November 26, 1996

MEMORANDUM TO: Charles J. Haughney, Acting Director
Spent Fuel Project Office, NMSS

FROM: Lawrence E. Kokajko, Project Manager
Spent Fuel Licensing Section
Spent Fuel Project Office, NMSS

SUBJECT: SECOND MEETING WITH THE U. S. DEPARTMENT OF ENERGY REGARDING SUBMITTAL OF CENTRAL INTERIM STORAGE TOPICAL REPORT

On November 20, 1996, the second meeting was held between representatives of the U.S. Department of Energy (DOE), its associated contractors, and the U.S. Nuclear Regulatory Commission staff to discuss a proposed submittal of a non-site-specific topical safety analysis report (TSAR) for a central interim storage (CIS) facility. Attachment 1 is an attendance list. Attachment 2 is a copy of the slides presented by DOE. The meeting was noticed on October 25, 1996.

DOE still anticipates that a TSAR application for a non-site-specific CIS will be submitted in May 1997. The DOE presentation included discussions on CIS design approach, design basis events, design criteria, and radiation analysis of storage area dose rates. During the presentation the staff noted concerns regarding quality assurance, design control, control of vendor processes, and use of probabilistic assessment in design activities. At the conclusion of the meeting, the staff recommended that both parties meet again in early 1997 to have a third meeting on this topic. At such a meeting, the staff requested that DOE present more information regarding the design, and include information regarding conduct of operations, maintenance and surveillance activities, operating controls and limits, and procedures. DOE agreed to this.

Members of the public attended this meeting. No proprietary information was disseminated or discussed at this meeting. No regulatory decisions were requested or made.

Docket 72-21

Attachments: 1. Attendance List
2. DOE Slides

Distribution:

Docket 72-21	NRC File Center	PUBLIC	NMSS R/F	SFPO R/F
PEng	SGagner, OPA	[redacted]	SShankman	PEng
EEaston	JJankovich	[redacted]	[redacted]	WReamer, OGC
KStablein	NRC Attendees			

OFC	SFPO	E	SFPO	E	SFPO	E		
NAME	LKokajko:dd		VThalpe		EJLeeds			
DATE	11/25/96		11/25/96		11/26/96			

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ATTENDANCE LIST
Meeting between U. S. Department of Energy and the
U. S. Nuclear Regulatory Commission Staff on the
Submittal of a TSAR for CIS*

November 20, 1996

Name	Affiliation
Lawerence Kokajko	NRC/NMSS/SFPO
Charles Haughney	NRC/NMSS/SFPO
Fritz Sturz	NRC/NMSS/SFPO
Eric Leeds	NRC/NMSS/SFPO
Mark Delligatti	NRC/NMSS/SFPO
Dennis Reid	NRC/NMSS/SFPO
Michael Raddatz	NRC/NMSS/SFPO
Steve McDuffie	NRC/NMSS/SFPO
Tim Kobetz	NRC/NMSS/SFPO
Mike Waters	NRC/NMSS/SFPO
David Tang	NRC/NMSS/SFPO
Charles Interrante	NRC/NMSS/SFPO
Elaine Keegan	NRC/NMSS/SFPO
Allen Howe	NRC/NMSS/SFPO
Carl Withee	NRC/NMSS/SFPO
Drew Persinko	NRC/NMSS/SFPO
Michael Lee	NRC/NMSS/DWM
Bill Reamer	NRC/OGC
Tom Pollog	DOE
Dan Kane	DOE
Donald Horton	DOE/OQA
Ram B. Murray	DOE/OQA
Richard Peck	DOE/QATSS
Mark Sanderling	DOE/RW-51
Fred Rogers	DOE/RW-52
Christopher Kouts	DOE/RW-45
Prasanna Kumar	DOE/RW-45
Jerry Parker	DOE/RW-45
Jafar Imam	DOE/RW-45
Jay Jones	DOE/RW-40
Steve Havaner	DOE/RW-2
John McConaghy	DE&S/Charlotte
Robert Garrett	DE&S/Charlotte
Dealis Gwyn	DE&S/Las Vegas
Bob Eble	DE&S
Stephen Benesole	DE&S
Joe B. Stringer	DE&S
Ralph Andersen	NEI
Woody Chu	NWTRB
Marshall David	Scientech
Mark Beaumont	Westinghouse
Sidney Crawford	SAIC

*Note: Due to the large number of people attending this meeting, it is not known if everyone signed-in on the attendance list.

ATTACHMENT 1

Status of Interim Storage Facility Design

Office of Civilian Radioactive Waste Management
U.S. Department of Energy

NRC/DOE Meeting
November 20, 1996

ATTACHMENT 2

Status of Interim Storage Facility Design

Office of Civilian Radioactive Waste Management
U.S. Department of Energy

NRC/DOE Meeting
November 20, 1996

Agenda

- Introduction - Dan Kane
- Design Approach - Joe Stringer
- Design Basis Events - Rob Garrett
- Design Criteria - John McConaghy
- Nuclear Analysis - Bob Eble
- Closing Remarks

Design Process
Phase I TSAR Development

Joe Stringer
Manager, ISF Design
November 20, 1996

Expectations

- Present key design criteria
- Present results from design for significant design features
- Recieve feedback on design criteria and design features
- Work in progress
- Design will change

Analysis of ISF Design Basis Events (DBEs)

Rob Garrett

Overview of Presentation

- Background
- Identification of ISF DBEs
- Evaluation Process for ISF DBEs
- Description of ISF DBEs
- Summary

Evaluation of ISF DBEs (cont.)

- Calculate/Evaluate Consequences (cont.)
  - Impact of event on radionuclide barriers
  - Compare offsite doses with limits (if applicable)
    - 25 mrem/yr from all normal and off-normal operations [10 CFR 72.104 offsite dose limit]
    - 5 rem/yr from each accident [10 CFR 72.106 offsite dose limit]
  - Recovery actions for credible events
- Identification of SSCs or operating controls that prevent or mitigate consequences of DBEs

Description of ISF DBEs

- 21 DBEs identified for evaluation
  - 10 Off-Normal Events
  - 7 Credible Accidents
  - 4 Beyond Design Basis Accidents

Design Criteria

John McConaghy

Design Criteria

- Graded QA Classifications
- Design Criteria
  - Storage
  - Transfer Facility
  - Structural Design
  - Security

Flexibility

- ISF design criteria accommodate 5 vendor designs:
  - HI-STAR 100 (TSC prepared for ISF storage)
  - NAC-STC (TSC prepared for ISF storage)
  - MP187 (NUHOMS canister prepared for horizontal storage in field module)
  - TranStor System (canister vertical transfer into Sierra concrete storage cask)
  - Westinghouse Large & Small MPCs (canister horizontal transfer into concrete storage cask)

Proven Design

- Vendor equipment used as licensed:
  - Cask handling yokes, cradles, upenders, etc.
  - Canister transfer casks
  - Use of complete vendor systems to avoid compromising NRC certifications

Subsystem Classifications

	QA Classification						
SSC	1	3	4	5	6	7	CQ
ISF TRANSFER FACILITY	X	X	X	X	X	X	
Cask Off-Loading and Loading	X			X		X	
Cask Carrier	X			X		X	
Transfer Preparation				X	X	X	
Canister Transfer	X			X	X	X	
Storage Mode Preparation	X			X	X	X	
Decontamination		X		X		X	
Radwaste Treatment		X				X	
Radiological Protection				X		X	
Radiation Monitoring				X		X	
Electrical				X		X	
Security					X	X	
Communications				X		X	
Fire Protection			X	X		X	
Water Utilities						X	
Wastewater Treatment						X	
HVAC				X		X	
Compressed Air Services				X		X	
Architectural			X	X	X	X	
Structural	X	X	X	X	X	X	

Transfer Facility Features

- Concrete building for environmental shielding
- Seismically Designed
- Single-failure proof lifting equipment
- Collect radwaste, contract processing
- Conventional HVAC systems
- Conventional Electric Power
- ALARA evaluations confirm and refine design.

Tornado Design Background

- NRC-licensed dual-purpose systems are designed for tornado winds and missiles in storage and in transportation overpacks.
- Vulnerability during transfer operations has been addressed using probabilistic evaluations.
- For utility ISFSIs, with less than 100 transfer operations, this has been accepted without comment.
- ISF will have many more transfer operations. (Approximately 500 transfers / year @ 3000 MTU)

ISF Tornado Evaluation Approach

- Use existing EPRI study (EPRI NP-2005) of tornado missiles at a generic power plant site.
- Consistent with existing ISFSI analyses:
  - Assume similar sources and distributions of missiles at ISF site.
  - Assume that likelihood of missile strike on transfer equipment can be scaled from probability of strike on plant structures using relative target areas.
  - Further scale strike probabilities based on duration of periods of vulnerability.

Structural Loading Combinations

- Use SRP (NUREG-0800) Section 3.8.4 & NUREG-1536 (Draft) for dry cask storage systems as guidance
- NUREG-1567 recently released for comment
- Service load and factored load combinations developed for concrete and steel QA 1 structures
- Extreme environmental loads (seismic & tornado) are not considered to act simultaneously
- Structural stability checked for overturning, sliding, & flotation
- QA 4, 5, 6, 7, and conventional structures designed to loading combinations specified in conventional codes, except QA 5 (seismic interaction) structures have design earthquake loads applied

Structural Design Requirements

- QA 1 structures:
  - Concrete designed in accordance with ACI 349
  - Steel designed in accordance with ANSI/AISC N690
  - Cranes designed in accordance with NUREG 0612 (control of heavy loads) and NUREG 0554 (single-failure-proof criteria)
- QA 3, 4, 5, 6, 7 & conventional structures:
  - Concrete designed in accordance with ACI 318
  - Steel designed in accordance with AISC

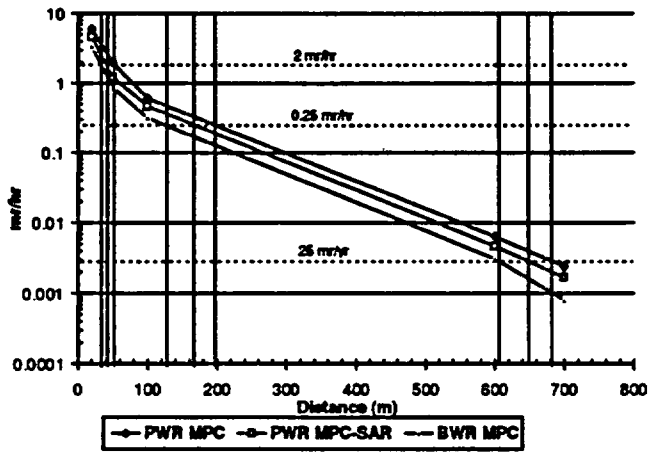
Radiation Analysis
Storage Area Dose Rates

Bob Eble

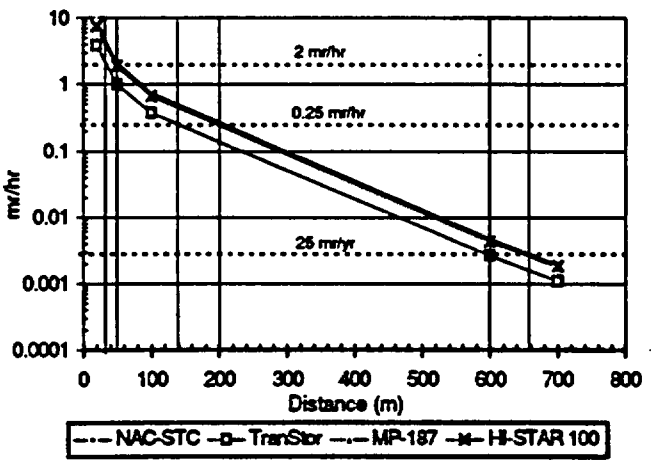
ISF Phase I TSAR Radiation Analysis

- Analysis Scope
- Computer Codes
- Methodology
- Preliminary Results
- Other ISF Radiation Analysis

Preliminary MPC Dose Rates



Preliminary Vendor System Dose Rates



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

November 26, 1996

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FROM: Lawrence E. Kokajko, Project Manager
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Status of Interim Storage Facility Design

Office of Civilian Radioactive Waste Management
U.S. Department of Energy

NRC/DOE Meeting
November 20, 1996

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NRC/DOE Meeting
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Agenda

- Introduction - Dan Kane
- Design Approach - Joe Stringer
- Design Basis Events - Rob Garrett
- Design Criteria - John McConaghy
- Nuclear Analysis - Bob Eble
- Closing Remarks

Last Meeting

- Last meeting held August 20, 1996
- Topics discussed
  - ISF Design Scope
  - Generic Design Criteria
  - Vendor Interface
  - General Site Arrangement

ISF Design Scope

- Phased Approach
- Phase I uses dual-purpose technologies licensed by NRC.
- Non-site specific design
  - Bounds most U.S. continental sites

Vendor Interface

- Initial ISF design is based on use of the following technologies:
  - VECTRA MP-187
  - NAC-STC
  - Holtec HI-STAR 100
  - Sierra Nuclear TranStor
  - Westinghouse MPC (Large and Small)

NRC Feedback

- Follow Part 72 approved criteria
  - Initial criteria for tornado windspeeds were derived from ALWR work
  - Changed to be consistent with RG 1.76
- Perform analysis for on-site explosion
  - Will be performed as part of Design Basis Event

Design Process
Phase I TSAR Development

Joe Stringer
Manager, ISF Design
November 20, 1996

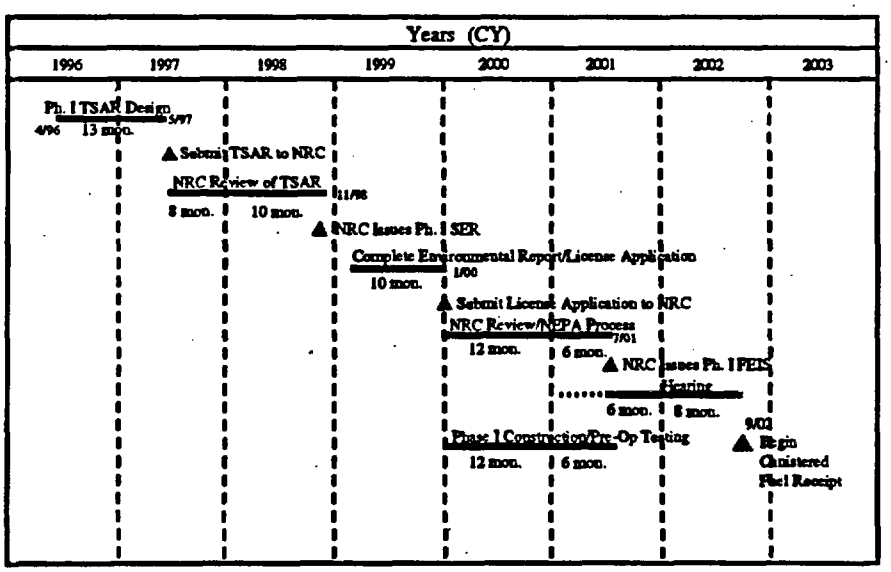
Expectations

- Present key design criteria
- Present results from design for significant design features
- Recieve feedback on design criteria and design features
- Work in progress
- Design will change

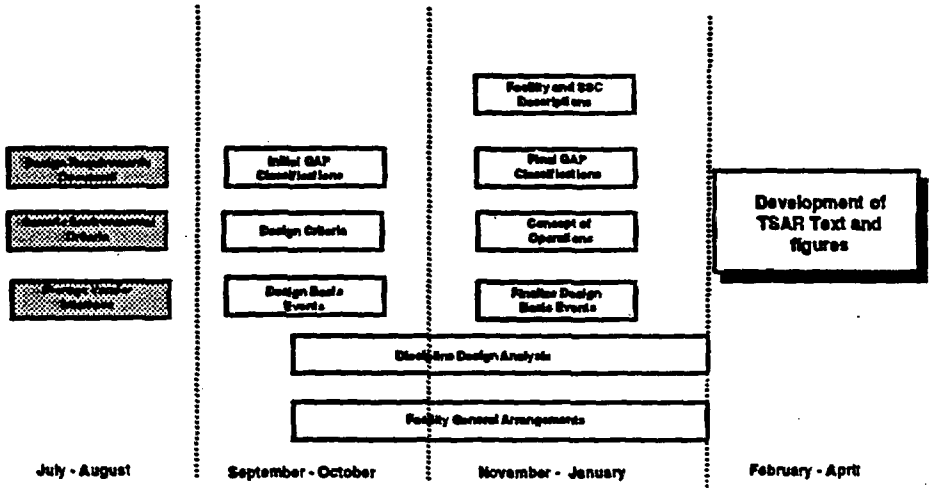
Phase I Interim Storage Facility

- Receive and store canistered only SNF
  - Transfer Facility
  - Security Facilities
  - SNF Storage Yard
  - Temporary Administrative Facilities
- SNF receipt rate consistent with S.1936
  - 1200 MTU/year - first two years

Phase I ISF Schedule



ISF Phase I TSAR Design Development



Analysis of ISF Design Basis Events (DBEs)

Rob Garrett

Overview of Presentation

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- Summary

Background - Regulatory Requirements

- Required by NRC regulations [10 CFR 72.24 (d), (m); specifies technical information required as part of the licensing application]
- Required by NRC Regulatory Guide 3.48
  - specifies SAR content for ISFSIs
    - Evaluation of Off-Normal Operations
    - Evaluation of Accidents
    - DBEs Classified per ANSI/ANS 57.9-1984 [ANSI/ANS 57.9-1992]

Background - Regulatory Requirements

- Analysis of DBEs required:
  - Establish certain license conditions and administrative controls [10 CFR 72.44]
  - Establish basis for evaluating facility changes (unreviewed safety questions) [10 CFR 72.48]

Process for Identifying ISF DBEs

- List of 81 potential DBEs was compiled
- Events evaluated using screening criteria
- Events dropped from consideration if:
  - Precluded by ISF Siting Criteria
  - Precluded by basic facility design & operation
  - Included in/bounded by another event
  - Precluded by site-specific assumptions and/or low probability

Categorization of DBEs

- 21 DBEs selected for further evaluation
- ANSI/ANS 57.9-1992 and Reg. Guide 3.48 provide guidance for classifying DBEs
- Off-normal event: ANSI/ANS Type I event (occur frequently in normal operations), Type II event (moderate frequency or once/year)
- Accident event: ANSI/ANS Type III event (once/lifetime of facility)
- Accident event: ANSI/ANS Type IV event (beyond design basis event)

Evaluation of ISF DBEs

- Iterative Process
  - Define the event
  - Review event with Design Team
  - Determine initial approach for Design and Operation
  - Perform initial analysis/determine consequences
  - Feed results of initial analyses into ISF design
  - Update and finalize analyses as ISF design is completed

Evaluation of ISF DBEs (cont.)

- Define Event
  - Determine initial conditions assoc. with event
  - Establish boundary conditions
  - Determine initiating failure or load
- Calculate/Evaluate Consequences
  - Many events covered by cask vendor analyses, as documented in vendor Safety Analysis Reports
  - Vendor analysis results referenced if applicable

Evaluation of ISF DBEs (cont.)

- Calculate/Evaluate Consequences (cont.)
  - Impact of event on radionuclide barriers
  - Compare offsite doses with limits (if applicable)
    - 25 mrem/yr from all normal and off-normal operations [10 CFR 72.104 offsite dose limit]
    - 5 rem/yr from each accident [10 CFR 72.106 offsite dose limit]
  - Recovery actions for credible events
- Identification of SSCs or operating controls that prevent or mitigate consequences of DBEs

Description of ISF DBEs

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Off-Normal Events

Off-Normal Event	Included in Design Analysis for:
– Failure of One Confinement Boundary	– Cask Vendor
– Off-Normal Temperature	– Cask Vendor, ISF
– Handling Event	– Cask Vendor, ISF
– Partial Blockage of Air Vents	– Cask Vendor
– Surface Contamination	– Cask Vendor, ISF

Off-Normal Events (cont.)

Off-Normal Event	Included in Design Analysis for:
– Canister Misalignment	– Cask Vendor
– Loss of External Power	– ISF
– Failure of Instrumentation	– Cask Vendor, ISF
– Lightning	– Cask Vendor, ISF
– Vehicular Impact	– Cask Vendor, ISF

Credible Accidents

Accident	Included in Design Analysis for:
– Tornado Missiles	– Cask Vendor, ISF
– Earthquake	– Cask Vendor, ISF
– Explosion	– Cask Vendor, ISF
– Loss of Shielding	– Cask Vendor

Credible Accidents (cont.)

Accident	Included in Design Analysis for:
– Extreme/Tornado Wind	– Cask Vendor, ISF
– Fire	– Cask Vendor, ISF
– Blockage of Air Inlets/Outlets	– Cask Vendor

Beyond Design Basis Accidents

BDB Accident	Included in Design Analysis for:
- Loss of Confinement	- Cask Vendor
- Drop Accident	- Cask Vendor, ISF
- Tipover/Overturning	- Cask Vendor
- Pressurization	- Cask Vendor

Summary

- 10 Off-Normal events, 11 Accidents considered in this analysis
- The evaluation of these DBEs is an important part of the overall ISF safety basis
- These ISF DBEs have been identified in a systematic, documented process
- ISF DBEs are being evaluated based on available information
- Initial DBE analysis results are being fed back into the design process
- DBE analyses will be finalized based on TSAR design information
- DBE analyses will be documented in Design Analyses (in compliance with the M&O QA program) and in TSAR Chapter 8

Design Criteria

John McConaghy

Design Criteria

- Graded QA Classifications
- Design Criteria
  - Storage
  - Transfer Facility
  - Structural Design
  - Security

QA Classification

- Graded Approach - 7 QA Classifications
- Evaluate intended function for each top-level SSC and its subsystems
- Determine its importance considering the safety function performed
- Determine the consequences of failure
- Commensurate with an item's function and importance to safety, design criteria are developed and applied to that item.

ISF Top-Level SSCs

- Site
- Transfer Facility
- Storage Area
- Auxiliary Systems
- Security

QA Classifications

- QA Classification 1 - Important to Radiological Safety
- QA Classification 3 - Important to Radioactive Waste Control
- QA Classification 4 - Important to Fire Protection
- QA Classification 5 - Important to Potential Interaction
- QA Classification 6 - Important to Physical Protection of Facility and Materials
- QA Classification 7 - Important to Occupational Radiation Exposure
- Conventional Quality - Not QA 1,3,4,5,6 or 7

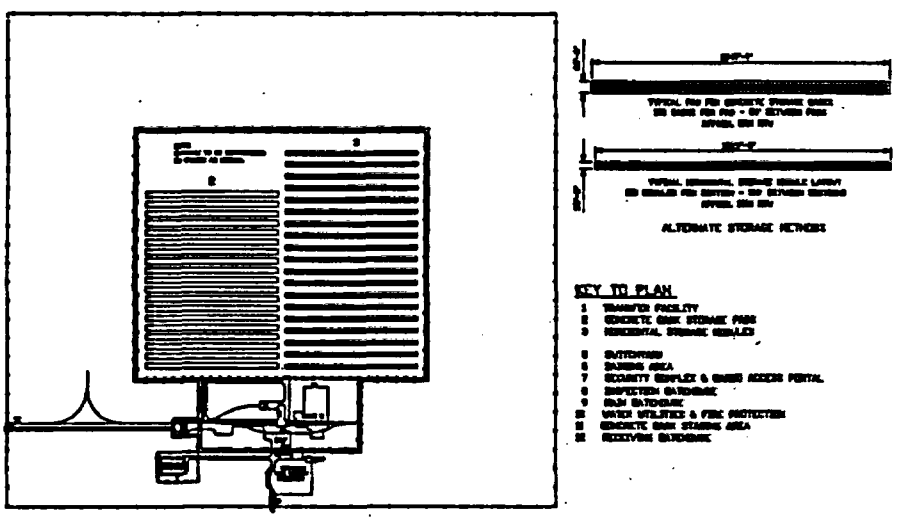
Initial QA Classifications

	QA Classification						
Top-Level SSC	1	3	4	5	6	7	CQ
Site	X	X				X	
Transfer Facility	X	X	X	X	X	X	
Storage	X	X	X	X	X	X	
Security					X	X	
Auxiliary Systems			X			X	

Design Criteria

- Storage
- Transfer Facility
- Structural Design
- Security

Conceptual Site Arrangement



Flexibility

- ISF design criteria accommodate 5 vendor designs:
  - HI-STAR 100 (TSC prepared for ISF storage)
  - NAC-STC (TSC prepared for ISF storage)
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  - TranStor System (canister vertical transfer into Sierra concrete storage cask)
  - Westinghouse Large & Small MPCs (canister horizontal transfer into concrete storage cask)

Proven Design

- Vendor equipment used as licensed:
  - Cask handling yokes, cradles, upenders, etc.
  - Canister transfer casks
  - Use of complete vendor systems to avoid compromising NRC certifications

Storage Design Criteria

Storage Functions

- Handle cask/canister subsystems and TSCs
- Transfer loaded canister/TSC into storage
- Retrieve canister/TSC from storage
- Maintain waste integrity
- Maintain storage system confinement
- Monitor storage system
- Support storage operations

Storage Subsystem Classifications

	QA Classification						
SSC	1	3	4	5	6	7	CQ
ISF STORAGE	X	X	X	X	X	X	
Storage Cask	X	X	X	X	X	X	
Storage Area						X	
Storage Cask Transporter	X					X	
Radiation Monitoring						X	
Concrete Pads				X			
Radiological Protection						X	
Fire Protection							X
Lighting							X

Storage Pad Design Criteria

- **Classified as QA Classification 5 (Important to Potential Interaction)**
- **Analyze for conventional load combinations, plus Design Earthquake**
- **Construct to conventional standards.**

Transfer Facility Design Criteria

Transfer Facility Functions

- Prepare cask/canister and TSCs for storage
- Transfer canister / TSC into storage
- Retrieve canister / TSC from storage
- Prepare cask/canister subsystems and TSCs for transport
- Provide operations support
- Provide protective services
- Process site-generated radwaste
- Process other site-generated waste

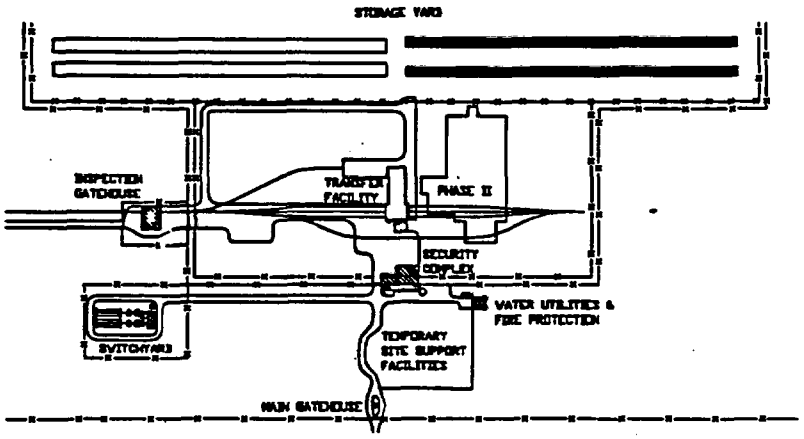
Subsystem Classifications

	QA Classification						
SSC	1	3	4	5	6	7	CQ
ISF TRANSFER FACILITY	X	X	X	X	X	X	
Cask Off-Loading and Loading	X			X		X	
Cask Carrier	X			X		X	
Transfer Preparation				X	X	X	
Canister Transfer	X			X	X	X	
Storage Mode Preparation	X			X	X	X	
Decontamination		X		X		X	
Radwaste Treatment		X				X	
Radiological Protection				X		X	
Radiation Monitoring				X		X	
Electrical				X		X	
Security					X	X	
Communications				X		X	
Fire Protection			X	X		X	
Water Utilities						X	
Wastewater Treatment						X	
HVAC				X		X	
Compressed Air Services				X		X	
Architectural			X	X	X	X	
Structural	X	X	X	X	X	X	

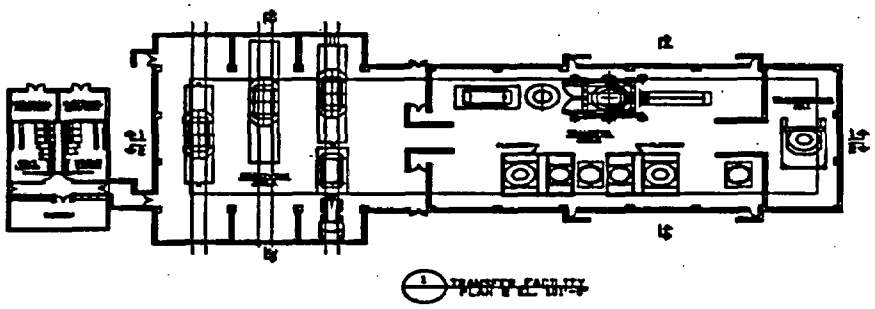
Transfer Facility Features

- Concrete building for environmental shielding
- Seismically Designed
- Single-failure proof lifting equipment
- Collect radwaste, contract processing
- Conventional HVAC systems
- Conventional Electric Power
- ALARA evaluations confirm and refine design.

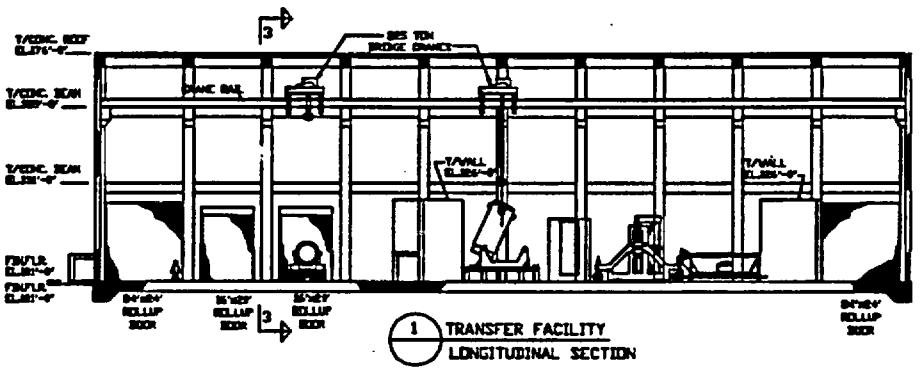
Transfer Area



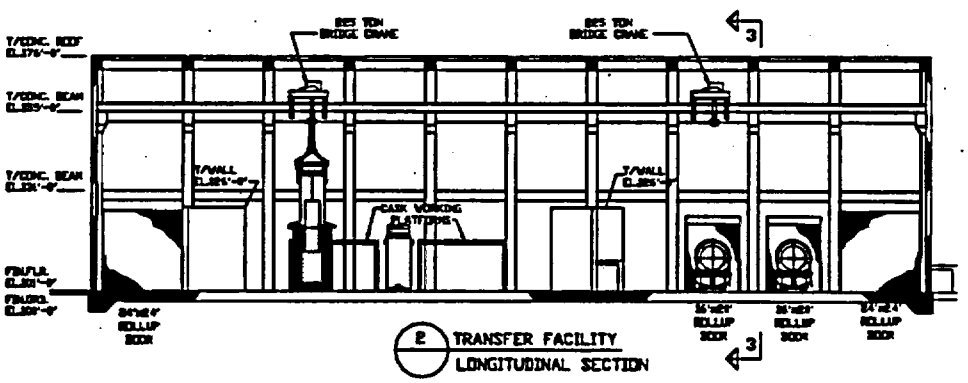
Transfer Facility Conceptual Plan



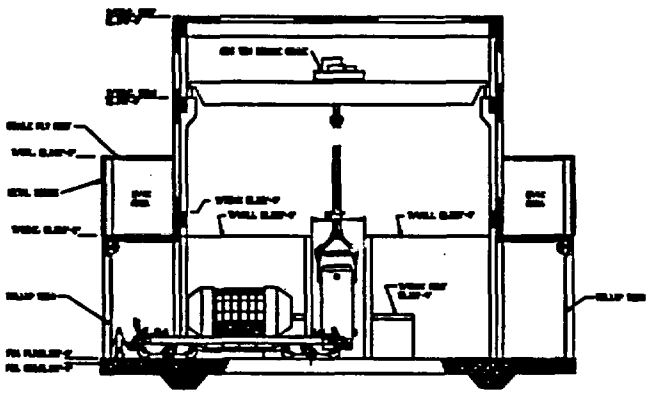
Transfer Facility Section 1



Transfer Facility Section 2



Transfer Facility Section 3



3 TRANSFER FACILITY CROSS SECTION

Tornado Event

Tornado Design Background

- NRC-licensed dual-purpose systems are designed for tornado winds and missiles in storage and in transportation overpacks.
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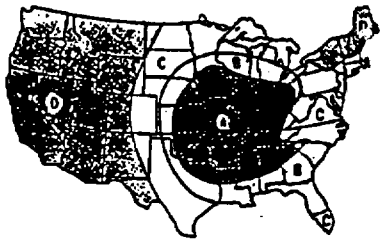
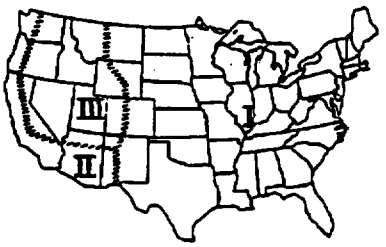
  - Assume that likelihood of missile strike on transfer equipment can be scaled from probability of strike on plant structures using relative target areas.
  - Further scale strike probabilities based on duration of periods of vulnerability.





ISF Target Model

- Size selected comparable to Westinghouse MPC system during transfer operations.
- ISF target area approximately 660 sq ft.
- Assume 500 transfer operations per year
- Assume 2 hour "window of vulnerability" per transfer.

Probability of Impact During Transfers

- Total annual probability of missile impact during transfer operations is calculated to be:
  - Region A 1.7 E-06 / yr
  - Region B 1.9 E-06 / yr
  - Region C 7.7 E-07 / yr
  - Region D 2.6 E-08 / yr
- Events less likely than 1.0 E -07 are considered to be "incredible".

Tornado Risk Conclusions for ISF

- ISF must make sure transfer operations are designed for this impact, or shielded from impact.
- Limited number of unshielded transfers can be demonstrated to be acceptable
  - Approximately 25 per year for most restrictive region
  - Approximately 1800 per year for least restrictive region

Structural Design Criteria

- Structural design criteria includes:
  - Structural Design Loads
  - Loading Combinations
  - Structural Design Requirements & Procedures
- Includes design criteria for all QA Classification and conventional structures

Structural Design Loads

- Normal loads include:
  - Dead loads (structure weight, permanent equipment, allowance for piping/electrical/HVAC)
  - Live loads (movable equipment, rain/snow/ice, vehicles, casks, cranes, thermal loads)
- Severe environmental loads include:
  - Wind loads (based on 110 mph basic wind speed, pressure forces per ASCE 7-95)
  - No flood loads
- Extreme environmental loads include:
  - Seismic loads (.75g for QA 1 and QA 5, .2 g for CQ)
  - Tornado loads (QA 1 Structures)

Structural Loading Combinations

- Use SRP (NUREG-0800) Section 3.8.4 & NUREG-1536 (Draft) for dry cask storage systems as guidance
- NUREG-1567 recently released for comment
- Service load and factored load combinations developed for concrete and steel QA 1 structures
- Extreme environmental loads (seismic & tornado) are not considered to act simultaneously
- Structural stability checked for overturning, sliding, & flotation
- QA 4, 5, 6, 7, and conventional structures designed to loading combinations specified in conventional codes, except QA 5 (seismic interaction) structures have design earthquake loads applied

Structural Design Requirements

- QA 1 structures:
  - Concrete designed in accordance with ACI 349
  - Steel designed in accordance with ANSI/AISC N690
  - Cranes designed in accordance with NUREG 0612 (control of heavy loads) and NUREG 0554 (single-failure-proof criteria)
- QA 3, 4, 5, 6, 7 & conventional structures:
  - Concrete designed in accordance with ACI 318
  - Steel designed in accordance with AISC

Security SSC Design Criteria

Security Subsystems

- Security complex
- Receiving Gatehouse
- Inspection Gatehouse
- Main Gatehouse
- Security Vehicles
- Physical security organization
- Protected area physical barriers
- Surveillance and monitoring
- Security lighting
- Communications
- Power supply

Subsystem Classifications

	QA Classification						
SSC	1	3	4	5	6	7	CQ
ISF SECURITY					X	X	
Security Complex					X		
Receiving Gatehouse							X
Inspection Gatehouse					X		
Main Gatehouse							X
Security Vehicles					X		
Physical Security Organization					X		
Protected Area Physical Barriers					X		
Surveillance and Monitoring					X	X	
Security Lighting					X	X	
Sommunications					X		
Power Supply					X		

Security Design Criteria

- Address requirements from:
  - 10 CFR 72 Subpart H (physical security plan)
  - 10 CFR 73.40 (general requirements)
  - 10 CFR 73.50 (physical protection)
  - NUREG-1497 (interim licensing criteria)
- Describe high-level security design
- No safeguards information presented in TSAR
- No separate submittal as part of TSAR (To be provided in site-specific SAR)

Radiation Analysis
Storage Area Dose Rates

Bob Eble

ISF Phase I TSAR Radiation Analysis

- Analysis Scope
- Computer Codes
- Methodology
- Preliminary Results
- Other ISF Radiation Analysis

Analysis Scope

- **Radiation Analysis Required at 2 Primary Boundaries**
  - **Controlled Area Boundary**
    - Controlled Area: area in which licensee exerts authority over its use (10CFR72)
    - Limits exposure to the general public in compliance with 72.104
  - **Protected ("Restricted") Area Boundary**
    - Restricted Area: area to which access is controlled for purposes of radiation protection (10CFR20)
    - Supports location of facilities to limit exposures to workers based on occupancy.

Computer Codes

- **QAD-CGGP**
  - Point kernal combinatorial geometry code
  - Used for gamma ray calculations only
- **MICRO-SKYSHINE**
  - Used for gamma air scattering calculations
  - Use QAD output as source term
- **MCNP**
  - Provides neutron & gamma, direct and scattered flux
- **SKYSHINE III**
  - Neutron and gamma air scatter

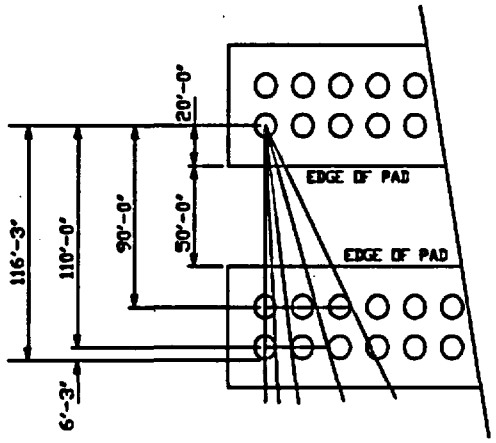
Methodology

- **Impacts of types of SNF storage modes**
  - Due to diversity of cask types and unknown mix at ISF, need to evaluate impact of cask design on off-site dose rates
  - Large Westinghouse PWR MPC chosen as initial condition
  - Other systems are analyzed by comparison
- **Gamma and neutron source terms**
  - 40,000 MWD/MTU, 5-year decay maximum used from the Westinghouse MPC SAR
- **Model MPC storage area and benchmark results to MPC SAR shielding analysis**

Methodology (cont)

- **Preliminary ISF storage yard layout**
  - Vertical storage, 150 casks/row, 2 rows/pad, 20 foot center-to-center cask spacing, 50 ft between pads, 20 pads, 6000 casks
- **Analysis performed in two parts: Direct radiation streaming and air scatter contribution**
- **Direct radiation streaming at selected distances (Controlled Area & Restricted Areas)**
  - Detector points from centerline to end of storage pad; maximum point found
  - First row main contributor; 2nd & 3rd rows partial contributors (due to self-shielding); other rows do not contribute

Direct Dose Analysis Model

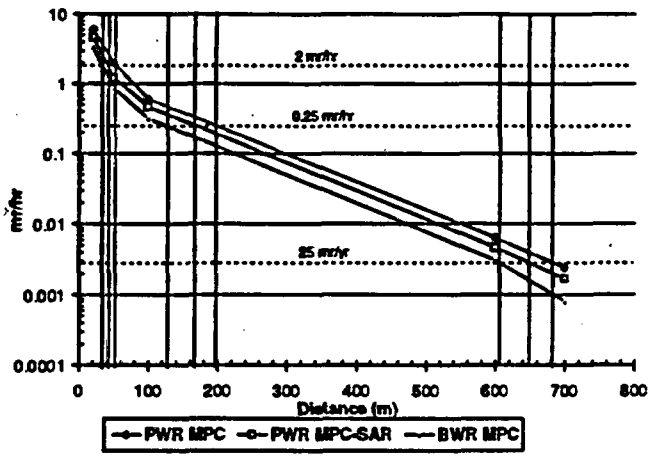


3 ROW COMBINATION MODEL

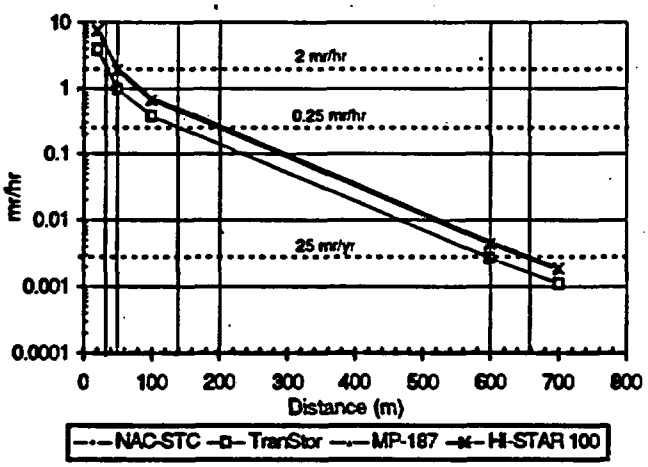
Methodology (cont)

- **Air Scattered Dose rates**
  - Contributions from all rows determined
- **Add together and compare with regulatory limits**
  - Choose conservative values for distances

Preliminary MPC Dose Rates



Preliminary Vendor System Dose Rates



Conservatisms in Results

- Source term (40,000 MWD/MTU, 5-Year decay)
- Direct dose calculational model (point kernal)
- 40,000 MTU in storage yard

Other Radiation Analysis

- Effluent contribution to controlled area boundary dose
- Accident consequence analysis
- Occupational dose assessment and ALARA evaluation