



# Extended Storage Technical Issues

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# Extended Storage – an International Issue

- Most “nuclear” countries face extended storage
  - No reprocessing
  - No disposal
  - Centralized (consolidated) storage is still storage

# EPRI Initiates Extended Storage-specific Work in 2009

- Recognized need for international collaboration
- Share existing information
- Are there common technical issues for future technical work?
  
- Identify specific industry needs for R&D

# **“Extended Storage Collaboration Program” (ESCP) Launched in 2009**

**Bring together US and international organizations engaged with active or planned R&D**

- Storage and transportation system vendors
- Regulators and their R&D contractors
- National waste management organizations
- R&D organizations
- Industry (utilities/cask vendors)

**Currently >200 members from ~20 countries**

# EPRI Extended Storage Collaboration Program (ESCP)

- Purpose: “Provide the technical bases to ensure continued safe, long-term used fuel storage and future transportability”
- Modeled on prior dry storage license extension research
- Phased approach
  - ✓ Phase 1: Review current technical bases and conduct gap analysis for storage systems
  - Phase 2: Conduct experiments, field studies, and additional analyses to address gaps (already underway)
  - Phase 3: Coordinate research that results in a program documenting the performance of a dry storage system loaded with high burnup fuel (>45 GWd/MTU)

# ESCP Subcommittees

- Fuel/Internals
- “Marine environments”
- Non-destructive evaluation (NDE)
- Concrete Systems
- High burnup confirmatory demonstration
- “International”
  
- 2013: Aging Management
  - Build on ANL and industry work

# Gap Analyses: Highest Priority Items

- **Welded SS canisters SCC**
- **High burnup cladding: hydride effects (reorientation, embrittlement)**
- **Bolted casks:**
  - Corrosion of bolts
  - Embrittlement and mechanical degradation of bolts
- **Fuel pellet swelling**

# Cross-Cutting Needs

- **Improved thermal modeling**
- Stress profiles
- **Degradation monitoring systems**
- Adequacy of drying
- Sub-criticality: burnup credit
- Examine casks at INL (DOE)
- Retrievability: fuel transfer options



# ESCP-Generated Collaboration

- Stainless steel dry storage canister field inspections (EPRI)
  - DOE providing co-funding and laboratory analysis support (thermal, potentially more)
- Laboratory experiments identifying conditions to support SCC in SS
  - Initiated by CRIEPI
  - Several countries and programs expanding initial testing
- High burnup used fuel confirmatory data demonstration
  - Several years of discussion within ESCP
  - EPRI proceeding with a demo
  - DOE issues RFP

# Field Inspections and Large-scale Testing

- In situ inspections of SS canisters
- Full-scale, high burnup confirmatory data collection (the “demo” program)



# EPRI Plans for In Situ Inspection of SS Canisters

# Inspection #1: Calvert Cliffs (June 2012)

- ISFSI ~ ½ mile from Chesapeake Bay
- Canisters in service for > 15 years
- Low decay heat canisters
- Two canisters were inspected
  - Aging management inspection for license renewal
  - Marine environment effects

# General Inspection Plans

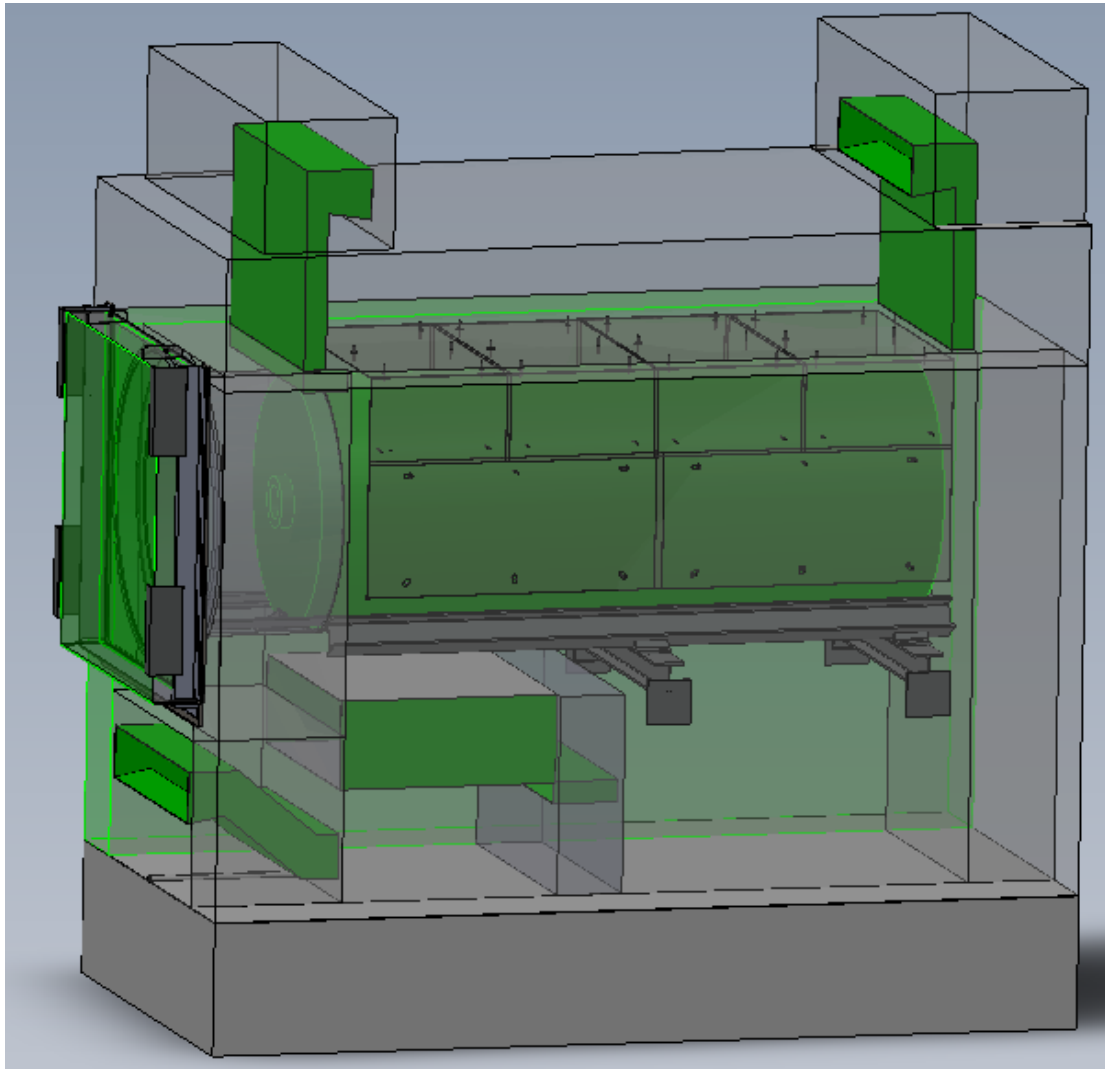
## Scope of inspections:

- Visual
- Temperature
- Surface contaminants

## Additional data collection on environment

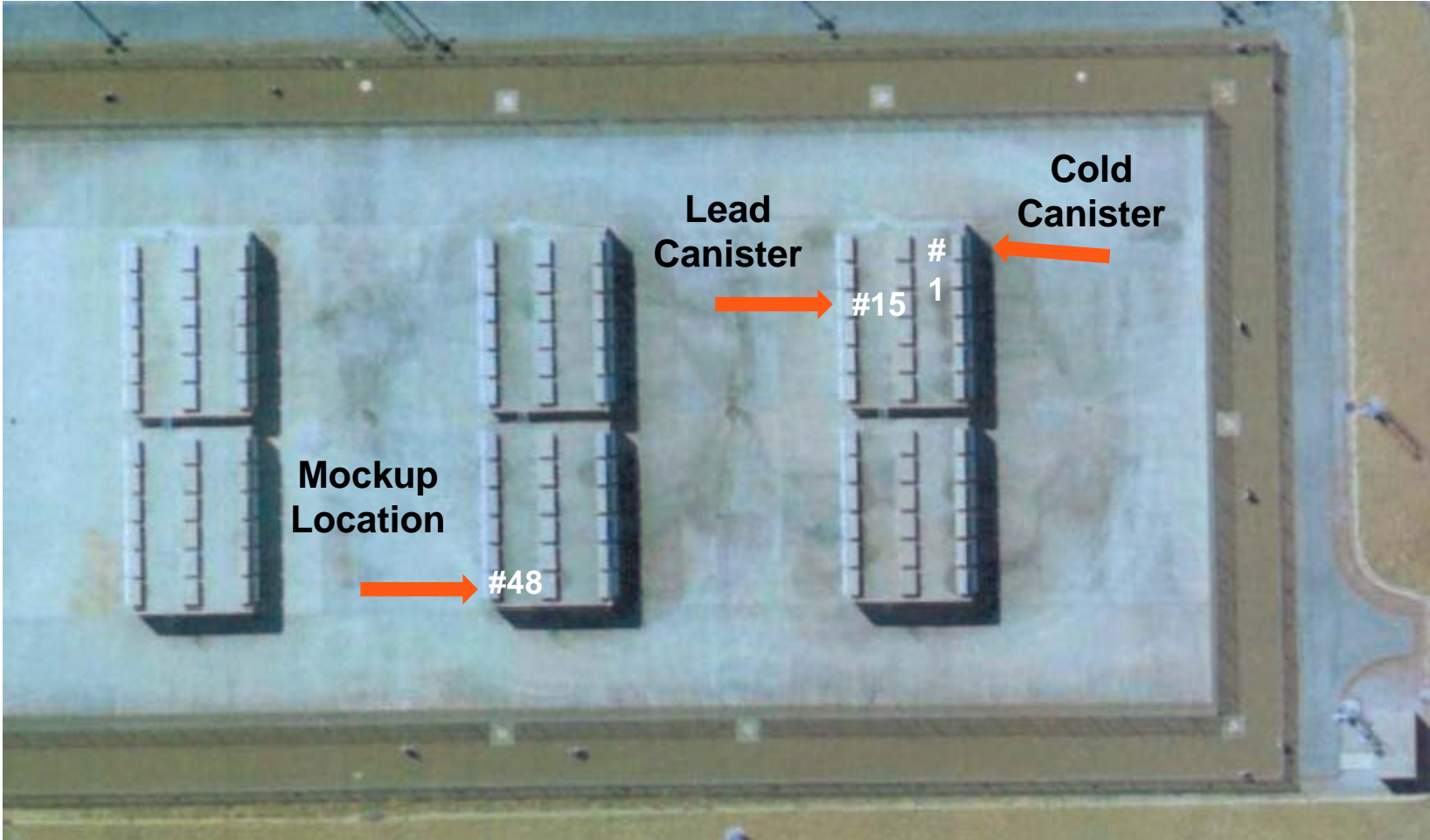
- Air temperature & humidity
- Salt content in air

# Calvert Cliffs Visual Inspection through NUHOMS Air Outlets



Calvert Cliffs  
NUHOMS Design

# DSC Inspection Locations



# DSC-6 Top Cover Plate and Closure Weld

Both in good condition with no signs of corrosion





# DSC-6 Lower East DSC Shell

Surface rust on scratched area near Top End

Possible carbon steel contamination due to gouging by tooling during fabrication or handling



Est. 2.4"



# Bottom DSC-6 Shell Between Rails

Light surface rust stain on near middle of DSC



# Future SS Canister Inspection and Aging Management Plans

- Mid 2013:
  - Hope Creek (southern New Jersey shore, next to cooling tower)
  - Diablo Canyon (West Coast)
- Potential third site
- Aging management
  - EPRI initiating FMEA (failure modes and effects analysis) as first step in an industry-wide aging management plan
  - New ESCP subcommittee

# Full-scale, High Burnup Confirmatory Data Collection (“high burnup demo”) Plans

## Confidence in understanding longer-term behavior of dry storage system requires

- Model development and benchmarking data
- “Separate effects testing”
- **Confirmatory testing under “prototypic” conditions**
  - Full scale
  - Representative dry storage conditions
    - Drying process and inerting
    - Thermal evolution
    - Geometry
  - Prefer multiple high BU fuel types (if possible)

# High Burnup Demo Option that Keeps Startup Time Short

- Initiate the demo at a reactor site
  - Avoids up-front transportation to a national lab
  - Avoids having to wait for a full-scale hot cell to be funded and constructed
  - Keeps costs low(er) prior to test initiation
- EPRI-Dominion-TN (start test in ~3 years)
  - Willing host (North Anna)
  - Multiple, high burnup fuel types
  - Partner with a cask vendor supplying cask(s) at low cost
  - EPRI providing funding for instrumented lid design
  - NRC may waive license review fees
  - Looking for co-funding



# Together...Shaping the Future of Electricity