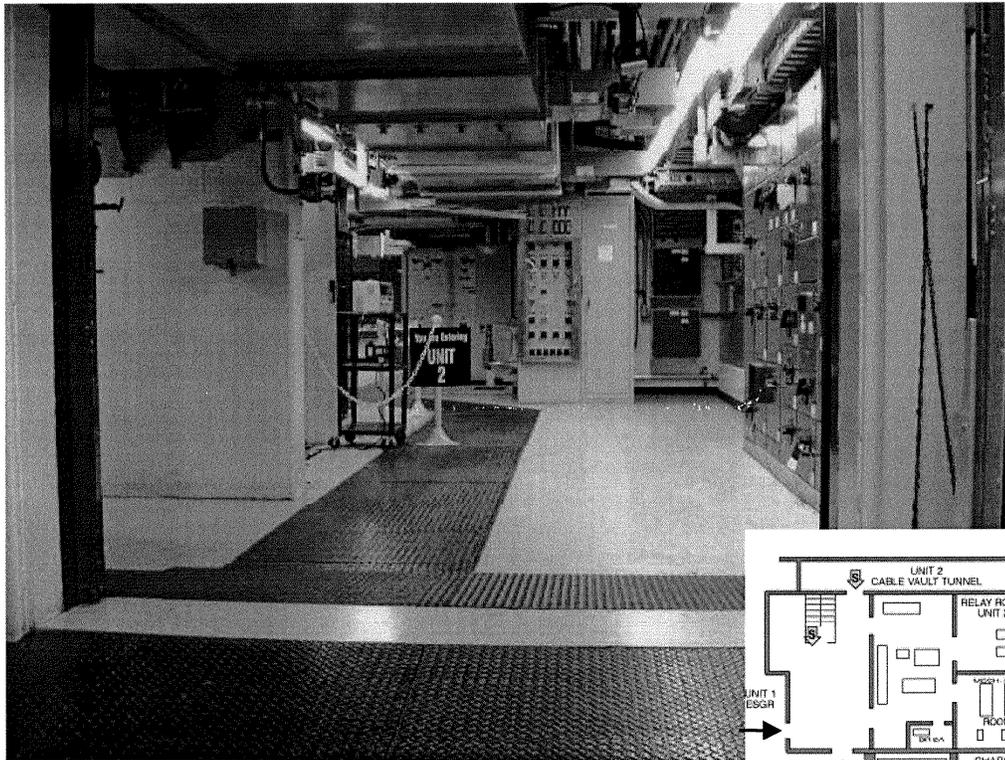
Camera



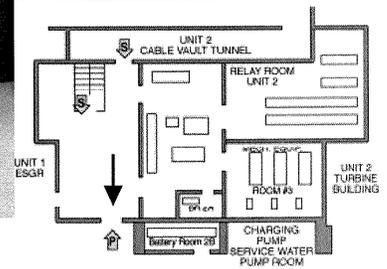
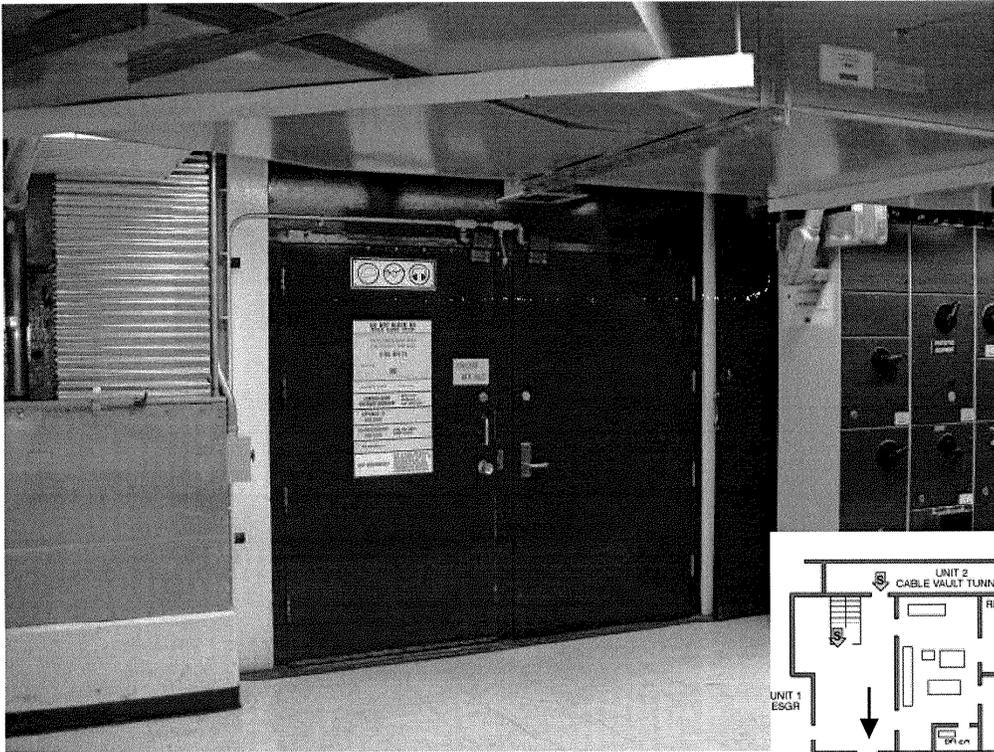








# Welding





*Assessment of NRC  
Phase 3 SDP Analysis*

*Tom Hook  
Probabilistic Risk Assessment*



## *SDP Phase 3 Assessment*

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- Plant specific features not reflected in NRC Phase 3 SDP for Surry Unit 1 ESGR
- Applicability of Unit 1 ESGR finding to Unit 2 ESGR
- Conclusions



**Dominion**

*Plant Specific Features not Reflected in  
NRC Phase 3 SDP for Surry Unit 1 ESGR*

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- Generic probability of non-suppression
- Generic severity factors and non-suppression probabilities for ESGR welding fires
- Generic RCP seal leakage probabilities



## *Generic Probability of Non-Suppression*

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- SDP used generic Halon System unavailability from EPRI data (i.e., 5%)
- No credit for fire brigade in electrical or transformer fires
  - ESGR near to Main Control Room and fire brigade equipment
  - 150-lb portable wheeled carbon dioxide extinguisher in ESGR
- Three means to manually actuate Halon System per Alarm Response Procedure “EMERG SWGR RM HALON SYS FIRE/TRBL”
  - Main Control Room panel
  - Local pull-station in ESGR
  - At Halon bottles (bypasses all electrical/instrumentation failures)



## *Generic Probability of Non-Suppression*

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- Halon System very reliable based on plant specific data
  - Periodic tests (every 31 days, 6 months, 18 months)
  - No failures over past 5 years
- Generic non-suppression probability should be reduced by at least factor of 10 to 0.5%



## *Generic Severity Factors and Non-Suppression Probabilities for ESGR Welding Fires*

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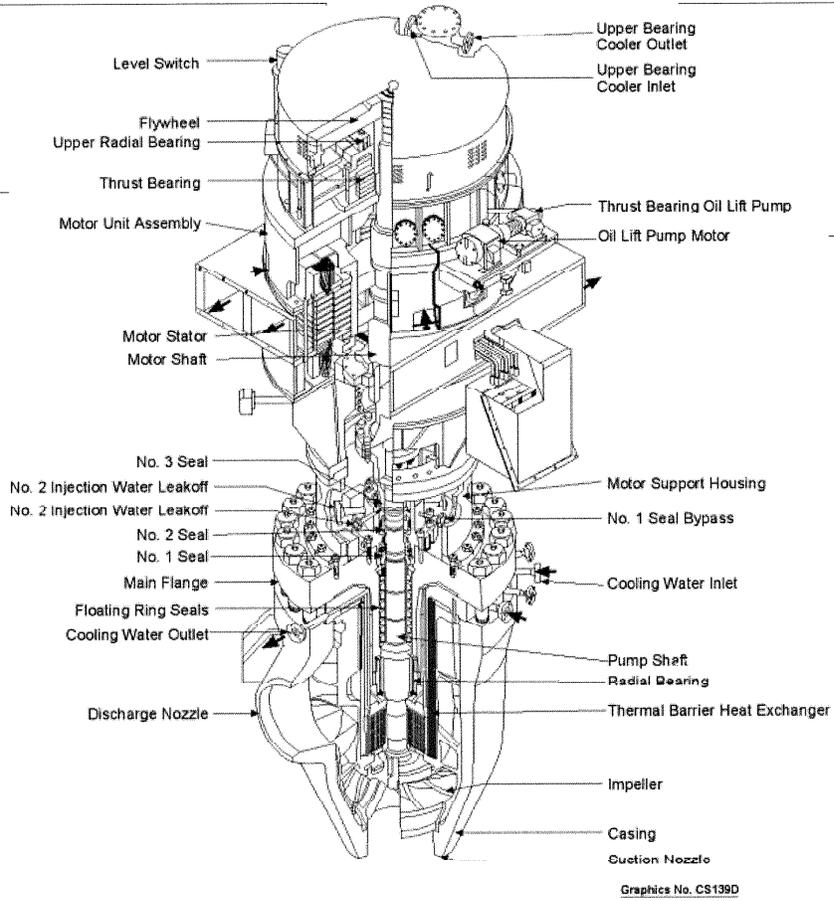
- SDP used generic 9% probability of welding fires lasting greater than 20 minutes from EPRI data
- Generic EPRI data not applicable to areas with Halon suppression, smoke detection system or mandatory continuous fire watch
- Lack of combustibles near areas where welding has occurred in ESGR when at power (doors)
- Welding non-suppression probability should be no greater than Halon non-suppression probability used in electrical cabinet or transformer fires (i.e., 0.5%)



## *Generic RCP Seal Leakage Probabilities*

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- SDP used generic RCP seal LOCA model from WCAP-15603 Rev. 1-A
- Generic RCP seal LOCA model does not consider floating ring seals
- Surry, North Anna and few older Westinghouse plants still use them
- NRC credited floating ring seals in Haddam Neck Plant SER



REACTOR COOLANT PUMP



## *Generic RCP Seal Leakage Probabilities*

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- Floating ring seals
  - Designed to limit leakage to 50 gpm in seal package failures
  - Original floating ring seals in all Surry RCPs, no degradation
  - Floating ring seal clearances larger than other seals
  - No floating ring seal failure in Haddam Neck Plant event where all RCP seal cooling lost for 30 minutes and seal injection restored
- Should give at least 0.1 to 0.5 credit for floating ring seals in RCP seal LOCA model
- EdF test data supports no impact from restoration of injection to hot seals



## *Sensitivity on Generic Assumptions*

Case	Changes to NRC Phase 3 SDP	Delta CDF	SDP Color
Base (NRC Phase 3 SDP)	N/A	2.3E-06	WHITE
Credit for multiple means to manually actuate Halon for all fires & credit Halon for transient and welding fires	<ul style="list-style-type: none"> <li>• Non-suppression (Halon &amp; fire brigade) probability changed from generic 0.05 to 0.005 for electrical cabinet and transformer fires</li> <li>• Non-suppression (Halon &amp; fire brigade) probability changed from generic 0.09 to 0.005 for welding and transient fires</li> </ul>	5.5E-07	GREEN
Credit for RCP floating ring seal (10% failure probability)	<ul style="list-style-type: none"> <li>• Revised branch points RP2 and RP3 in event trees from 0.20 to 0.021</li> </ul>	2.6E-07	GREEN
Credit for RCP floating ring seal (20% failure probability)	<ul style="list-style-type: none"> <li>• Revised branch points RP2 and RP3 in event trees from 0.20 to 0.042</li> </ul>	5.2E-07	GREEN
Credit for RCP floating ring seal (30% failure probability)	<ul style="list-style-type: none"> <li>• Revised branch points RP2 and RP3 in event trees from 0.20 to 0.063</li> </ul>	7.7E-07	GREEN
Credit for RCP floating ring seal (50% failure probability)	<ul style="list-style-type: none"> <li>• Revised branch points RP2 and RP3 in event trees from 0.20 to 0.10</li> </ul>	1.2E-06	WHITE
Credit for multiple means to manually actuate Halon per procedure & RCP floating ring seal (50% failure probability)	<ul style="list-style-type: none"> <li>• Non-suppression (Halon &amp; fire brigade) probability changed from generic 0.05 to 0.005 for electrical cabinet and transformer fires</li> <li>• Revised branch points RP2 and RP3 in event trees from 0.20 to 0.10</li> </ul>	8.9E-07	GREEN



## *Sensitivity on Generic Assumptions (cont.)*

Case	Changes to NRC Phase 3 SDP	Delta CDF	SDP Color
Credit Halon for transient and welding fires & RCP floating ring seal (50% failure probability)	<ul style="list-style-type: none"> <li>• Non-suppression (Halon &amp; fire brigade) probability changed from generic 0.09 to 0.005 for welding and transient fires</li> <li>• Revised branch points RP2 and RP3 in event trees from 0.20 to 0.10</li> </ul>	6.2E-07	GREEN
Partial credit for multiple means to manually actuate Halon for all fires, partial credit Halon for transient and welding fires & RCP floating ring seal (50% failure probability)	<ul style="list-style-type: none"> <li>• Non-suppression (Halon &amp; fire brigade) probability changed from generic 0.05 to 0.01 for electrical cabinet and transformer fires</li> <li>• Non-suppression (Halon &amp; fire brigade) probability changed from generic 0.09 to 0.01 for welding and transient fires</li> <li>• Revised branch points RP2 and RP3 in event trees from 0.20 to 0.10</li> </ul>	3.7E-07	GREEN
Credit for multiple means to manually actuate Halon for all fires, credit Halon for transient and welding fires & RCP floating ring seal (50% failure probability)	<ul style="list-style-type: none"> <li>• Non-suppression (Halon &amp; fire brigade) probability changed from generic 0.05 to 0.005 for electrical cabinet and transformer fires</li> <li>• Non-suppression (Halon &amp; fire brigade) probability changed from generic 0.09 to 0.005 for welding and transient fires</li> <li>• Revised branch points RP2 and RP3 in event trees from 0.20 to 0.10</li> </ul>	3.0E-07	GREEN



## *Applicability of Surry Unit 1 ESGR Finding to Unit 2 ESGR*

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- ESGR compartment sizes and equipment orientation similar
- Unit 1 and 2 ESGRs adjacent to each other
- Normally open sliding door between Unit 1 and 2  
(automatically closes on smoke detection or Halon actuation)
- Routing of critical RCP seal cooling cables in higher trays at Unit 2
  - All RCP seal cooling cables routed in 3rd or higher trays above electrical cabinets (versus trays 1 and 2 at Unit 1 ESGR)
  - Cables for Component Cooling to RCP thermal barrier coolers in 5th and 6th trays above 4160V switchgear



## *Applicability of Surry Unit 1 ESGR Finding to Unit 2 ESGR (cont.)*

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- Time to damage of critical RCP seal cooling cables longer at Unit 2
- More time available for manual suppression (portable and 150-lb wheeled carbon dioxide extinguishers)
- Core damage risk lower for Unit 2 ESGR (i.e., Green)



## *Conclusions*

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- Surry Unit 1 ESGR finding is applicable to Unit 2 ESGR, but longer time to loss of RCP seal cooling and greater potential for fire brigade mitigation
- Plant specific features should be incorporated into NRC Phase 3 SDP
- Sensitivity analyses indicate risk significance is low (GREEN), even if only two of the three generic assumptions are adjusted to reflect plant design



## *Summary*

*Richard Blount, II*  
*Site Vice President*



## *Summary*

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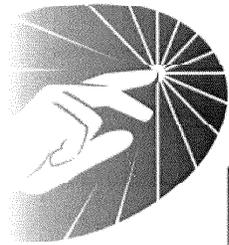
- Implemented a temporary modification and administrative control to permit timely restoration of RCP seal cooling
- Revised procedures to:
  - preclude restoration of RCP seal injection following a prolonged loss of seal cooling (i.e. >13 minutes)
  - provide alternate flowpaths (via cold leg safety injection lines) for make-up to the RCS to maintain pressurizer level
  - preclude restart of an RCP unless seal injection and thermal barrier cooling have remained in service throughout the event
  - permanently restrict quantity of flammable liquids permitted in safety-related areas
- Design modification in development to permanently resolve the RCP loss of seal cooling issue



# *Management Perspective*

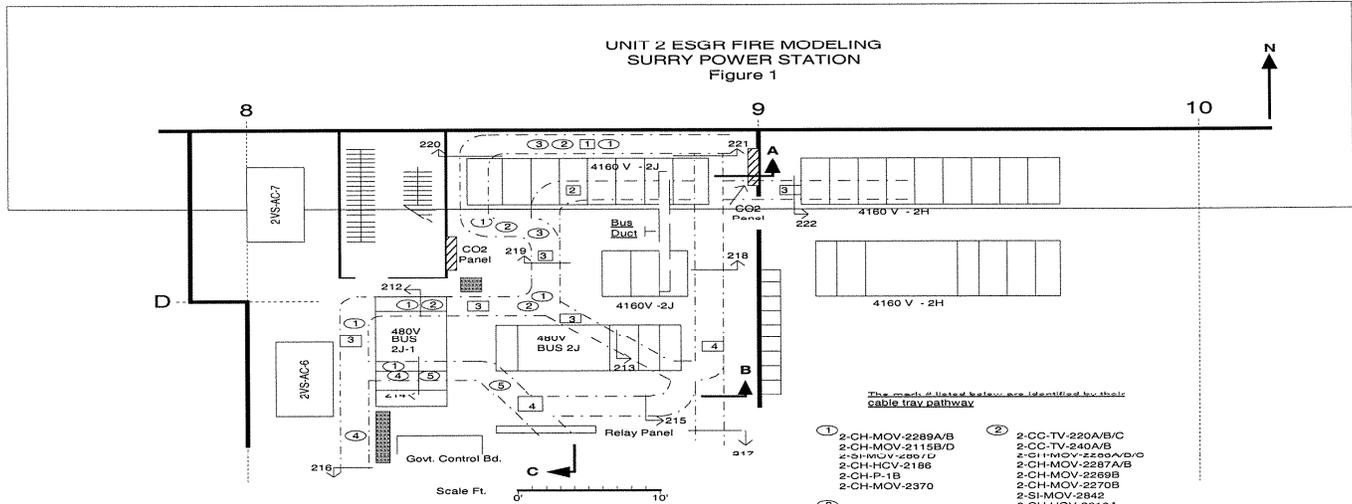
*Gene Grecheck*

*Vice-President, Nuclear Support Services*



**Dominion<sup>SM</sup>**

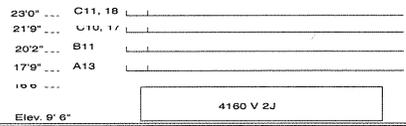
UNIT 2 ESGR FIRE MODELING  
 SURRY POWER STATION  
 Figure 1



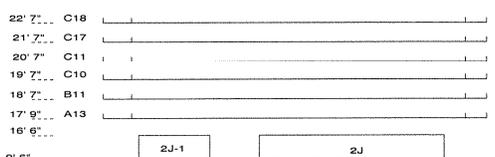
The name of listed devices are identified by their cable tray pathway

- ① 2-CH-MOV-2269A/B  
2-CH-MOV-2115B/D  
2-SI-MOV-2269A/B/C  
2-CH-HCV-2186  
2-CH-P-1B  
2-CH-MOV-2370
- ② 2-CC-TV-220A/B/C  
2-CC-TV-240A/B  
2-CH-MOV-2269A/B/C  
2-CH-MOV-2287A/B  
2-CH-MOV-2269B  
2-SI-MOV-2270B  
2-SI-MOV-22842  
2-CH-HCV-2310A
- ③ 2-CH-MOV-2267A/B  
2-CH-MOV-2297C  
2-CH-MOV-2270A  
2-CH-MOV-2269A
- ④ 2-CH-P-1A, 1C  
2-CH-FCV-2122
- ⑤ 2-SI-MOV-2267C

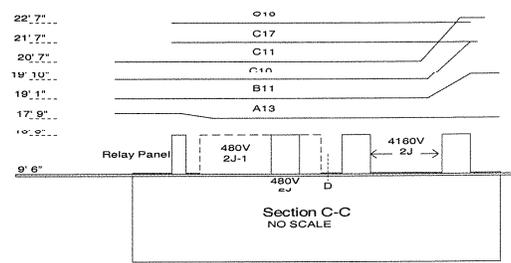
- 1 Trays: C11, C10, B11, A13
- 2 Trays: C18, C17
- 3 Trays: C18, C17, C11, C10, B11, A13
- 4 Trays: C10, C11, C11



SECTION A-A  
 NO SCALE



SECTION B-B  
 NO SCALE



Section C-C  
 NO SCALE