



Washington Group International

Integrated Engineering, Construction, and Management Solutions

Fire Analysis Preparation Implementation Approaches for DOE Nuclear Facilities

Energy Facility Contractors Group (EFCOG), Safety Analysis
Working Group (SAWG) Fall 2007 Workshop,
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Overview of Presentation

- ◆ **Initial Issue & Early Efforts**
- ◆ **Observations from 2007 SAWG EFCOG**
- ◆ **FHAs & DSAs in Context**
- ◆ **DSA Purpose**
- ◆ **FHA Purpose**
- ◆ **Preparation Processes**
- ◆ **Present Activities**
- ◆ **Path Forward**

Initial Issue

- ◆ **“Evidence of FHA and DSA’s not integrated”**
 - Perhaps better stated as:
 - What fire do you start with in developing a DSA?
 - What is an realistically conservative unmitigated fire?
 - How to differentiate if a scenario is credible or not?
- ◆ **Formed team to**
 - Define the problem
 - Seek solution
- ◆ **Discussed topic at May 2007 SAWG EFCOG**

Scenarios That Exemplify Issue

- ◆ **Robust storage container**
 - Containers assumed to fail during severe fire
 - Requires design SSCs & SAC to prevent failure
- ◆ **Fire-induced failure of robust container**
 - Fire occurs during a brief intermittent transfer
- ◆ **Fire-induced failure Type B package at loading dock**
 - Structure fire is more severe than transportation fire
- ◆ **Unmitigated room fire scenario in process cell**
 - Conservative fire loading cause evaporation of total inventory
- ◆ **Multiple Type A containers staged for transfer**
 - Fire causes release of contents from every container

Initial Efforts

- ◆ Many involved in early telecons & a basic proposed integration flowchart
- ◆ Drafted a paper getting at the differences & common ground of FHA's & DSA's
- ◆ Considered how guidance should be revised to better drive proper integration
- ◆ Small team efforts resulted in a draft paper
- ◆ Basic intent and content to follow

2007 Annual SAWG FHA-DSA Discussions

◆ FHA-DSA Papers

- Synthesis of SAR and FHA Methodologies
- Lessons Learned from Close Interaction Between Nuclear Safety and Fire Protection within the Idaho Cleanup Project

◆ Recognitions

- FHA & DSA footprints might differ
- Revision schedules might differ
- Active FP systems should not be initial conditions

◆ Needed & Desired Outcomes

- Understanding of the perceived FHA-DSA differences
- Closer coordination between FHA-DSA
- Consensus on FHA-DSA development processes

FHA & DSA Hierarchy

FHA Requirement Basis

10 CFR 851, Worker Safety and Health Program



DOE Guide 440.1-8, Implementation Guide for use with 10 CFR Part 851 Worker Safety and Health Program

DOE Order 420.1B, Facility Safety



DOE Guide 420.1-3, Implementation Guide for DOE Fire Protection and Emergency Services Programs for Use with DOE O 420.1B, Facility Safety



DSA Requirement Basis

10 CFR 830, Nuclear Safety Management



DOE Order 420.1B, Facility Safety



DOE Guide 421.1-2, Implementation Guide for Use in Developing Documented Safety Analyses to Meet Subpart B of 10 CFR 830



DOE-STD-3009-94, Preparation Guide for U.S. Department of Energy Nonreactor Nuclear Facility Documented Safety Analyses

DSA & FHA are Pieces of Individual Programs

Fire Protection Program (DOE Order 420.1B)

Documented policies, criteria, and procedures

Fire Hazard Analyses

Equivalency review & approval process

Access to qualified & trained FP staff

Self-assessment process

Design process

Emergency Response Program

Nuclear Safety Program (10 CFR 830)

Documented Safety Analysis (DSA)

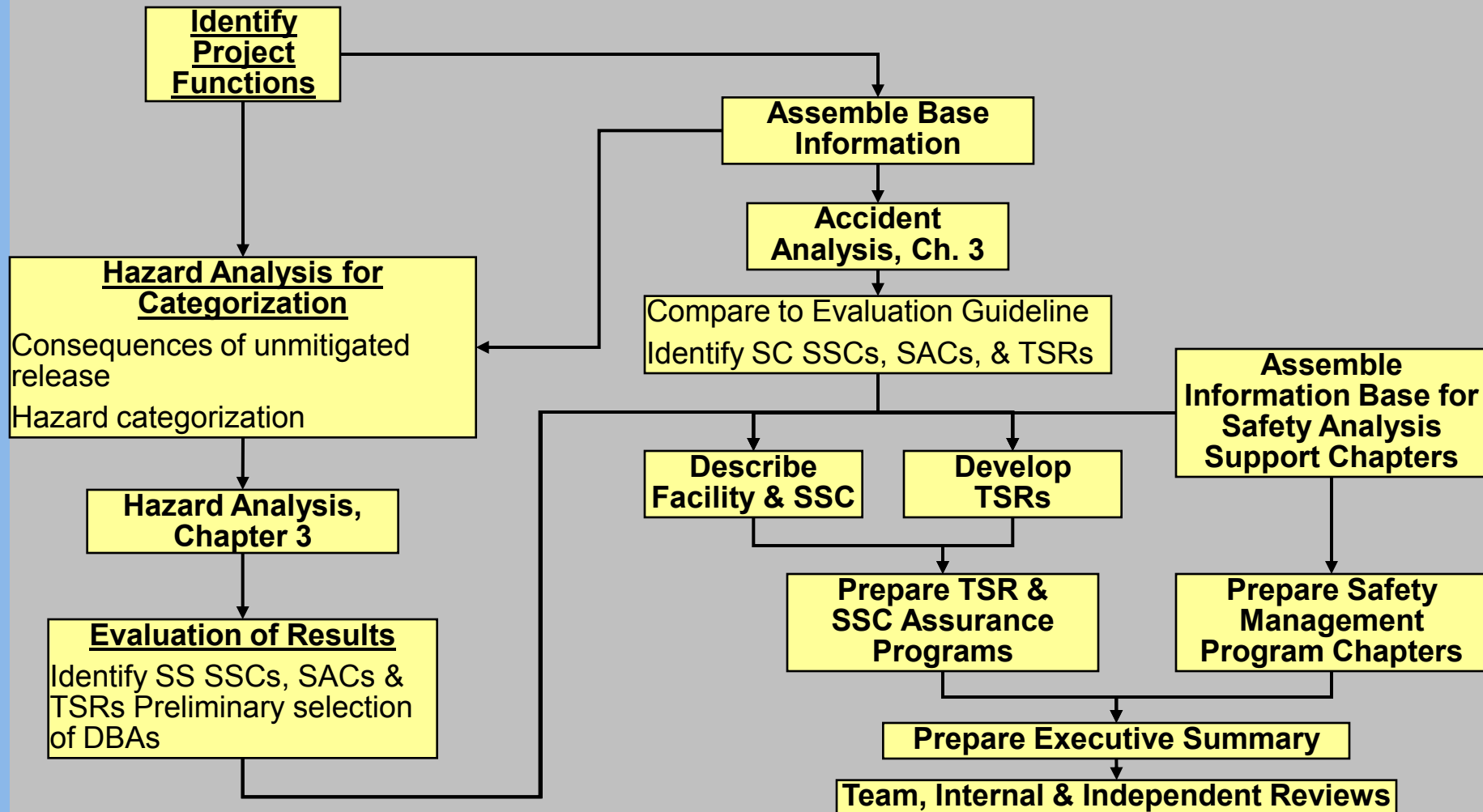
Unreviewed Safety Question (USQ) Process

Technical Safety Requirements (TSRs)

Documented Safety Analysis Purpose (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**

DSA Process (from DOE-STD-3009-94)



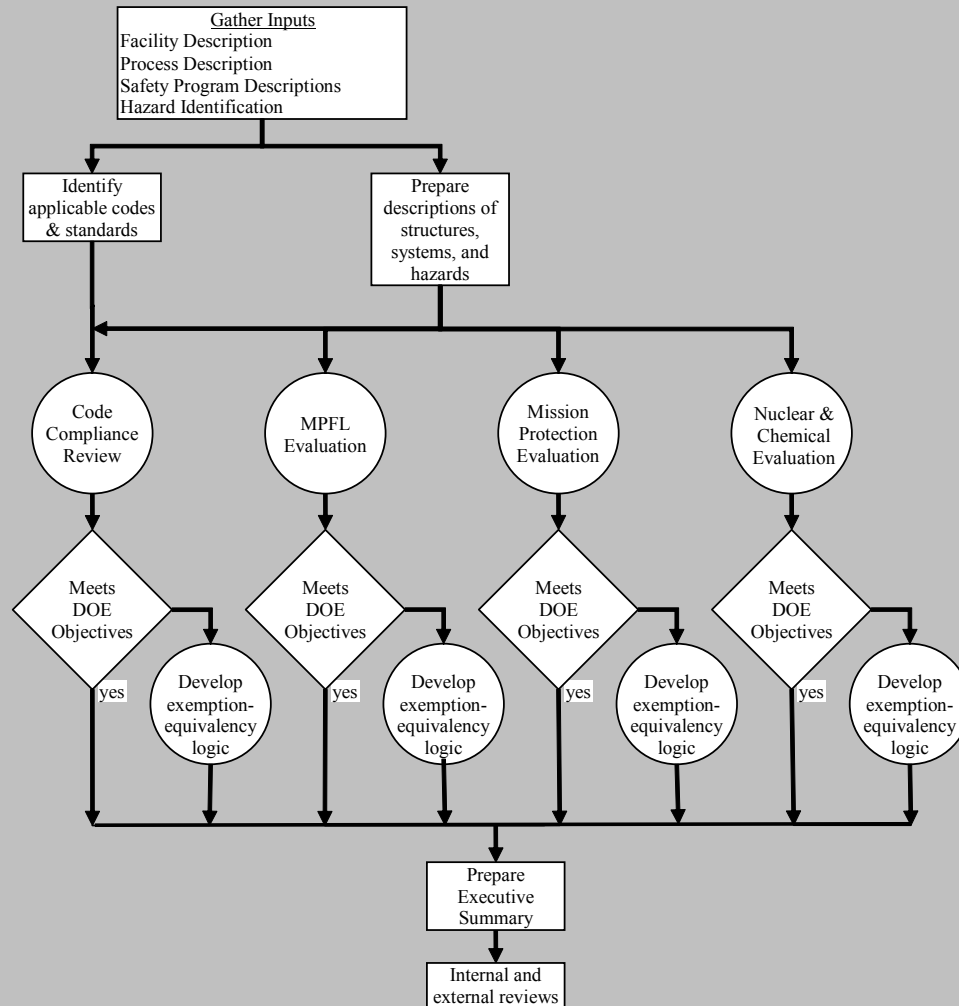
Fire Hazard Analysis Purpose (FHA)

- ◆ **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**

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 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

Typical FHA Process



Maximum Possible Fire Loss

- ◆ **“Include all direct and indirect costs associated with the fire and clean-up operations.”**
 - a. Replacement cost of building
 - b. Replacement cost of contents
 - c. Mission interruption costs
 - d. Environmental clean-up costs
 - e. Exposure damage to nearby buildings & property
 - f. Costs to re-establish operations (e.g., redesign approval & start-up)
- ◆ **MPFL is not a scenario**
- ◆ **Where MPFL is too high “it is permissible to use a lower value if justified in the FHA”**

Maximum Possible Fire Loss (con't)

If the MPFL exceeds	Minimum protection	Reference
\$ 3 MM	Protected by a supervised automatic fire suppression system	DOE G 420.1-3
\$50 MM	A redundant fire protection system (e.g., fire-rated barriers in conjunction with fully capable fire department) in addition to the suppression system required above.	DOE G 420.1-3
\$100 MM	An additional, independent source of fire protection water . (Also is suggested for Significant Nuclear Facilities.)	DOE-STD-1066-94

Differing Perspectives

◆ Project Design

- Meet current codes & standards
- Be robust to avoid high project risk
- Intent is to conform with scope, schedule & budget

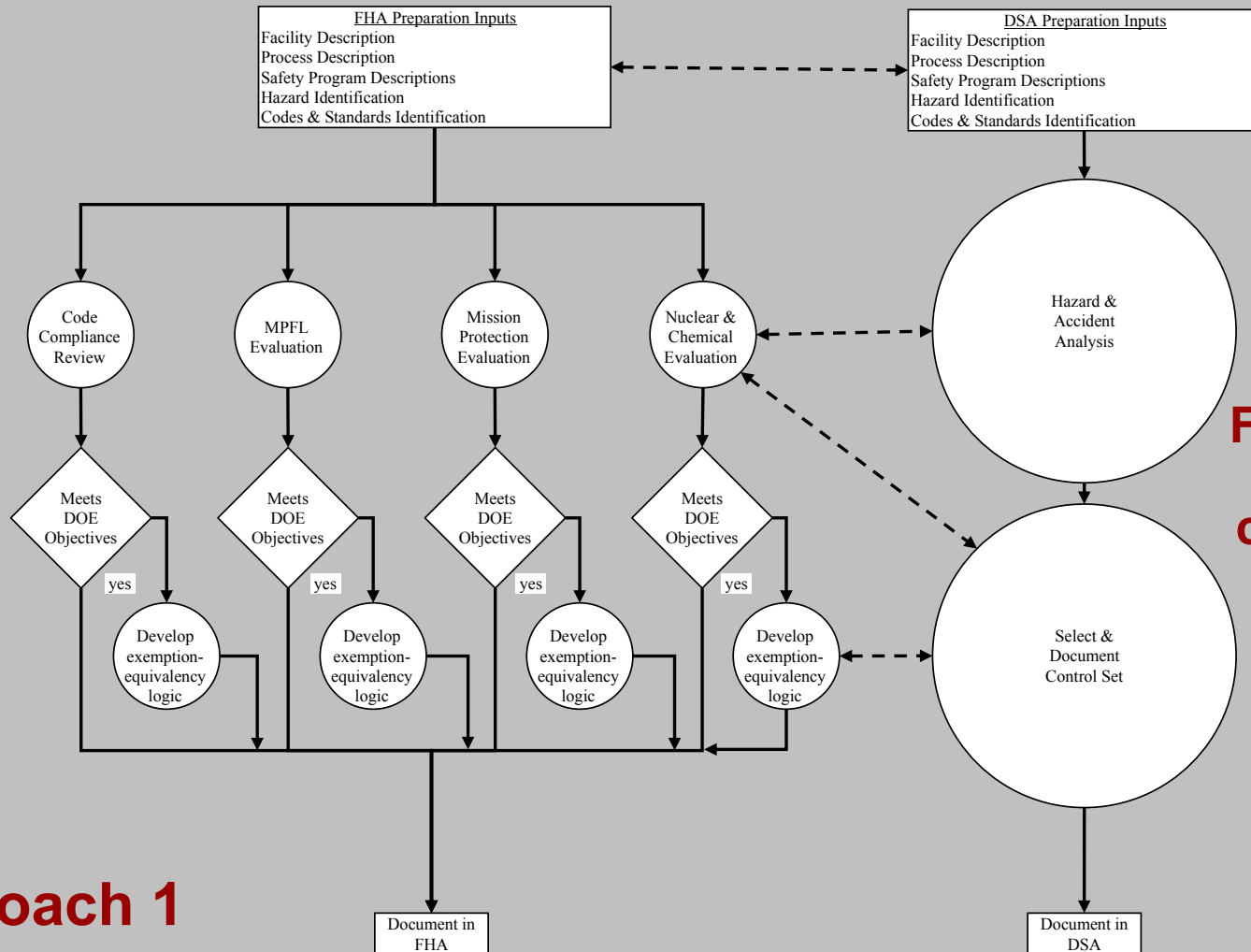
◆ Fire Protection (NFPA 801)

- FHA will be initiated early in the design process
- FHA will identify necessary fire protection
- Intent is to limit risk from fire

◆ Nuclear Safety

- For robust facility, new engineered features not expected
- Intent is to show evaluation guidelines are not challenged

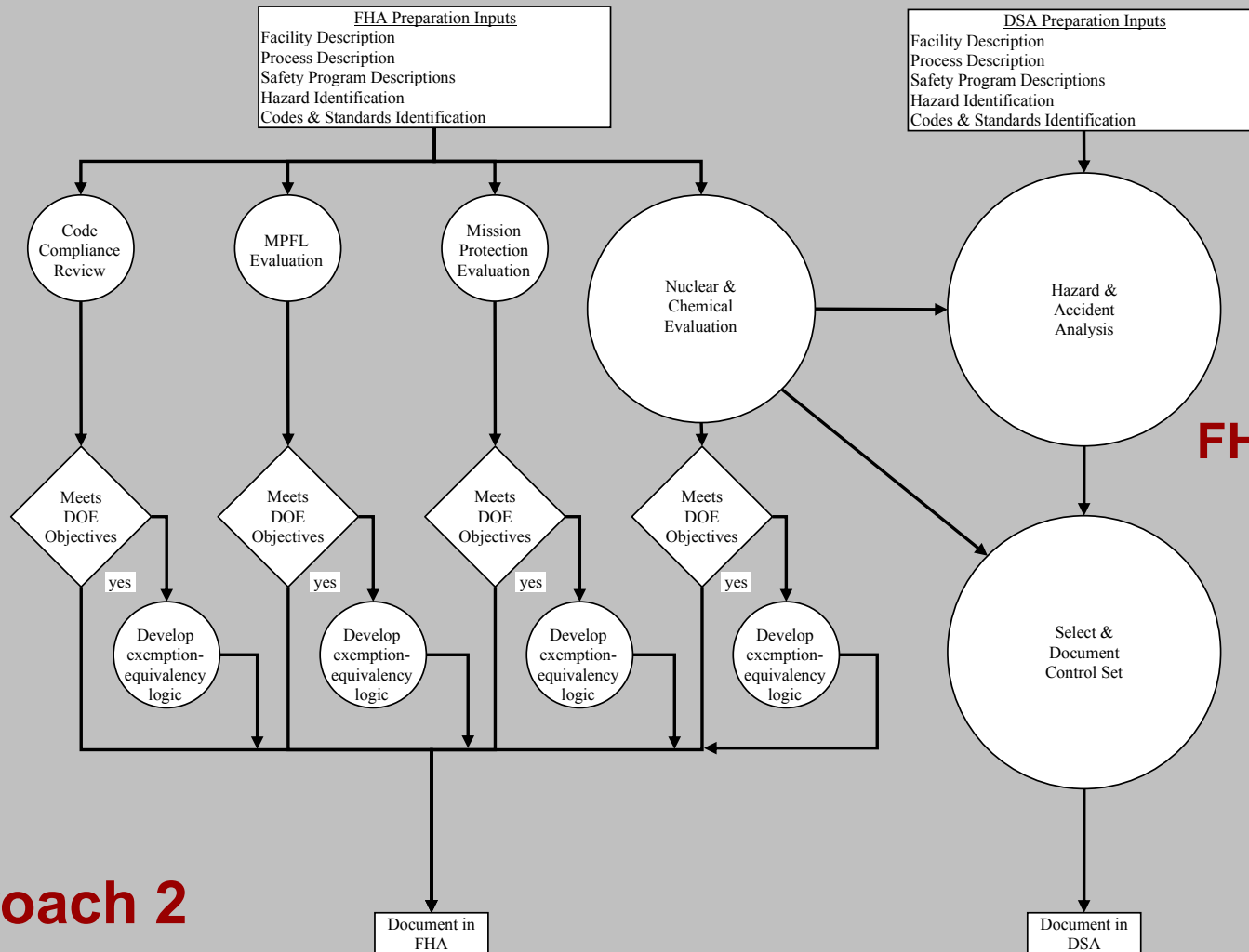
FHA & DSA Efforts Kept Independent



FHA & DSA authors coordinate efforts

Approach 1

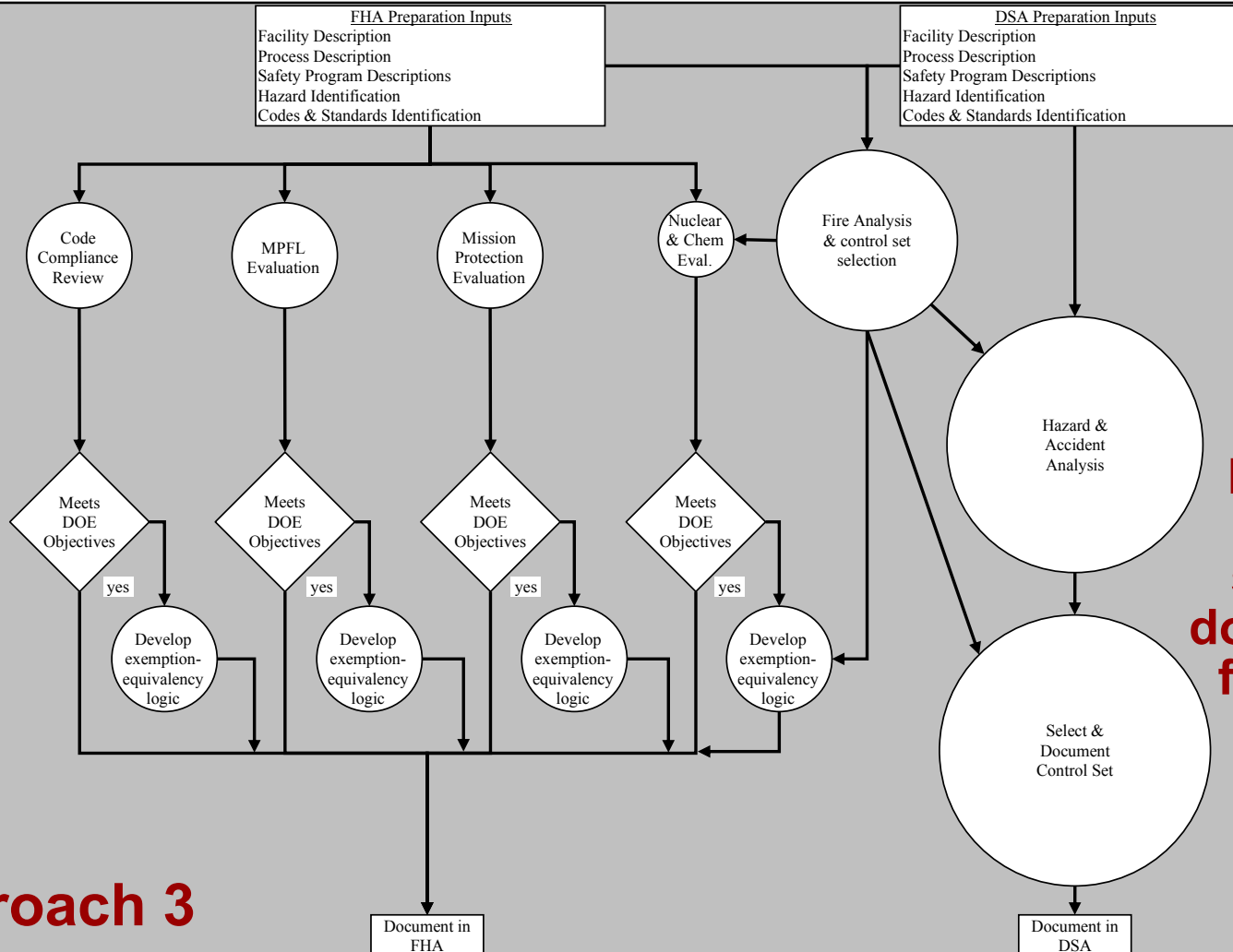
Develop All DSA Fire-Related Analysis in FHA



FHA develops DSA fire analysis

Approach 2

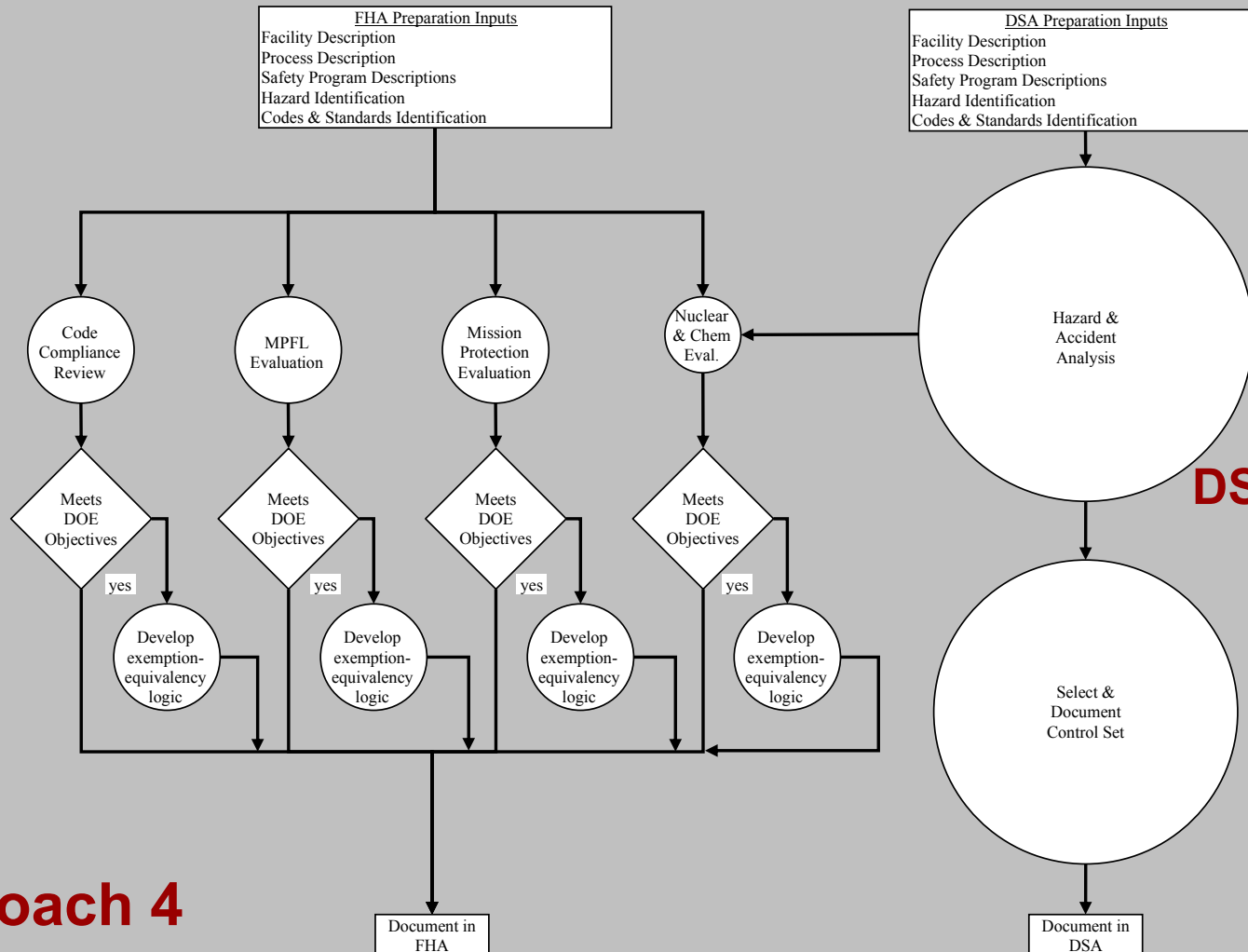
Develop Fire Analysis in Support Documents



**FHA & DSA
rely on
supporting
documents for
fire analysis**

Approach 3

Capture Fire Analysis in DSA



**DSA develops
FHA fire
analysis**

Approach 4

Tentative Sample Problems

- ◆ **Vehicle fire at loading dock with 9975s present**
 - 55 gallons of combustible liquid
 - 400 gallons of combustible liquid
- ◆ **Cell fire exposing an aqueous solutions hold tank**
 - Bounding radiological inventory & complete boil off
 - Bounding radiological inventory & limited combustibles
 - Reduced radiological inventory & limited combustibles
- ◆ **Process room fire**
 - Very restricted combustible loading program
 - Nominal combustible loading program
- ◆ **Process facility fire**
 - No significant loss of structural integrity
 - Loss of structural integrity

Sample Problem Discussion Points

- ◆ **Appropriate unmitigated assumptions**
- ◆ **Appropriate initial conditions**
- ◆ **Scenario reasonableness**
- ◆ **Control selection**
- ◆ **Control classification**
- ◆ **Variations in results for differing assumption**

Sample Problem – Glove Box Fire

◆ Scenario

- Small fire starts in glove box
- Direct damage limited to box
- Smoke & contamination spread to room

◆ FHA Treatment

- Not usually explicitly evaluated
- NFPA 801 Compliance (limit combustibles & suppression)

◆ DSA Treatment

- Public - Bounded by more severe fire (document in HE table)
- Worker - Qualitative assessment to establish controls needed for worker protection

Sample Problem – Worst Case Fire (FHA term)

◆ Scenario

- Small fire starts in room
- Fire not controlled by sprinkler system (sprinkler fails)
- Smoke & contamination spread to outside room

◆ FHA Treatment

- Qualitative assessment – Fire construction limits fire spread
- Harm - Loss of room & contents, MPFL estimate bounds scenario, workers have time to evacuate

◆ DSA Treatment

- Public – Qualitative, if at all – Bounded by room fire
- Worker – Qualitative – Does scenario timing permit evacuation before significant contamination spread?

Sample Problem – Multiple Fire Areas

◆ Scenario

- Small fire starts in room
- Suppression system fails to control fire
- Full room involvement
- Fire propagates to involve multiple rooms in the fire area
- Fire department does not control fire
- Fire extends beyond fire area into second fire area

◆ FHA Treatment

- Not considered “in scope” - Requires multiple failures

◆ DSA Treatment

- Public – Quantitative – Demonstrate EGs not challenged
- Worker – Qualitative – Credit loss of multiple levels of SS protection and/or demonstrate successful evacuation

Path Forward

- ◆ Discuss proposed path forward – today
- ◆ Adjust draft guidance based on input from today's discussions
- ◆ Complete preparation of sample problems
- ◆ Publish guidance document for general review

Other Actions?