Integrating Safety into Design of IWTU

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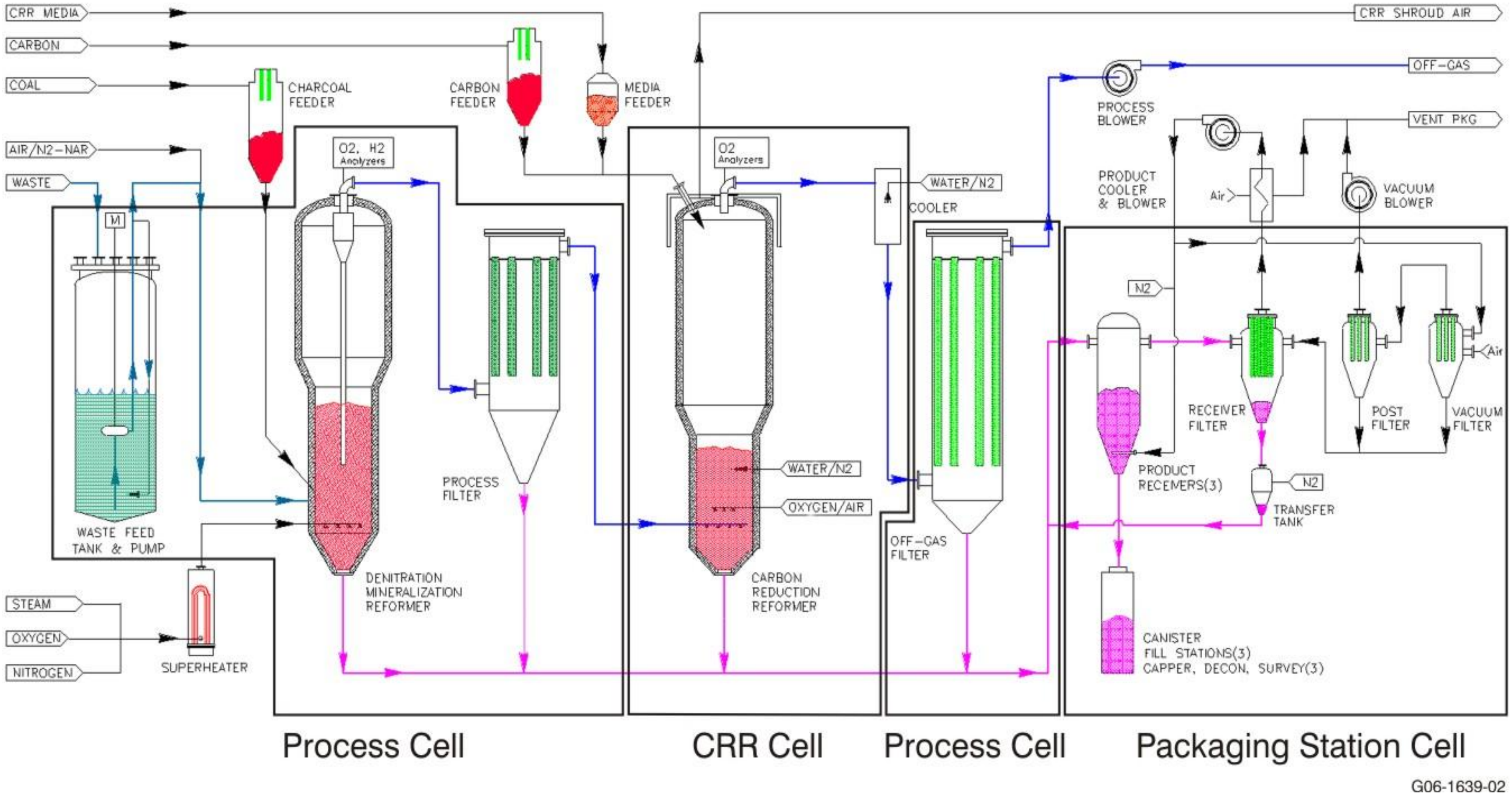
Introduction

Using an integrated approach for the early identification of appropriate and reasonably conservative safety structures, systems, and components (SSCs) has minimized the potential for significant cost and schedule impacts from changing system design requirements late in the IWTU project life cycle.

IWTU Process Background

- IWTU uses existing steam reforming technology to treat approximately 900,000 gal of radioactive liquid waste containing nitric acid and mercury
- The end product is highly stable radioactive granules
- Conceptual design started 2005
- CD-2 Submitted May 2006
- CD-3 Submitted June 2007
- Treatment to start Late 2009 or early 2010
- Project completed 2011 (18 month cycle)

Process Flow and Confinement



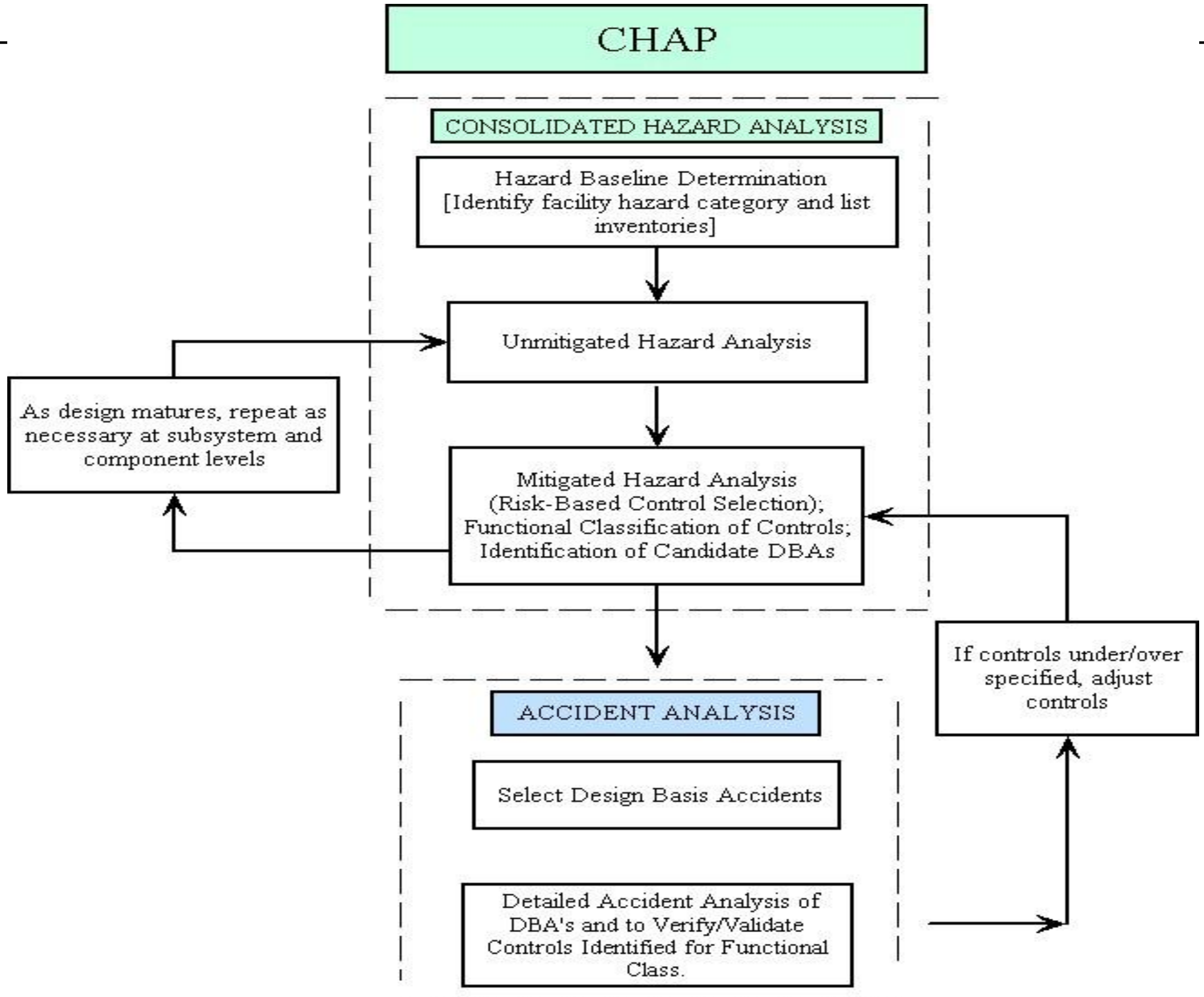
IWTU Safety Analysis Background

- Nuclear Safety involved at critical decision (CD)-1, April 2005
- Approval of preliminary hazard analysis, Sept 2005
- PDSA issued with CD-2, May 2006
- PDSA revision with CD-3, June 2007
- FDSA/TSRs to be developed 2008
- PDSA developed prior to DOE-STD-1189 and DOE O 413.3A
- Meets the intent of the draft order and standard

Hazards Analysis Process

- A comprehensive hazard analysis methodology applied to process hazard analysis throughout a facility or project life cycle.
- Integrates the project scope of work, process hazard analysis, and equipment functional classification into a unified process.
- Ensures specialized hazard analyses use common data and assumptions.

Overview of Safety Analysis



Hazard Analysis Process (cont.)

- **Two HAZOP reviews performed**
  - CD-2
  - CD-3
- **Reviews multidisciplinary**
  - Design Engineers
  - System Engineers
  - Facility Operations
  - Radiological Controls
  - Nuclear Safety
  - Industrial Hygiene
  - Industrial Safety
  - Environmental Safety

Hazard Analysis

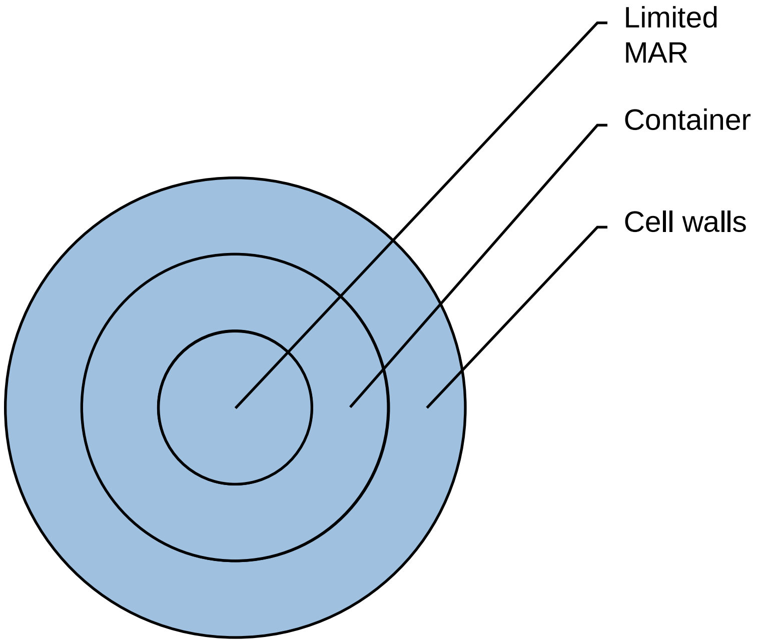
- **Following hazards were identified and carried into the hazards analysis**
  - High radiation
  - Radioactive/hazardous materials
    - Equipment breaches
    - Fires/deflagrations
  - External Events
    - Fire
    - Loss of power
  - NPH
    - Lightning
    - Flood
    - Earthquake
    - High wind
    - Snow loads

Hazards Analysis (cont.)

- **The following events were brought forward into the accident analysis**
  - Waste feed tank breach (bounding liquid breach)
  - Vessel breach (bounding solids breach)
  - Activated carbon bed fire (bounding fire)
  - Vessel deflagration (bounding explosion)
  - Design basis earthquake (bounding natural phenomena hazard)

IWTU Nuclear Safety Control Strategy

- **Design to prevent material release**
- **Provide multiple barriers to release**
  - MAR inventory is confined to areas with limited or no personnel access
  - Primary barrier failure is protected by secondary confinement
- **Designed to all DOE STD-3009 and DOE O 420.1 protocols**
- **Select significant Defense-in-Depth for worker safety elevated to Safety Significant**



IWTU Control Strategy (Continued)

- **Consideration of defense in depth included the following:**
  - choosing an appropriate site;
  - minimizing the quantity of material at risk;
  - applying conservative design margins and quality assurance;
  - using successive physical barriers for protection against radioactive releases;
  - using multiple means to ensure critical safety functions needed to—
    - control processes,
    - maintain processes in safe status, and
    - confine and mitigate the potential for accidents with radiological releases

Safety SSCs Identified

Safety SSC Groups	Classification	Function
Rapid Shutdown System	Safety Significant	Prevent an in-vessel deflagration Mitigate GAC bed fire
Passive confinement features	Safety Significant	Prevent release to occupied areas
Shielding features	Safety Significant	Prevent exposure to high levels of radiation
Carbon feed pipes	Safety Significant	Prevent in-cell deflagrations
Uninterruptible power supply	Safety Significant	Defense in Depth for RSS

Lessons Learned

- Safety integration must be a project goal at the very beginning
- Integration must be shared by all disciplines
- Involvement must start early in design
- Invite and welcome participation from:
  - DOE
  - DNFSB
  - EPA
  - State

Idaho Cleanup Project

Lessons Learned (Continued)

- **Perform a consolidated hazard analysis**
- **Revise the hazards analysis as design matures**
- **Quickly adjust to change**
- **Involve DOE recognized SMEs**
- **Frequent interaction between safety and project**
  - Locate with project
  - Document and design reviews
  - Involvement in hazards analysis
- **On going dialog between safety and project**

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