



Washington Group International

Integrated Engineering, Construction, and Management Solutions

Synthesis of Safety Analysis and Fire Hazard Analysis Methodologies

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Overview of Presentation

- ◆ **Historical Perspective**
- ◆ **Requirement Overview**
- ◆ **Nuclear Safety**
 - Objectives
 - Purpose of Documented Safety Analysis (DSA)
- ◆ **Fire Protection**
 - Objectives
 - Purpose of Fire Hazard Analysis (FHA)
- ◆ **Example – Non-Nuclear vs. Nuclear**
- ◆ **Recommendations**

Historical Perspective

- ◆ **1994 - DOE STD-3009-94, *Preparation Guide For U.S Department of Energy Nonreactor Nuclear Facility Documented Safety Analyses***
- ◆ **1999 - *Fire Risk Implications in Safety Analysis Reports* – Presented at EFCOG Safety Analysis Workshop & DOE/Contractor Fire Protection Conference**
- ◆ **1999 - *Synthesis of SAR and FHA Methodologies* – Published in draft version of DOE-HDBK-1163**
- ◆ **2003 - *The Practical Implementation of Integrated Safety Management for Nuclear Safety Analysis and Fire Hazard Analysis Documentation* – DOE-HDBK-1163-2003**

Requirements - Code of Federal Regulations

- ◆ **10 CFR 830 – Nuclear Safety Management**
 - Applies to all Nuclear Facilities
 - Requires hazard controls to ensure protection of workers, public, & environment
- ◆ **10 CFR 851 – Worker Safety & Health Program**
 - Applies to all DOE Facilities
 - Requires a comprehensive fire safety & emergency response program to protect workers
 - Requires compliance with applicable building codes & National Fire Protection Association (NFPA) code set

Requirements – DOE Documents

◆ Orders

- **DOE O 420.1B** - *Facility Safety*
- **DOE O 440.1A** - *Worker Protection Management*

◆ Standards

- **DOE STD-3009-94** - *Preparation Guide for DOE Nonreactor Nuclear Facility DSA*
- **DOE-STD-1066-1999** - *Fire Protection Design Criteria*

◆ Guides & Handbooks

- **DOE G 440.1-8** - *Implementation Guide for use with 10 CFR Part 851 Worker Safety and Health Program*
- **DOE G 440.1-5** - *Implementation Guide for use with DOE Orders 420.1 and 440.1 Fire Safety Program*
- **DOE-HDBK-1163-2003** - *Integration of Multiple Hazard Analysis Requirements and Activities*

DOE Nuclear Safety Objectives

- ◆ **DOE Order 440.1A**
 - **DOE non-reactor nuclear facilities are to be “designed and constructed so as to assure adequate protection for the public, workers, and the environment from nuclear hazards.”**

Purpose of Documented Safety Analysis (DSA)

- ◆ Define scope of the work to be performed
- ◆ Identify & analyze the hazards associated with the work
- ◆ Categorize facility per DOE-STD-1027-92
- ◆ Document the safety analysis for the facility
- ◆ Establish hazard controls to ensure adequate protection of workers, public, & environment

DOE Fire Protection Objectives

- ◆ **DOE Order 420.1B - Minimize the potential for:**
 - Occurrence of a fire or related event;
 - Fires that cause an unacceptable onsite or offsite releases of hazardous or radiological material
 - Unacceptable interruption of vital DOE programs
 - Property loss from fire exceeding DOE-established limits
 - Fire damage to critical process controls & SC SSCs
- ◆ **DOE Order 440.1A**
 - Establish a comprehensive fire protection program to protect workers & public from fire & related hazards

Fire Hazard Analysis (FHA)

- ◆ Part of a comprehensive fire protection program
- ◆ DOE Order 420.1B requires FHA for:
 - Hazard Category 1, 2 and 3 Nuclear Facilities
 - Significant New Facilities
 - Facilities that represent unique fire safety risks
- ◆ Expectation is for use of a graded approach
- ◆ Can be used as:
 - Design input
 - Justification for a design choice

Purpose of a Fire Hazard Analysis (FHA)

- ◆ **To assess the risk from fire within individual fire areas & document if the DOE fire safety objectives are met (DOE Guide 440.1-5)**
- ◆ **The focus of the FHA should be the individual fire areas that comprise the facility (DOE Guide 440.1-5)**
- ◆ **A fire area is a location bounded by fire-rated construction, having a minimum fire resistance rating of 2 hours**

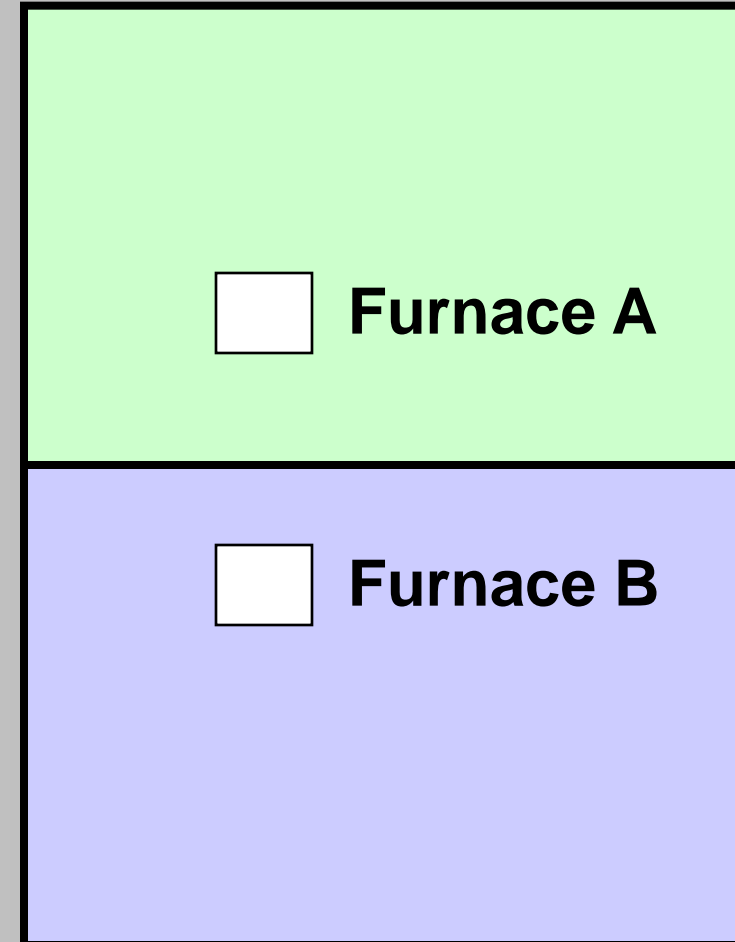
Comparing DSAs & FHAs

- ◆ **The tale of two documents**
 - Documented Safety Analysis
 - Fire Hazard Analysis
- ◆ **Understanding differing paradigms**
 - Non-nuclear example
 - Nuclear example
 - Initial conditions vs. protective features

Example – Large Non-Nuclear Facility

Facility Description

- ◆ Principal hazard:
Combustible metal
- ◆ Principal process:
Sinter metal parts
- ◆ Investment: \$90MM
- ◆ Two large furnaces
- ◆ No radioactive material
- ◆ 10 psf fire load



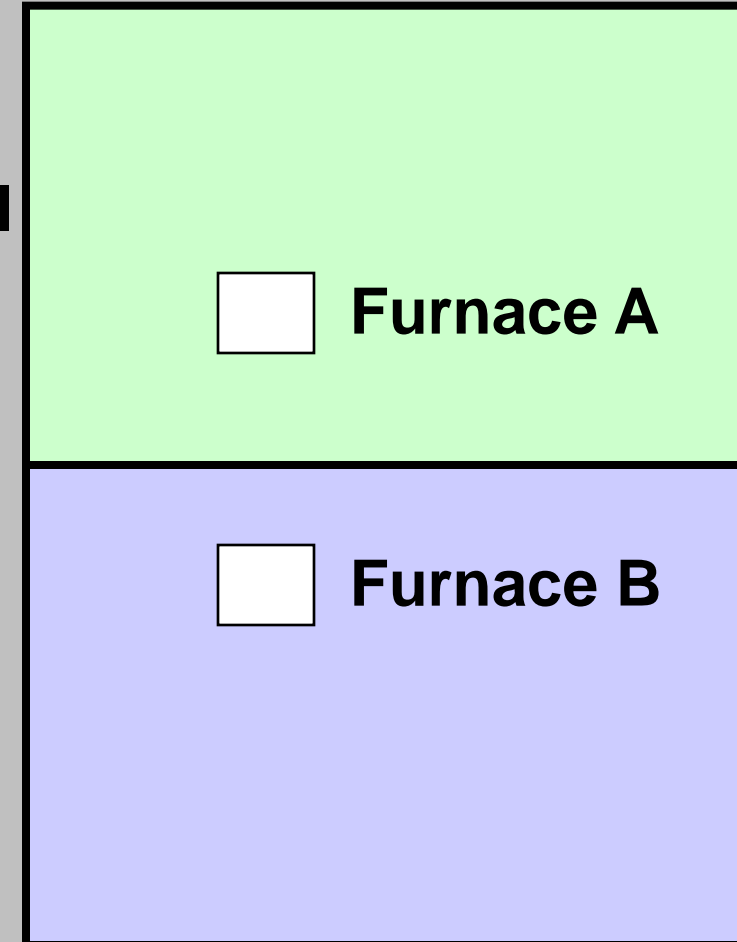
Example – Analysis of Non-Nuclear Facility

- ◆ **Required Fire Protection Programmatic Features**
 - Provide Fire Department response
 - Provide automatic sprinklers
- ◆ **Hazard-Based Requirements (Identify in FHA)**
 - Furnaces: NFPA 86, *Ovens & Furnaces*
 - Combustible metal: NFPA 484, *Standard for Combustible Metals*
 - Life Safety: NFPA 101, *Life Safety Code*
 - Monetary: Separate into 2 fires areas (<\$50MM each)
- ◆ **FHA Conclusion**
 - Given FD capabilities, automatic sprinklers, code compliance, & fire barrier, facility is adequately protected

Example – Large Category 2 Nuclear Facility

Facility Description

- ◆ Principal hazards:
Combustible & **radioactive** metal
- ◆ **Unmitigated MOI consequence:
30 rem**
- ◆ Principal process:
Sinter metal parts
- ◆ Investment: \$90MM
- ◆ Two large furnaces
- ◆ 10 psf fire load



Example – Analysis of Nuclear Facility

- ◆ **Required Fire Protection Programmatic Features**
 - Provide Fire Department Response
 - Provide Automatic Sprinklers
 - **Filtered Ventilation**
- ◆ **Hazard-Based Requirements (Identify in FHA)**
 - Furnaces: NFPA 86, *Ovens & Furnaces*
 - Combustible metal: NFPA 484, *Standard for Combustible Metals*
 - **Radioactive material: NFPA 801, *Standard for Fire Protection for Facilities Handling Radioactive Materials***
 - Life Safety: NFPA 101, *Life Safety Code*
 - Monetary: Separate into 2 fires areas (<\$50MM each)

Example – Hazard Analysis Table

Scenario Description	Initial Conditions	Unmitigated consequences	Mitigative & protective features	Mitigated dose
Furnace interlock fails – causes fire leading to release	Meet NFPA 86, 484 & 801 FD Response Sprinklers Fire walls	< 30 rem	Ventilation system	low
Furnace interlock fails – causes fire leading to release	None	60 rem	Meet NFPA 86, 484 & 801 FD Response Sprinklers Fire walls Ventilation system	low

Recommendations from Example

- ◆ **Communication & consistency are good things**
- ◆ **Consistency between DSA & FHA for consistency sake is not necessary – There may be a very good reason they present different material**
- ◆ **Focus discussions more on mitigated results, less on unmitigated**
- ◆ **Treating FP features as initial conditions may mask importance of controls**

Other Recommendations

- ◆ **Development schedule for DSA & FHA should be compatible**
- ◆ **DSA & FHA control selection processes should be coordinated**
- ◆ **DSA control selection process should utilize controls that are already implemented in the facility, if possible**
- ◆ **The fire protection engineer who authored the FHA should be on the DSA "team"**
- ◆ **FHA conclusions should be incorporated into DSA**