

Waterford

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NFPA 805 LAR

Waterford 3

Main Control Room (MCR)
Abandonment Analysis

Public Meeting

August 11, 2015

Agenda

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- Purpose
- MCR and Remote Shutdown Panel Overview
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 - Equipment Failures
 - CCDP & CLERP
- Variances from Deterministic Requirements (VFDR)
 - VFDR Development
 - VFDR Post Transition Modeling
- Conclusions

Introductions

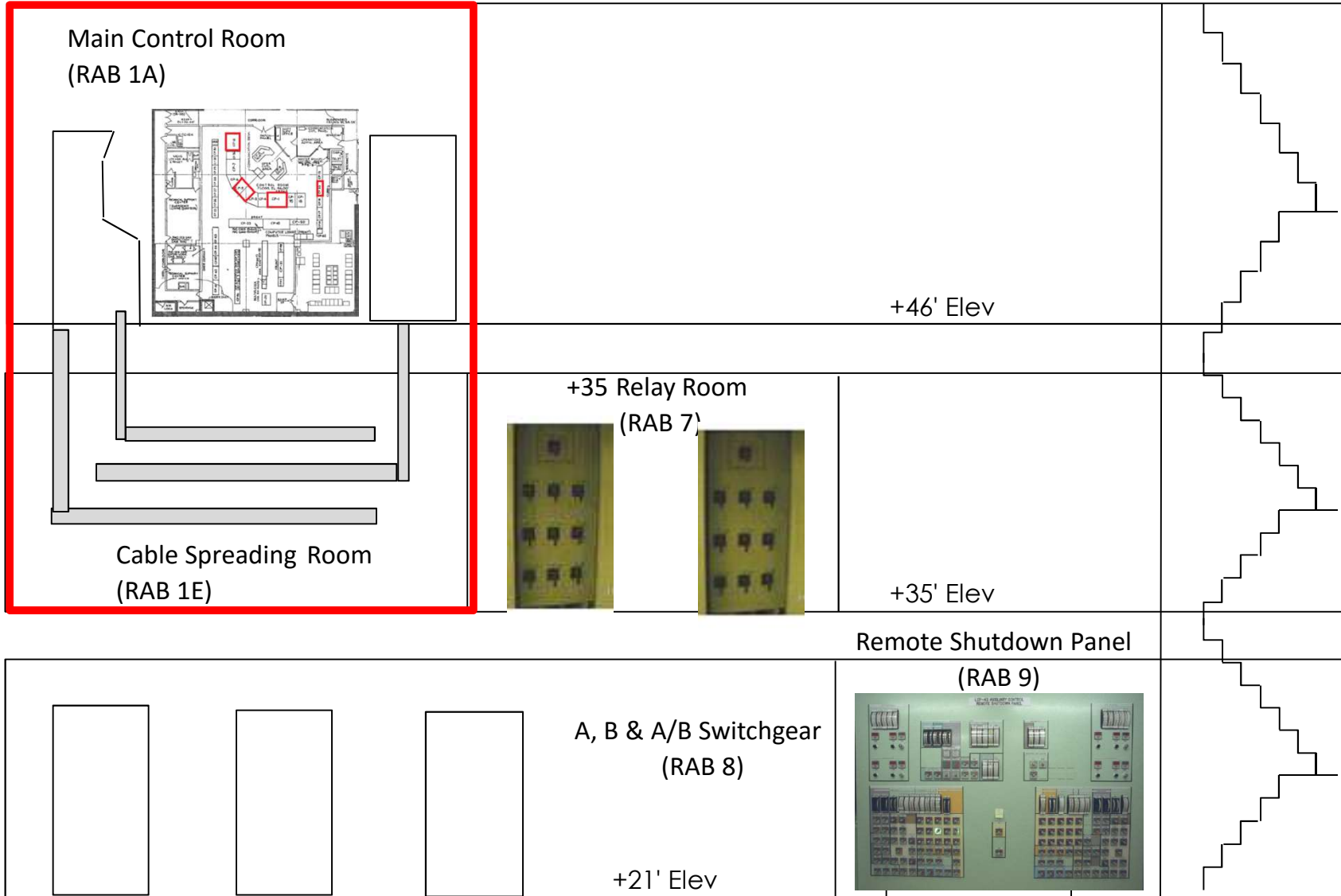
- John Jarrell – Manager, Regulatory Assurance
- Mark Thigpen – Design Engineering, PRA
- Kevin Fitzsimmons – NFPA 805 Project Manager (c)
- Alan Harris – NFPA 805 Licensing Lead (c)
- Ricky Summitt – PRA Consultant (RSC Engineers)
- Andy Spotts – PRA Consultant (JENSEN HUGHES)

(c) denotes on-site contractor

Purpose

Explain methods and assumptions used to develop the MCR Abandonment Fire PRA and provide insights into responses to PRA RAIs S04 and S04.01 to provide assurance that results obtained have a sound and acceptable basis.

MCR and Remote Shutdown Panel Overview



Evacuation of MCR (Procedure Overview)

- Upon confirmation of Cable Spreading Room or Main Control Room Fire, Shift Manager determines need to evacuate.
- Main Control Room Actions
- Recovery Actions
- Actions to transfer control to LCP-43
- Safe and Stable condition verified
- Plant conditions maintained until decision to:
 - Return to Main Control Room
 - Proceed to Cold Shutdown

MCR Abandonment Modeling

- Timing determination
- Scenario development
- Human Action modeling
- Equipment Failure (minor to major loss of function)
- CCDP and CLERP values

Time Determination

- Loss of Habitability
 - CFAST modeling used to determine abandonment times due to habitability
 - CFAST results used for SF*NSP factor development for habitability abandonment scenarios (NUREG/CR 6850 Appendix E)
 - Average abandonment time is approximately 14.6 minutes for scenarios in the Fire PRA
 - At this point the operators would implement MCR abandonment per OP-901-502

Time Determination

- Loss of Control
 - Timing for loss of control is scenario-specific for various ignition sources
 - Damage timing criteria guidance from Appendices H & S of NUREG/CR-6850 indicate timing is consistent with loss of habitability timing
 - Once damage challenges plant control function, operators will implement MCR abandonment per OP-901-502


Time Determination

- System Time Window
 - MCR abandonment HRA (loss of control and habitability) allows 30 minutes to establish control at remote shutdown panel (LCP-43)
 - This time provides at least a 30 minute buffer based on plant specific T/H analysis to feed SGs and prevent core uncover
 - System time window used in HRA is bounding for both loss of control and habitability scenarios

Scenario Development

- Loss of Habitability
 - Transient fires
 - Main Control Board fires
 - Fixed Source fires (control panels)
 - Abandonment scenarios developed with and without HVAC operating

Scenario Development

- Loss of Control
 - Cable Spreading Room Fires (transients)
 - MCR Fires leading to loss of control
 - Based on equipment controlled on key panels which, if lost, could impact key functions 
 - Includes transients, fixed sources (panel fires), and MCB fires

MCR Human Reliability Analysis

- Based on the MCR abandonment procedure (draft for NFPA 805)
- Operator actions relevant to Fire PRA important functions identified
 - Initial MCR actions
 - Recovery Actions
 - Actions to establish Remote Shutdown Panel (LCP-43) - operation of transfer switches in Relay Room
 - Actions at Remote Shutdown Panel


MCR Human Reliability Analysis

- Initial MCR actions
 - Trip the Reactor
 - Direct field operator to locally trip RCP breakers
 - Secure Charging and Letdown
 - Verify Turbine and Generator tripped
 - Close MSIVs
- Human Failure Events (HFE) developed for actions relevant to FPRA (securing charging/letdown)



MCR Human Reliability Analysis

- Recovery Action to locally trip RCP breakers
 - Prevents RCP Seal LOCA on loss of CCW
 - Separate HFE developed and incorporated in MCR abandonment model

MCR Human Reliability Analysis

- Actions to establish control at LCP-43
 - PCS Actions per RG 1.205 C.2.4
- Operation of transfer switches in + 35 Relay Room 
 - Isolates MCR circuits and aligns control to LCP-43
 - 6 sets of switches in 4 Auxiliary panels (62 total switches)
 - Only 4 of 6 sets are PRA significant (2 sets assumed failed)
 - Credit switch operation recovery from LCP-43 observation
 - Each scenario expanded to consider combinations of failed switch operation and resulting equipment impacts

MCR Human Reliability Analysis

- Actions at Remote Shutdown Panel 
 - PCS Actions per RG 1.205 C.2.4
 - Verify controllers transferred properly
 - EFW Flow Control Valves (4)
 - ADV's
 - Pressurizer Level and Pressure
 - Letdown Back Pressure
 - Establish control
 - Match switch position to indication
 - Depress "Push to Activate" switches 
 - Bounding HFE developed for relevant PRA action to verify Emergency Feedwater

Equipment Failures

- Equipment Failures incorporated in 3 categories
 - Impacts resulting from the fire (scenario specific based on fire source ZOI)
 - Failed Transfer of LCP-43 Switch
 - Each set of switches mapped to relevant PRA equipment
 - Failed switch operation prevents operation from LCP-43 and modeled as failed in FPRA
 - Random Failures from FPRA model

CCDP and CLERP

- Same quantification for Loss of Control as for Habitability based on HRA and fire impacts
- CCDP and CLERP values quantified for specific scenarios
- Over 800 scenarios developed based on possible failed transfer switch combinations for each original scenario
- Post-Transition:
CCDP range from 1.0 to 2.83E-03 and
CLERP range from 0.43 to 6.01E-05

VFDRs

- Identified based on the deterministic separation criteria assuming MCR Abandonment and successful transfer to LCP-43
- VFDRs applied to post transition plant model using guidance from FAQ 08-0054 to develop compliant plant model
- Compliant plant model equals the post transition plant model with impact of all VFDRs “removed” (VFDR cable impact removed from fire area along with associated equipment)

Conclusions

- The approach used to assess MCR/CSR Fires is performed in accordance with guidelines of NUREG/CR 6850, NEI 04-02 & FAQ 08-0054 Rev 1
- The approach provides sufficient detail to define available equipment and capture both fire-induced and random failures during abandonment and with control at LCP-43 established
- Risk and Δ Risk Results within acceptable values

Questions

Remote Shutdown Panel (LCP-43)

