



# **Public Meeting Concerning Rev 4 to NUMARC 93-01**

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***TMI Fire (a)(4) Tabletop  
Pilot Method and Results***

Leo Shanley

## TMI Fire (a)(4) Pilot - Overview

- ✓ Methodology
  - Use Fire PRA to identify important components based on table in 93-01 Rev. 4
  - Fire PRA CDF top event quantified
    - Determine equipment to consider in scope of Section 11 revisions
    - Determine important scenarios when equipment is unavailable
    - Obtain insights and help identify Risk Management Actions (RMA)
  - Focus of Fire PRA use will be on development and application of insights

## TMI Fire (a)(4) Pilot - Overview

- ✓ Why not use CDF values directly (i.e., similar to internal events)?
  - Fire PRAs are in various states of refinement at the 10 Exelon sites
    - Fire PRA level of detail not yet comparable to that of Internal Events PRA
  - General conservatisms in methodology, some of which are being addressed by industry initiatives
  - Specific conservatisms revealed when removing equipment from service

## TMI Fire (a)(4) Pilot - Overview

- ✓ TMI Fire PRA Status
  - Fire PRA databases updated in 2007, underlying PRA model updated in 2009
  - Internally reviewed, but not peer reviewed
  - Includes SSEL components
  - Scenarios and cutsets have not yet been reviewed against specific maintenance configurations

## TMI Fire (a)(4) Pilot - Methodology

- ✓ Scope: *“...identify equipment within the existing (a)(4) scope that is found to have appreciable impact on core damage mitigation for fire initiators.”*
- Looking for components that, when removed from service, result in one or more scenarios where no success paths are available (i.e., CCDP = “1.0”)
  - Per the table in NUMARC 93-01 (Draft) Rev. 4, these components require risk management actions if removed from service for 3 – 30 days
- Should be able to screen scenarios that already have CCDP = “1.0” in the base case

## TMI Fire (a)(4) Pilot – Methodology

- ✓ Table from NUMARC 93-01 (Draft) Rev. 4 [Section 11.3.7.3]

Number of Core Damage Avoidance Success Paths Available					
1 or More Success Paths Available			No Success Paths Available		
Duration of Unavailability			Duration of Unavailability		
<3d	3-30d	>30d	<3d	3-30d	>30d
Normal Controls		RMA	Normal Controls	RMA	Avoid Config.

## TMI Fire (a)(4) Pilot - Methodology

- ✓ Risk Management Actions (RMA):  
*“...develop a process for implementing risk management actions related to fire risk impacts of equipment identified...”*
- Review Fire CDF cutsets for cases with identified equipment out-of-service
  - Identify the scenarios in which there are no success/mitigation paths
  - Determine what is driving scenario
  - The RMA must address the initiator or plant configuration that results in core damage

## TMI Fire (a)(4) Pilot - Results

### ✓ Scope

- Started with at-power internal events (a)(4) scope of equipment
  - Approximately 160 components that affect the PRA are included in the TMI (a)(4) model.
- Quantified Fire PRA CDF with (a)(4) components unavailable one at a time.
  - Identified scenarios of interest by comparing CCDFP for each scenario with base case CCDFP for each scenario
  - Used PARAGON® software to help automate process of quantification and CCDFP calculations



## TMI Fire (a)(4) Pilot - Results

### ✓ Scope

- Identified about 50 components that resulted in one or more scenarios that met the criteria
  - Mostly electrical buses, ECCS pumps, Service Water and EDGs
  - Some asymmetry in trains (EFW, 120V Vital AC)
- Nothing unexpected – most potentially fire risk significant components are important for internal events

## **TMI Fire (a)(4) Pilot – Scope Results**

- ✓ **Electrical Buses, MCCs, Distribution Panels (19)**
  - 4kV ESF Buses (2), 480V ESF Buses and MCCs (10), DC Distribution (6) Panels, 120V Vital AC (1)
- ✓ **ECCS (8)**
  - Make-up Pumps (3), Decay Heat Removal Pumps (2), BWST Suction Valves (2), BWST
- ✓ **Service and Component Cooling Water (11)**
  - Service Water Pumps (3), Decay Heat Service Water Pumps and HX (2), Nuclear Services CCW HX (2), Decay Heat CCW Pumps (2), Intermediate CCW Pumps (2)

## **TMI Fire (a)(4) Pilot – Scope Results**

- ✓ **Emergency Feedwater (4)**
  - Motor-driven EFW Pump (1), Turbine-driven EFW Pump (1), Turbine-driven EFW Turbine Inlet Valve (1) CST (1)
- ✓ **Diesel Generators (3)**
  - EDG (2), SBO DG (1)
- ✓ **Miscellaneous (6)**
  - 250/125VDC Batteries (2), ESF Instrument Air Compressors (2), 120V Vital AC Inverter (1), Atmospheric Dump Valve (1)

## **TMI Fire (a)(4) Pilot - Results**

- ✓ Risk Management Actions (RMA)
  - Reviewed CCDP =1 cutsets to characterize the scenarios and develop RMAs
    - With one train unavailable, a fire affecting the other train could result in core damage
  - Affected Fire Areas and Scenarios
    - Minimum of one scenario in one fire area (e.g., EDG-1A)
    - Some equipment important to fire (buses, ECCS pumps) have many scenarios (>15) in multiple fire areas (>5)

## TMI Fire (a)(4) Pilot - Results

- ✓ Risk Management Actions (RMA)
  - Nearly all identified components require RMAs in current (a)(4) program (e.g., protect opposite train, minimize time in configuration)
    - Internal events CDF or LERF > 2x Baseline
    - Reduced Defense-in-depth
  - About 60% of the identified components have Tech Spec AOTs  $\leq$  72 hours.
  - Nearly half of the identified components are not normally removed from service while at-power
    - Buses, MCCs, Batteries, BWST, CST

## **TMI Fire (a)(4) Pilot – Potential RMAs**

- ✓ Transients/Cable Fires
  - Sensitivity to or control of hot work in fire zones or areas within fire zones
  - Minimize transient combustibles
  - Fire watches
- ✓ High Energy Arcing Faults (HEAF)
  - Minimize electrical switching
- ✓ Incipient Detection
  - Ensure it's available for scenarios where it's important
- ✓ Suppression
  - Ensure automatic suppression systems are available where important and/or brief Fire Brigade

# TMI Fire (a)(4) Pilot – DHR Pump RMA

Equip ID	Equip Description	Fire Area ID	Fire Area Description	Detection/Suppression	Cause of Fire	No. of Scenarios	Potential RMAs
DH-P-1A	DHR Pump 1A	AB-FZ-5	281' General Area	None	Cable fires in various trays with potential to spread to other trays	2 (B01, B02)	Avoid or minimize hotwork in area.
						1 (B06)	Avoid or minimize hotwork in area.
		CB-FA-2b	322' 1S (Train B) ESF 480V Switchgear	Incipient Detection	Fire in Remote Shutdown Transfer Switch Panel with failure of detection or fire brigade response	1 (E01)	a) Ensure detection system is available b) Brief operators and fire brigade on significance of fire in this room.
						Cable fire with potential to spread to other trays	1 (F04)
		CB-FA-2c	322' Tech Support Center	Incipient Detection	Fire in cabinet RS-SCC-B2 with failure of detection or fire brigade	1 (J02)	a) Ensure detection system is available b) Brief operators and fire brigade on significance of fire in this room.

## TMI Fire (a)(4) Pilot – EDG RMAs

Equip ID	Equip Description	Fire Area ID	Fire Area Description	Detection/Suppression	Cause of Fire	No. of Scenarios	Potential RMAs
EG-Y-1A	EDG 1A	CB-FA-3b	338' 1E (Train B) Switchgear Room	Incipient Detection	HEAF in 1E switchgear	1 (B6)	Avoid or minimize breaker manipulations on 1E switchgear
EG-Y-1B	EDG 1B	CB-FA-3a	338' 1D (Train A) Switchgear Room	Incipient Detection	HEAF in 1D switchgear	5 (B3, B4, B5, B6, B7)	Avoid or minimize breaker manipulations on 1D switchgear
EG-Y-4	SBO DG	CB-FA-1	306' Rad Con Office and Lab Area	No	Cable fire in tray with propagation to other trays	2 (B01, B03)	Avoid or minimize hotwork in area



## **TMI Fire (a)(4) Pilot - Conclusions**

- ✓ Fire PRA can be used to identify fire risk significant equipment
  - No 'surprises' in equipment identified – most equipment already risk significant for internal events
  - Identified equipment list is manageable – nearly half of equipment is not normally removed from service while at-power
- ✓ Fire PRA can be used to establish RMAs
  - Review needed at the cutset level to evaluate the scenario and develop RMAs
  - Some components have many scenarios that may require RMAs

## TMI Fire (a)(4) Pilot - Conclusions

- ✓ Lessons Learned
  - Fire PRAs provide conservative results when equipment removed from service – some screening needs to be done during review
  - Need to account for flags and split fractions – best to set them to 1.0 to ensure nothing is missed
  - More than 1 component removed from service
    - Are there new scenarios beyond the union of the individual equipment scenarios?
    - Some cases were reviewed as part of tabletop
    - Generally not found