UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

February 24, 2000

MEMORANDUM TO: Melvyn Leach, Acting Chief
Special Projects Branch
Division of Fuel Cycle Safety
and Safeguards, NMSS

THRU: Melanie Galloway, Section Chief
Enrichment Section
Special Projects Branch
Division of Fuel Cycle Safety
and Safeguards, NMSS

FROM: Andrew Persinko, Sr. Nuclear Engineer
Enrichment Section
Special Projects Branch
Division of Fuel Cycle Safety
and Safeguards, NMSS

SUBJECT: SUMMARY OF MEETING WITH DUKE COGEMA STONE & WEBSTER TO DISCUSS TECHNICAL TOPICS ASSOCIATED WITH THE MIXED OXIDE FUEL FABRICATION FACILITY

On February 3, 2000, the U.S. Nuclear Regulatory Commission (NRC) staff met with representatives from Duke Cogema Stone & Webster (DCS) to discuss technical topics associated with the mixed oxide (MOX) fuel fabrication facility. Topics discussed include worker dose, HVAC/confinement, use of polycarbonate materials for glovebox windows, fire protection, and controlled area boundary. The attendance list, meeting agenda and slides used in the presentation are attached (Attachments 1, 2 and 3, respectively).

At the meeting, DCS proposed various technical positions and its proposed, or planned, approaches for key design topics and sought NRC staff feedback regarding the DCS approach. The NRC staff provided the feedback sought by DCS to the extent possible. DCS still intends to submit an application in September 2000 with sufficient information to allow construction to commence.

During the presentations, in response to NRC staff questions, DCS indicated that: 1) regarding the location of the worker with respect to potential accidents, the worker doses discussed by DCS would apply, in general, to the worker located at the potential breach of a glovebox; 2) the pressure differential between outside the building and the C1 confinement area is normally maintained at zero; 3) the positive value indicated on page 8 of the HVAC/confinement slide for the C1 confinement area normally occurs when the truck bay doors are opened; 4) DCS's use of the word "intact" on page 17 of the HVAC/confinement slide means that the confinement systems are able to perform their functions; 5) whether DCS considers radiation monitors as "items relied on for safety" will depend on the results of the integrated safety analysis; and 6) a DCS design goal, with respect to fire protection, is to not designate fire protection systems as "items relied on for safety," as defined in the proposed Part 70 rule, but to assure that the fire protection systems are seismically restrained so that they do not interfere with items that are designated as "items relied on for safety"; to do this, risk from fire would have to be shown to be "highly unlikely."

The staff indicated that it would be useful for DCS to provide NRC with documents describing the criteria that it would apply to the technical areas discussed during the meeting.

Docket: 70-3098

Attachments: As stated

cc: Mr. Peter Hastings
Duke Cogema Stone & Webster
P.O. Box 31847
Charlotte, MC 28231-1847

ATTENDEES

NAME	AFFILIATION
Andrew Persinko	Nuclear Regulatory Commission (NRC)
Melanie Galloway	NRC
Melvyn Leach	NRC
Timothy Johnson	NRC
Rex Wescott	NRC
Richard Struckmeyer	NRC
Fred Burrows	NRC
M. Srinivasan	NRC
Wilkins Smith	NRC
Alex Murray	NRC
Michael Adjodha	NRC
Rob Lewis	NRC
Ed Brabazon	Duke Cogema Stone & Webster (DCS)
Peter Hastings	DCS
Laurence Cret	DCS
Bill Hennessy	DCS
Tom St. Louis	DCS
Frazie Gerard	DCS
Juteau Frederic	DCS
Bruce Brunsdon	DCS
Don Silverman	DCS/Morgan Lewis
Charlie Sanders	FCF
Jamie Johnson	Department of Energy (DOE)
Patrick Rhoads	DOE
Dan Bruner	DOE-Savannah River
Don Williams	Oak Ridge National Laboratory
Faris Badwan	Los Alamos National Laboratory
Phil Kasik	MPR/DOE
Steven Dolley	Nuclear Control Institute
Sidney Crawford	Consultant (self)

ATTACHMENT 1

Agenda

Meeting with Duke Cogema Stone&Webster (DCS) to Discuss Technical Issues Associated with the Mixed Oxide (MOX) Fuel Fabrication Facility

February 3, 1999
8:30am in Room T8A1

- Introduction - NRC
- Opening Remarks - DCS
- Technical issues in order of presentation:
  - Worker Dose
  - HVAC/Confinement
  - Use of Polycarbonate Materials for Glovebox Windows
  - Fire Protection
  - Controlled Area Boundary
- Closing Remarks

Format:
DCS will make a 30-45 minute presentation on each issue followed by NRC/DCS discussion.

ATTACHMENT 2

ATTACHMENT 3

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Briefing Objectives

- Propose various technical positions and proposed/planned approaches for key design topics
- Solicit NRC staff feedback regarding planned approach
  - concurrence with approach where feasible
  - identification of additional information needed for clarification of approach
  - discuss actions necessary to facilitate timely NRC review

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Agenda

• Worker Dose	Bill Hennessy
• HVAC/Confinement	Tom St. Louis
• Use of Polycarbonate for Glovebox Windows	Bruce Brunsdon
• Fire Protection	Tom St. Louis
• Controlled Area Boundary	Bill Hennessy

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Worker Dose

Bill Hennessy
Bruce Brunsdon
03 February 2000

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Worker Dose Briefing Objectives

- Describe DCS approach for protecting personnel and demonstrating compliance with 10 CFR 70.61 requirements
- Solicit NRC staff feedback regarding planned approach

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Presentation of Topic

- Proposed 10 CFR 70 requires worker protection from credible high and intermediate consequence events
- Reference design is not subject to this new regulatory requirement
  - personnel protection is significant factor in MELOX and La Hague designs, <u>and</u>
  - both facilities demonstrate good personnel safety record, <u>but</u>
  - regulatory requirements are different, so DCS must determine how best to demonstrate compliance with requirement

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DCS Approach

- Capitalize on proven performance of reference design
  - MELOX and La Hague designs and operational concepts minimize likelihood and/or consequences of confinement breaches
  - e.g., all events in MELOX operating history have resulted in virtually no consequence (all within occupational limits)
- Modify reference design as necessary to demonstrate compliance with worker protection requirements
  - add engineered controls (e.g., IROFS* [seismic] design of glovebox ventilation)
  - complement design measures with management measures for mitigation similar to MELOX, e.g., emergency procedures, training, respiratory protection, room evacuation upon airborne contamination detection
  - controls to be based upon results of PHA/ISA

**Item Relied On For Safety*

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DCS Approach (continued)

- Evaluate (as part of PHA/ISA process) events that could release Pu into normally occupied areas
  - criticality must be made highly unlikely, so internal exposure is remaining concern
  - Aqueous Polishing cells with welded equipment do not present significant hazard for release
  - loss of tightness of primary confinement/containment in rooms containing gloveboxes or rods (e.g., earthquake, fire, load drop)
- Assess acceptability of engineered/management measures
  - demonstrate low consequence for normal/not unlikely events
  - demonstrate intermediate/high-conseqence breaches are unlikely/ highly unlikely
  - qualify confinement boundary (barrier and ventilation)

Rationale/Results to Date

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- Example of low-consequence event: glove or seal failure on a glovebox
  - MELOX experience demonstrates engineered and management measures maintain doses below occupational limits
- Potentially intermediate- and high-consequence events
  - events that are unlikely/highly unlikely: e.g. glovebox overpressure, load drop on rods
  - events requiring qualification of confinement barrier: e.g. earthquake, internal/external impact

Example Results to Date

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Event Scenario	With No Controls	With Controls	Control Examples
Glove/seal failure	Not unlikely; high consequence	Not unlikely; low consequence	Negative ventilation (ensure inflow); procedures & training
Glovebox overpressure	Not unlikely; high consequence	Unlikely; intermediate consequence	[illegible] control and safety valves; min/max design pressure; limit pressure/volume within glovebox to safety valve capacity; alarm on high pressure
Load drop on rods	Unlikely; high consequence	Highly unlikely; low consequence	Control of loads/equipment over rods; single-failure crane design; monitoring & evacuation procedure
Earthquake	Unlikely; high consequence	Unlikely; intermediate consequence	Post-seismic glovebox ventilation; qualification of glovebox structure and MOX structure
Internal/external impact	Unlikely; high consequence	Highly unlikely; high consequence	Glovebox qualification for static/ dynamic loads

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Confinement Boundary Qualification

- Preclude release of radioactive particulates (to occupied rooms)
- Ensure confinement boundary integrity during normal operation, accidents, design basis natural phenomena events
- Static confinement (physically block particulate transport)
- Dynamic confinement (ventilation flow through gaps in the physical barrier)

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Static Confinement Boundary Qualification

- Physical barriers qualified analytically
- Barrier response to maximum applied loads calculated and compared to quantitative acceptance criteria (stress or deflection)
  - qualification by stress performed in accordance with design code loading combinations and allowable stresses
  - items include glovebox shell, frame, window panels, gloveports, mechanical/electrical penetrations, internal process/maintenance equipment, etc.
  - qualification by deflection involves maximum deflections and geometric or empirical acceptance criteria
  - items include glovebox bellows, window panel seating

Dynamic Confinement Boundary Qualification

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- Demonstrate confinement flow will be maintained through any gaps
  - postulate maximum sized breach (safety analysis typically assumes one gloveport-size breach)
  - determine airflow velocity through breach required to confine airborne particulates (typical capture velocity of 125 linear ft/min ± 25 ft/min through opening)
  - size ventilation system and ductwork to provide required flow capability
  - design and qualify ventilation system components required to provide flow to withstand accidents which can challenge system

Confinement Boundary Example: Glovebox Qualification

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- Analytical qualification of static and dynamic confinement, augmented with management measures
  - IROFS C4 (glovebox) confinement and ventilation
  - analytically demonstrate integrity of frame, windows, and seals
  - maintain negative pressure
  - procedures, training for operators
  - IROFS C3 static confinement provides additional defense in depth for public exposure
- Window frame configuration
  - design overlap between window and frame
  - design window gasket compression

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Glovebox Example (continued)

- Failure mechanism
  - gap develops between window and frame due to in-plane distortion of frame
  - window assumed to remain rigid in-plane
  - gaskets assumed to remain expanded in gap between window panel and frame
- Evaluation process
  - modal sum of window frame corner in-plane differential deflections calculated during seismic inertial response analysis
  - modal sum compared to design overlap to determine if gap develops

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Summary/Conclusion

- Engineered and management controls ensure worker protection and enable compliance with proposed requirements
  - MELOX and La Hague designs and operational concepts minimize likelihood and/or consequences of confinement breaches
  - low glove/seal rupture consequences are ensured through design and operating procedures based on MELOX experience
  - load drop, glovebox over/under pressure accidents precluded by design
  - during earthquake, glove boxes maintain their leaktightness, and dynamic confinement exhaust system maintains vacuum in gloveboxes
  - procedures, training, personnel protective equipment, and monitoring/alarm systems augment engineered features

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HVAC/Confinement

Tom St. Louis
03 February 2000

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HVAC/Confinement Briefing Objectives

- Describe DCS approach for HVAC/confinement design
- Solicit NRC staff feedback regarding planned approach

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DCS Approach

- MFFF design should capitalize on proven performance of MELOX and La Hague designs to the extent practical
- Confinement systems must support public exposure requirements and worker protection requirements
- Prevent permanent contamination in areas where personnel can be present (i.e. designed to be operated without respiratory protection)

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HVAC System Functional Requirements (Normal and IROFS)

- Cooling and heating to provide required design conditions
- Ventilation to control gases and process byproducts
- Air conditioning for occupied areas
- Reduce/control airborne contaminants transfer and release
  - HEPA filtration
  - Inducing dynamic confinement to prevent transfer/release to lesser contamination areas or the environment

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MFFF Confinement

- Primary and secondary confinement systems
  - primary confinement provides protection of facility personnel and is first barrier to release to public/environment
  - secondary confinement
    - normally/routinely occupied areas
    - provides protection of public/environment
  - static confinement barrier[s] with dynamic confinement system[s] (i.e., ventilation)

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Confinement Zones

Confinement zone designation based on contamination potential

Contamination potential: Higher ↑ Lower

Zone	Typical examples	
C4	Gloveboxes	*Permanent contamination allowed*
C3	Process rooms containing gloveboxes	*No permanent contamination*
C2	Cells containing welded chemical process equipment	
	Rooms containing welded rods	
	Corridors or rooms surrounding the C3 process areas	
C1	Uncontrolled access to outside environment	*No expected contamination*

Note

Zone designation is consistent with MELOX and La Hague designation; order is consistent with Reg. Guide 3.12

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Static Confinement Barriers

Physical state of radioactive products	Primary confinement system	Secondary confinement system	
Chemical solution	Completely welded vessel	Cell	Building
	Not completely welded vessel in glovebox	Process room	Building
Powder	Can or process vessel in glovebox	Process room	Building
Pellets	Glovebox	Process room	Building
Welded rods	Rod cladding	Building	

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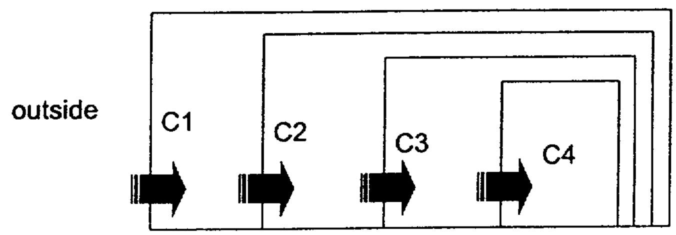
Dynamic Confinement

- Dynamic confinement achieved by inducing & maintaining pressure gradient via HVAC systems
  - pressure gradients maintained across confinement zone boundaries
  - ensure air exchange between zones is from zones of lower to higher potential contamination



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Dynamic Confinement

Confinement class	HEPA/MEPA filter stages		Rated pressure	
	Blowing	Exhaust	(inches WG)	with respect to:
Chemical process exhaust	–	$2H^{(1)}$	< -2.0	Cell/glovebox
C4	$H^{(2)}$ + H + M	$H^{(2)}$ + H + 2H	-1.2 to -2.0	Process room
C2cell	M	2H	-0.7 to -0.9	Atmosphere
C3	H + M	H + 2H	-0.6 to -0.7	Atmosphere
	M	H + 2H	-0.5 to -0.6	Atmosphere
C2	M	2H	-0.3 to -0.4	Atmosphere
	M	2H	-0.2 to -0.3	Atmosphere
C1	0	0	-0.0 to +0.1	Atmosphere

(1) Chemical recombination and demisting before HEPA filter
(2) 1 barrier: 1 HEPA filter & 1 HEPA prefilter to facilitate filter replacement

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HVAC/Process Exhaust Systems

- Major HVAC Subsystems
  - Primary Dynamic Confinement
    - VHD-very high depressurization
  - Secondary Dynamic Confinement
    - HD - high depressurization
    - PO - cell ventilation
    - MD - medium depressurization
  - Supply Air System
  - Central Control Room Air Conditioning System
- Process Exhaust System

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IROFS HVAC/Confinement Design

- IROFS criteria
  - seismically designed
  - tornado designed
  - active systems powered from Emergency Diesel
  - single failure considerations applied to active components (e.g., redundancy)
- Multiple barrier approach provides defense in depth for public exposure
  - C4 static and dynamic, C3 static are IROFS
- Multi-stage HEPA filtration used at inlets and outlets of gloveboxes

Confinement Systems: Powders and Pellets

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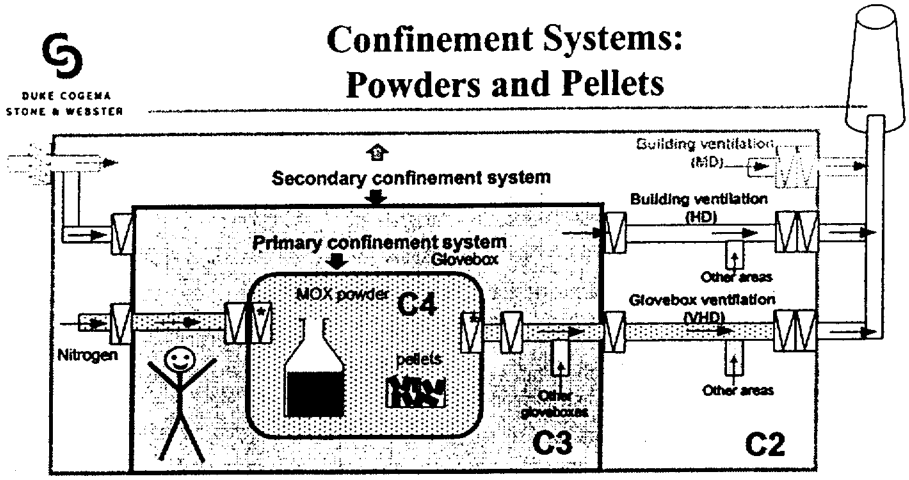

- Primary confinement system: *Powder:* Process vessel or glove box
  Pellets: Glovebox
- Secondary confinement system: Process room and building

Confinement Systems: Solutions in Not-Completely-Welded Equipment

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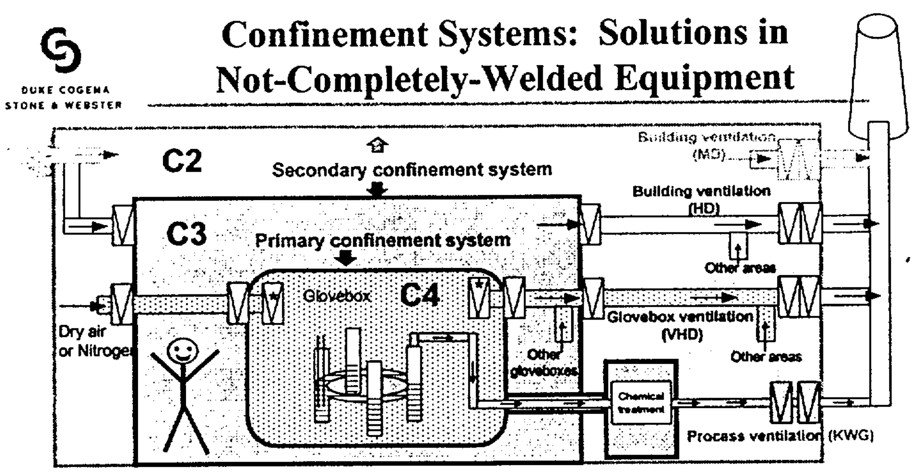

- Primary confinement system: Process vessel or glove box
- Secondary confinement system: Process room and building

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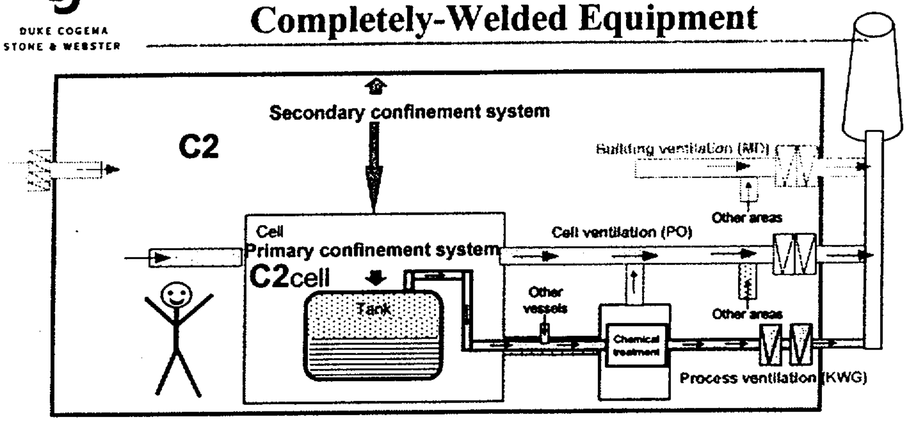
Confinement Systems: Solutions in Completely-Welded Equipment



- Primary confinement system: Process vessel in cell
- Secondary confinement system: Building

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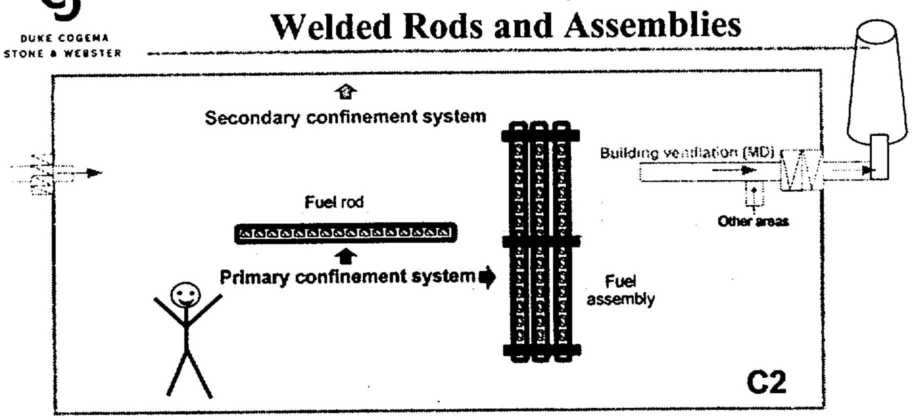
Confinement Systems: Welded Rods and Assemblies



- Primary confinement system: Welded rod
- Secondary confinement system: Building

Wet Process Vessel Exhaust

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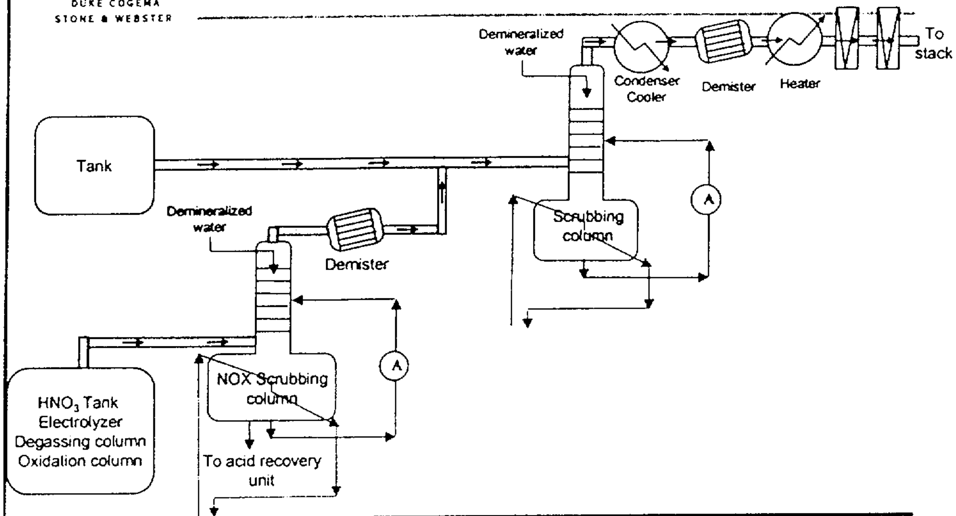

Confinement in Off-Normal Situations

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Type of situation	Design measures	Safety requirement
Failure of glovebox confinement boundary (e.g. glove)	Air speed should be 125 fpm at gloveports	Limitation of room contamination
Leak of a vessel or pipe containing chemical solution	- Drip-tray - Cell + ventilation	Limitation of room/cell contamination
Over / under pressure in glove box	- Dampers against over / under pressure - Gloveboxes designed to resist -10 in WG / +6 in WG	No loss of confinement boundary
Fire	- Fire-rated room boundaries - Design of building ventilation	- Release to environment within regulatory limits - Limitation of fire spreading - Limitation of contamination spreading
Earthquake	(see details in next slides)	- Release to environment within regulatory limits - Dose to the personnel within regulatory limits

Confinement During/After Seismic Event

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- Primary confinment
  - static confinement remains intact within design limits
  - dynamic confinement (VHD) minimizes releases
  - evacuation of personnel and other management measures to augment engineered controls for worker protection
- Secondary confinement
  - static barriers remain intact within design limits
  - provides defense in depth for protection of public and environment

Seismic Confinement: Powders and Pellets

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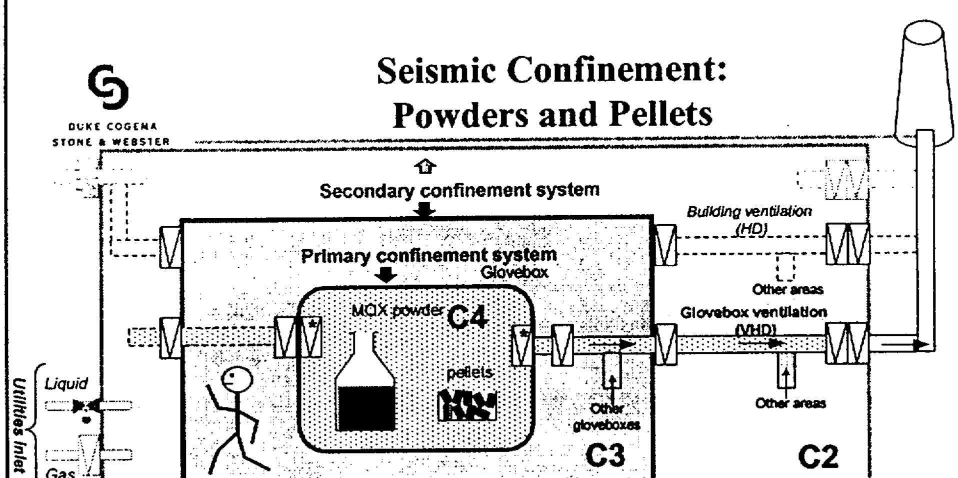

- Primary confinement system: Static barrier remains tight (potential slight degradation) Dynamic confinement (VHD exhaust) maintained
- Secondary confinement system: Static barriers remain tight (potential slight degradation) *Analysis in progress to determine possible requirements for dynamic containment (HD exhaust)*

Seismic Confinement: Solutions in Not-Completely-Welded Equipment

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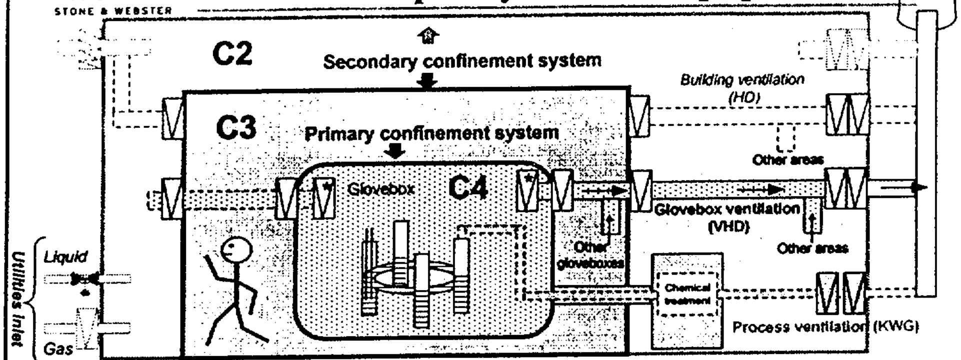

- Primary confinement system: Main process vessels remain tight
  Gloveboxes remain tight (potential slight degradation)
  Dynamic confinement (VHD exhaust) maintained
- Secondary confinement system: Static barriers remain tight (potential slight degradation)
  Analysis in progress to determine possible requirements for dynamic containment (HD exhaust)

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Seismic Confinement: Solutions in Completely-Welded Equipment

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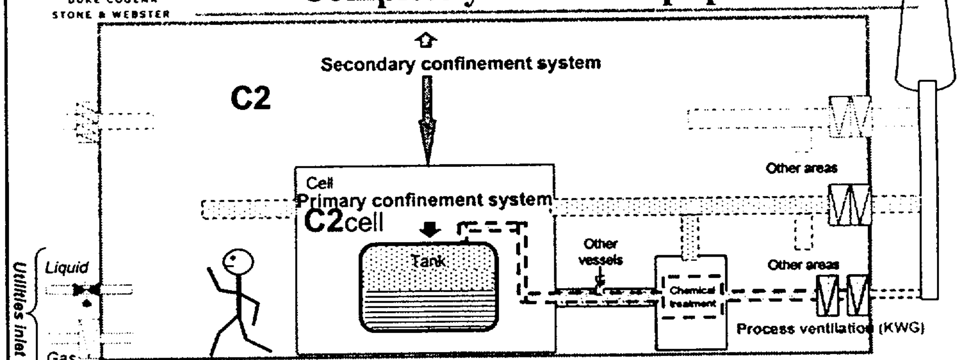

- Primary confinement system: Main process vessels remain tight
- Secondary confinement system: Static barrier remains tight (potential slight degradation)

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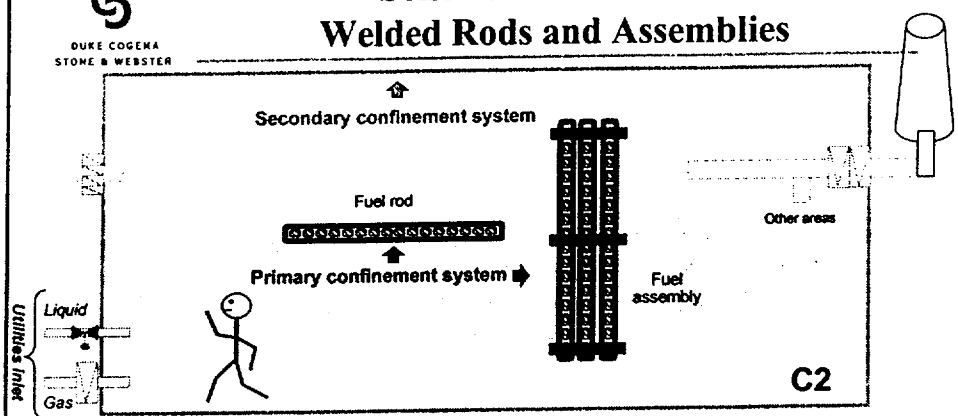
Seismic Confinement: Welded Rods and Assemblies



- Primary confinement system: Rods remain intact with some postulated leakage
- Secondary confinement system: Static barrier remains tight (potential slight degradation)

HVAC/Confinement Monitoring

- Public/environment protection: release monitoring at stack
  - Air sampling with activity measurement (redundant measurement)
- Worker protection
  - Monitor/control external irradiation, airborne contamination, surface contamination
  - Airborne contamination sensors located at workstations
  - Alarms if the contamination threshold is reached
  - Procedures/training (MELOX)
    - operator notifies HP team in an incident
    - operators don personal respiratory protection and leave room immediately in response to alarm

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Summary/Conclusion

- Summary of design principles
  - MFFF design capitalizes on proven performance of MELOX and La Hague designs to the extent practical
  - confinement systems meet public exposure requirements and additional worker protection requirements
  - confinement and filtration prevent permanent contamination in areas where personnel can be present (i.e., designed to be operated without respiratory protection)

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Use of Polycarbonate for Glovebox Windows

Tom St. Louis

03 February 2000

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Use of Polycarbonate Briefing Objectives

- Describe DCS approach for evaluating use of polycarbonate material for glovebox windows
- Solicit NRC staff feedback regarding planned approach

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Presentation of Topic

- Polycarbonate material is preferred over glass for glovebox window design
  - design/operational advantages of polycarbonate
  - MELOX/La Hague glovebox and equipment designs (reference designs for MFFF) use polycarbonate sheets for window material
- DCS must demonstrate adequacy of material
  - NFPA-801 fire protection standard "requires" use of non-combustible materials in glovebox construction
  - NFPA-801 also provides for alternative methods
  - polycarbonate meets definition of "combustible," but is fire-resistant, superior for other reasons, and best-suited for glovebox application

DCS Approach

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- Capitalize on proven performance and operational experience of reference design
- Demonstrate acceptable risk and compliance with 10 CFR 70 and NFPA to guide material selection
  - evaluate fire hazard of alternate window materials using a typical process room
  - perform mechanical analysis to compare strength and flexibility of polycarbonate with respect to other materials
  - evaluate operational performance of polycarbonate over alternate materials

Rationale/Results to Date

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- Fire Hazard Analysis
  - polycarbonate fire hazard is essentially equivalent to that of glass
- Mechanical Stress Analysis
  - structural resistance of polycarbonate to mechanical loading is far superior to that of glass
- Other Considerations
  - polycarbonate is superior in terms of fabrication, cost, ease of window replacement
  - polycarbonate and glass are equivalent in other operational considerations
- Conclusion: polycarbonate is preferred material

Glovebox Window Description

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- Basic design
  - flat panels of maximum 1.5 m x 1.0 m
  - perimeter retaining clamps with neoprene channel gaskets
  - gloveports and bagports mounted in windows to maximize visibility and accessibility
  - minimum hole-to-hole spacing to maintain required strength
- Specific advantages to large panel design
  - provides superior visibility and permits thorough cleaning of the glovebox when necessary
  - gloveport locations can be optimized for particular operation or maintenance tasks to reduce occupational exposures
- Operational experience with window design at MELOX and La Hague is positive

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Glovebox with Window/Port Detail

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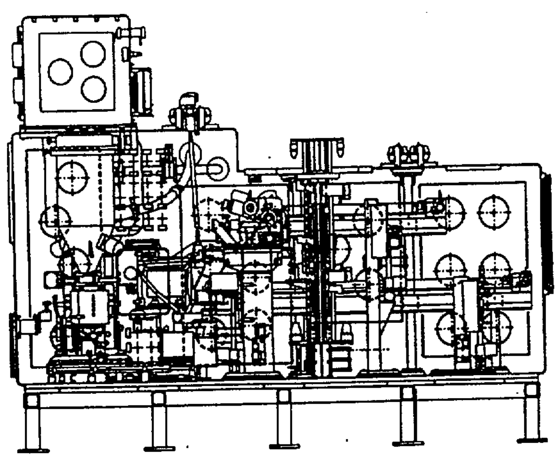

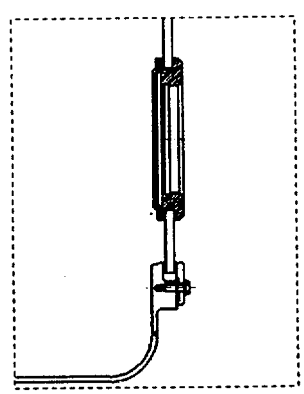

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Glovebox Window Materials

Material Properties	Polycarbonate	Tempered Safety Glass
Physical Description	Monolithic 10-mm sheet	Two 6-mm layers of annealed plate glass with polyvinylbutyryl laminate interlayer
Tensile Strength (MPa)	65	100 – 200 *
Flexural Strength (MPa)	103	100 – 200 *
Elongation at Yield (%)	8%	<1%
Elongation at Rupture (%)	80%	<1%
Specific Gravity	1.2	2.5
Optical Transmissibility	85%	89%

* the strength of glass varies widely due to small surface imperfections which are difficult to measure and evaluate

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Window Performance Requirements

- Confinement of radioactive materials under:
  - normal operating and transient differential pressure loading
  - seismic inertia and differential displacements between support points
  - impact of seismically generated missiles or dropped loads
- Provide visibility and access to equipment inside glovebox for operations and maintenance
- Impervious to passage of moisture and oxygen to protect fuel from oxidation (process requirement)

Fire Hazards Analysis

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- Bounding analysis
  - MELOX pelletizing room is bounding - contains multiple gloveboxes and largest quantities/types of combustibles and ignition sources
    - potential combustibles include polycarbonate glovebox windows, PMMA (Kyowaglass) radiological shielding, and incidental PVC and polyethylene
    - ignition sources include lighting systems, electrical motors, cabinets, and circuits (design features reduce fire risk of lighting systems and circuitry)
  - consider material behavior and design features and evaluate credible fire scenarios (e.g., electrical/cabinet failure during normal operations; transient ignition source during off-normal operations)

Fire Hazards Analysis Results/Conclusions to Date

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- Results
  - electrical motor or cabinet failure generates smoke but insufficient heat to impact polycarbonate windows, as supported by fire modeling
  - polycarbonate is most difficult combustible in the room to ignite from transient ignition source
  - special precautions taken during infrequent maintenance evolutions reduce likelihood of fires due to transient ignition sources
- Conclusions
  - fire hazard posed by polycarbonate glovebox windows is essentially equivalent to that posed by glass glovebox windows

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Mechanical Stress Analysis

- Calculate response to individual applied loads, combine responses and compare result to acceptance criteria
- Principal Applied Loads: maximum differential pressure, seismic inertia, seismic deflection, and impact loads
- Acceptance Criteria
  - Ductile material stress (e.g. stainless steel, polycarbonate) per AISC N690
  - Brittle material stress (e.g. glass)
    - no specific design code allowable stress criteria
    - guidance from ASME B&PV code, Section VIII (cast iron): allowable tensile stress = 0.1 times ultimate strength

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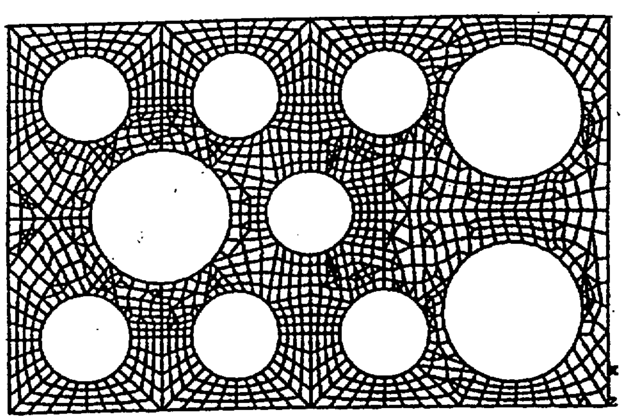
Window Analytical Model



Linear elastic finite plate element model

Gasket compliance boundary conditions at edges

Von Mises stress criterion for maximum stresses

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Mechanical Stress Analysis Results/Conclusions to Date

- Results
  - Pressure Loading
    - Glass: Peak Stress = 6.24 MPa < 10.0 MPa
    - Polycarbonate: Peak Stress = 4.65 MPa < 25.7 MPa
  - Seismic Inertia Loading
    - Glass: Peak Stress = 21.1 MPa > 16.0 MPa *
    - Polycarbonate: Peak Stress = 25.9 MPa < 41.2 MPa
  - Normal Operating + Seismic Inertia + Frame Distortion Loading
    - Glass: Peak Stress = 52.9 MPa > 16.0 MPa *
    - Polycarbonate: Peak Stress = 30.6 MPa < 41.2 MPa
  - Impact Loading
    - Glass: Maximum Energy @ Rupture = 5.7 J
    - Polycarbonate: Maximum Energy @ Rupture = 960 J

** considered well beyond limits of acceptability*

- Conclusion: structural resistance of polycarbonate to mechanical loading is far superior to that of glass

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Other Considerations

- Fabrication Considerations
  - extensive experience with fabricating large polycarbonate panels with multiple penetrations vs. limited experience with fabricating similar glass panels
  - delaminations of glass during fabrication and fractures during shipping and installation proved to be problematic
- Operational Considerations
  - specific gravity of glass is more than double that of polycarbonate, complicating window replacement operations
  - optical clarity of either material is acceptable
  - abrasion resistance of glass is superior to polycarbonate
  - polycarbonate offers more neutron radiation shielding than glass
  - polycarbonate window material used with great success at MELOX and La Hague

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Summary/Conclusion

- Polycarbonate is preferred material for glovebox windows
  - offers significant advantages during operation by enabling use of large windows providing:
    - superior visibility to glovebox operations
    - access to equipment inside gloveboxes for maintenance
  - offers significant advantages in resisting mechanical loadings
  - operations and fabrication experience is extensive and successful
  - poses little incremental risk of fire, without considering fire protection (fire detection and suppression provisions included in design to mitigate consequences of fire)

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Fire Protection

Tom St. Louis

03 February 2000

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Fire Protection Briefing Objectives

- Describe DCS approach for fire protection, with emphasis on fire mitigation design measures
- Solicit NRC staff feedback regarding planned approach

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DCS Approach to Fire Protection

- Capitalize on proven performance of reference design
  - maximize MELOX fire suppression design experience
- Provide suppression coverage in accordance with US requirements (UBC, NFPA 801, and Life Safety Code)
- Minimize use of water in MOX and AP process areas
- Goal: fire protection not IROFS (but seismically restrained as necessary to prevent interference with IROFS)

MFFF Fire Protection Philosophy

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Fire Protection is achieved by:

- Fire Prevention
  - Design practices (e.g., choice of process, choice of materials)
- Fire Detection and Alarm
- Mitigation of Fire
  - Design Measures
    - Prevention of fire spreading (fire barriers)
    - Fire suppression
  - Organization of fire fighting

MFFF Fire Suppression System Types

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- Carbon dioxide for glovebox process rooms and laboratories
- Clean Agent for electrical/electronic rooms and process rooms with solvent
- Water for life safety in corridors and stairwells
- Suppression type based on results of hazard analyses/ISA
- Design differences as compared with MELOX where US regulations impose different requirements

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Carbon Dioxide Systems

- In areas where use of water presents a criticality hazard
- Consistent with MELOX carbon dioxide suppression system coverage
- High-pressure system
- Storage containers on 3rd level of MOX processing area
- Manual actuation required when glovebox pressurization is a concern

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Clean Agent Systems

- In areas containing electrical/electronic equipment
- Protects space under raised floors
- Clean agent in MOX processing area will be halogen-free
- Clean agent in AP processing area will be halogenated to knock down solvent fires
- Storage containers to be located in vicinity of protected areas

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Water-Based Systems

- Preaction or wet-pipe inside MFFF buildings
  - preaction in process buildings for criticality defense-in-depth
  - wet-pipe for remaining areas per FHA
- Water to be provided by MFFF supply, sized to handle the largest demand plus 500 gpm hose stream capacity (minimum)
- Dedicated source if host site supply insufficient
- Criticality control
  - dry pipes (preaction)
  - protection of process rooms from water ingress
  - fissile materials in gloveboxes above ground

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Fire Area Philosophy

- Builds upon MELOX Fire and Protected Sector determinations
- Fire areas confine fire in its area of origin and prevent its spread
- Fire-rated structural barriers segregate fire areas
- Barriers fire-rated 2-hour minimum

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Fire Protection Quality Levels

- Fire barriers:
  - QL1 if serving confinement function in QL1 structures
  - QL2 if not serving confinement function in QL1 structures
- Fire suppression systems: QL2 (for structural integrity) in QL1 structures
- Fire detection systems: QL2 (for structural integrity) in QL1 structures
- All other fire protection systems: conventional quality

QL1 - IROFS

QL2 - not IROFS but still subject to QA program

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Fire Protection Program Management

- Programmatic elements driven by 10 CFR 70 and regulatory guidance
  - Fire Hazards Analysis (FHA)
  - Fire Prevention Program
  - Pre-Fire Plan
  - FHA and Fire Prevention Program input to ISA
  - Pre-Fire Plan input to LA

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Summary/Conclusion

- Summary of design approach
  - maximize MELOX fire suppression design experience, minimize design differences between MELOX and MFFF fire suppression systems except where requirements differ
  - provide suppression coverage in accordance with US requirements (UBC, NFPA 808, and Life Safety Code)
  - minimize use of water in MOX and AP process areas
  - goal: fire protection not IROFS (but seismically restrained as necessary to prevent interference with IROFS)

MELOX Fire / Confinement Areas: Confinement in case of Fire

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- The MELOX concept of «Fire & Confinement Area» is used:

  A *«Fire & Confinement Area (FCA)» a group of rooms, in an area capable of confining the radioactive byproducts that may be released by a fire in the area*

- The following design measures are utilized for an «FCA»:
  - For the areas:
    - Fire rated barriers
    - Separate ventilation for access airlocks
    - Fire dampers operable at high temperature on supply & exhaust ducts
    - Exhaust ventilation ducts & Filters resistant to high temperature
    - Dilution of fire byproducts exhaust by mixing with exhaust air from other areas to protect the «Final Filters*».
    - Fire Detection System
    - Permanent Fire Suppression System

MELOX Fire / Confinement Areas: Confinement in case of Fire (cont'd)

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- The following measures are utilized for an «FCA» (cont'd):
  - For the gloveboxes:
    - Fire dampers on ventilation supply & exhaust ducts
    - Fire Detection System inside gloveboxes, as determined by FHA**
    - Quick Disconnects for extinguishing gas agent injection while maintaining confinement, as determined by FHA**

  N.B. For process reasons, some MOX Process glove boxes are ventilated with nitrogen, that contributes to lower fire risk.

* «Final Filters» are the last level of filters before the stack

** «FHA» Fire Hazard Analysis

MELOX Fire / Confinement Areas: Confinement in case of fire (cont'd)

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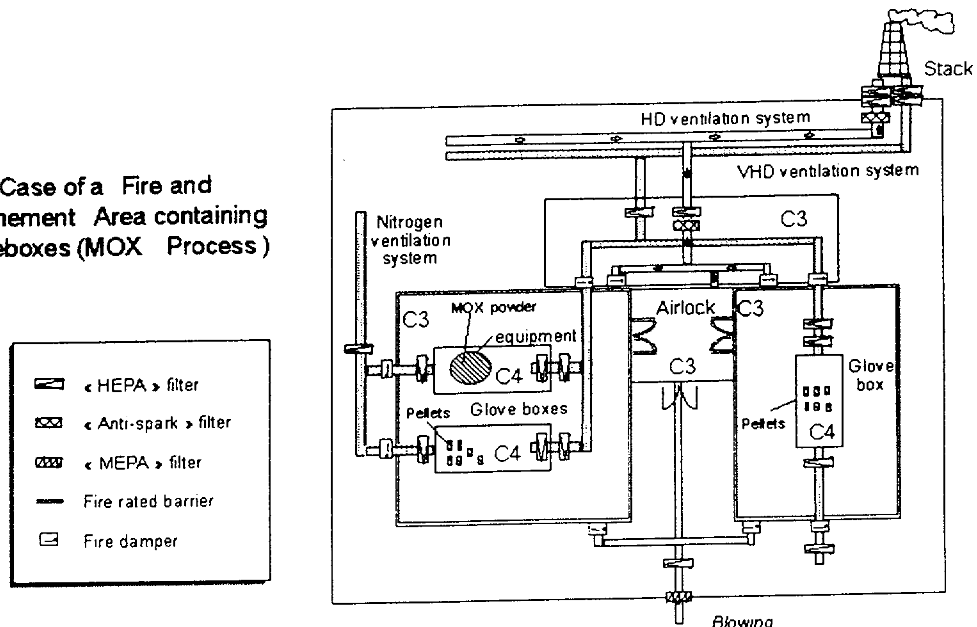
Case of a Fire and Confinement Area containing gloveboxes (MOX Process)



MELOX Fire / Confinement Areas: HVAC operation in case of fire

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- Two possible cases:
  - The area contains no glovebox (e.g. waste store, Polishing cells):
    - The objective is to maintain pressure gradient for the room as long as the exhaust system especially the «final filters», is not in danger
  - The area contains gloveboxes:
    - Changes to the HVAC system configuration could impair the pressure gradient between gloveboxes and room
    - If the incipient fire can be suppressed immediately and does not threaten the first confinement system (glovebox): no modification of HVAC configuration
    - In case of a larger fire that may affect the first confinement system: The objective is to maintain differential pressure in the room as long as the exhaust system especially the «final filters», is not in danger

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Controlled Area Boundary

Bill Hennessy
03 February 2000

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Controlled Area Boundary Briefing Objectives

- Propose MFFF controlled area boundary
  - describe rationale for selection
  - describe DCS approach for demonstrating compliance with 10 CFR 70.61(f) requirements
  - address implications of selection on integration with host site
- Solicit NRC feedback on planned approach

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Presentation of Topic

- Proposed 10 CFR 70 establishment of a controlled area
  - licensee retains authority to determine all activities, including exclusion or removal of personnel and property from the area
- DCS must designate an MFFF controlled area and control activities within the MFFF controlled area
  - ability to control public access as necessary
  - persons not defined as *workers* may perform ongoing activities within controlled area
    - IF their risk is commensurate with public limits

      OR

    - IF they are trained/informed in accordance with 10 CFR 19

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DCS Approach

- MFFF CAB is coincident with Savannah River site controlled access area
  - meets proposed 10 CFR 70.61(f) requirements
  - takes advantage of existing site access/control infrastructure
- Non-MFFF DOE workers subject to worker limits
  - requires significant interface with host site
    - establishment of effective training and posting methodology, including DOE workers not associated with MFFF
    - development of linkages to host-site radiation protection and emergency management programs

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Controlled Area Boundary (CAB)

- 10 CFR 70.61(f) CAB determination as per definition in 10 CFR 20.1003
- Licensee exercises control for protection from radiological risks
  - Worker (Licensee)
    - High-Consequence Events: 100 rem [70.61(b)]
    - Intermediate-Consequence Events: 25 rem [70.61(c)]
  - Public
    - High-Consequence Events: 25 rem [70.61(b)]
    - Intermediate-Consequence Events: 5 rem [70.61(c)]
  - DOE workers - subject to licensee worker limits as per 10 CFR 70.61(f)(2)

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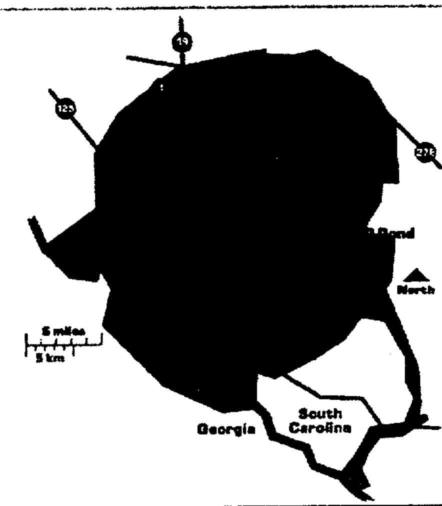
Savannah River Site Map



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Control of Non-Workers Within CAB

- 10 CFR 70.61(f)(2) provides for individuals not defined as workers to perform ongoing activities within the CAB, subject to:
  - 10 CFR 19.12(a) training - awareness of MFFF radiological risks
  - 10 CFR 19.11(a) posting and maintaining notices
- Requires DCS to exercise control
  - for removal/evacuation of personnel in an emergency
  - take advantage of DOE's existing SRS programs to implement requirements

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DCS-SRS Interfaces

- Comprehensive DCS-SRS protocol to integrate programs
  - training and employee notification
  - radiation protection
  - emergency management
- DCS - SRS Protocol Elements
  - augment site training program to address 10 CFR 19.12(a) requirements
  - develop site Work Task Agreement (WTA) that ensures adequate protection of site general employees
  - Integrate MFFF Emergency Plan (EP) with SRS site-wide/area-wide EP

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DCS-SRS Interfaces (continued)

- Training
  - SRS General Employee Training (GET)
    - required for all unescorted individuals
    - augmented with 10 CFR 19.12(a) training module
  - 10 CFR 19.11(a) Postings
- Integrate MFFF Emergency Plans
  - ensure appropriate SRS Emergency Management linkages (e.g., availability of emergency response resources)
  - ensure protection of general employees in event of emergency (e.g., activation of site emergency operations, timely notification of affected employees, consequence assessment/protective actions, evacuation/sheltering)

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DCS-SRS Work Task Agreement

- Define licensee and host site responsibilities
- Ensure availability of requisite host site emergency management resources
- Enable training and protection of host site general employees

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Summary/Conclusion

- CAB is coincident with Savannah River site controlled access area, consistent with 10 CFR 70.61(f) requirements
- Non-MFFF workers subject to worker limits in accordance with 10 CFR 70.61(f)(2)
- DCS interface with SRS implements licensee requirements
  - augmentation of existing General Employee Training
  - Radiation Protection program
  - Emergency Management program

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