



U.S. DEPARTMENT OF  
**ENERGY**



# Update on AMCAP Fuel Inspections

## Augmented Monitoring and Condition Assessment Program

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*Savannah River Site Citizens Advisory Board – Full Board Meeting  
July 30, 2019*

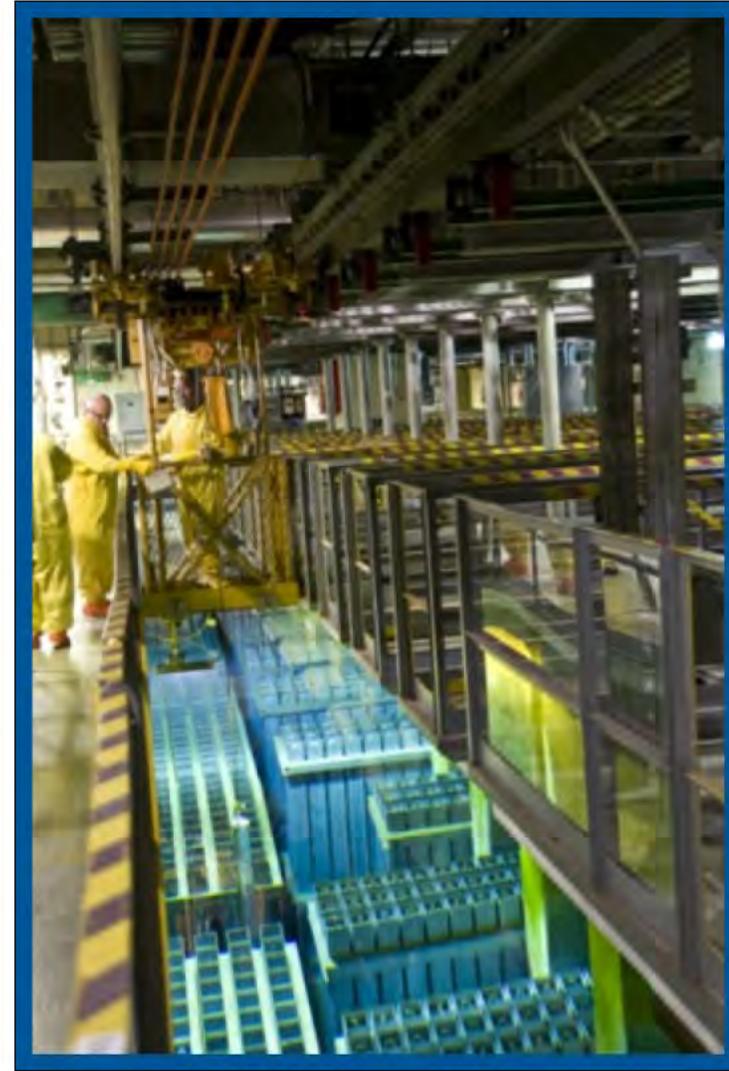
# Introduction to Augmented Monitoring and Condition Assessment Program (AMCAP)

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- Extended safe storage of fuels in L Basin
  - Support spent nuclear fuel missions of DOE/NNSA
    - *Continue receipt of foreign & domestic research reactor fuel*
    - *Ship fuel to H Canyon for processing*
  - Augmentation to previously-existing surveillance and maintenance programs
    - *Basin water chemistry control program*
    - *Corrosion surveillance program*
    - *Structural integrity program*
  - Evaluate fuel & storage systems for extended storage
    - *Meet general safety functions for fuel storage*
      - Maintain criticality safety
      - Maintain cooling of the fuel
      - Maintain confinement by fuel and basin systems
      - Maintain ability to retrieve fuel
    - *Enable full range of disposition options*

## AMCAP – Program Elements

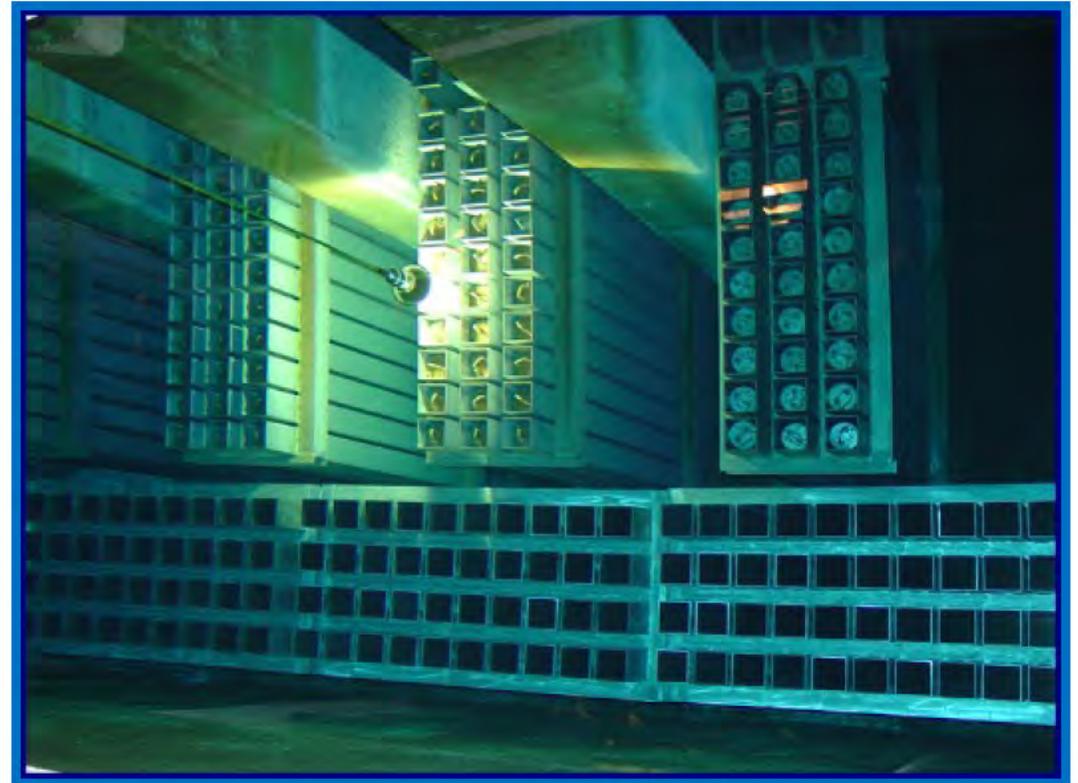
- **Implement three additional programs to assess long term viability of:**
  - Aluminum-based fuels in standard storage configurations
  - Non-aluminum fuels
  - Basin structural integrity
- **Adjust existing programs to incorporate new information**



## Al-Based Fuels in Standard Storage Configurations

- **Standard storage configuration**

- Typically 4 to 5 assemblies placed in cylindrical tube, called a “bundle”
- Bundle has openings at ends; assemblies immersed in purified basin water
- Bundles placed in vertical racks



## AMCAP – Aluminum Based Fuels

- **Establish in-service inspection program for bundled fuel**
  - Select fuels for inspection (complete)
    - *Fuels with known defects and various burnups*
  - Develop inspection equipment & procedure (complete)
    - *Defined regions of interest for each assembly*
    - *Underwater cameras with reproducible geometry & lighting*
  - Sample water inside fuel bundles before disturbing (complete)
    - *Conductivity, pH, alpha, beta/gamma, chlorides, metals*
    - *No anomalies noted*
  - Perform baseline visual inspections; evaluate results
    - *First assembly inspection completed in January 2019*
    - *Next three assemblies inspected in June 2019*
    - *Remaining six inspections planned for later in 2019*
  - Periodic reexamination; trend changes
    - *Confirm or revise corrosion models*



Inspection Table ↑

← Pulling water sample from bundle

# AMCAP – Aluminum Based Fuels: Baseline Inspection Results

- **January 2019 Inspection – RA-3 Assembly S-113**
  - Received from Argentina early 2001
    - *After almost 30 years of wet storage*
    - *Known cladding corrosion*
  - Inspection System Performance – Objectives met
    - *No issues with debundling, handling, or rebundling fuel*
    - *Excellent lighting & camera resolution*
    - *Clear observation of plates, ends, tags*
  - Fuel Observations
    - *Contrasting colors in active fuel region*
    - *Corrosion nodules at edges and crevices*
    - *Small corrosion nodules on plates*



Assembly on underwater inspection table ↑

# AMCAP – Aluminum Based Fuels: Baseline Inspection Results

- January 2019 Inspection – RA-3 Assembly S-113

Edge corrosion product on side plate ↓

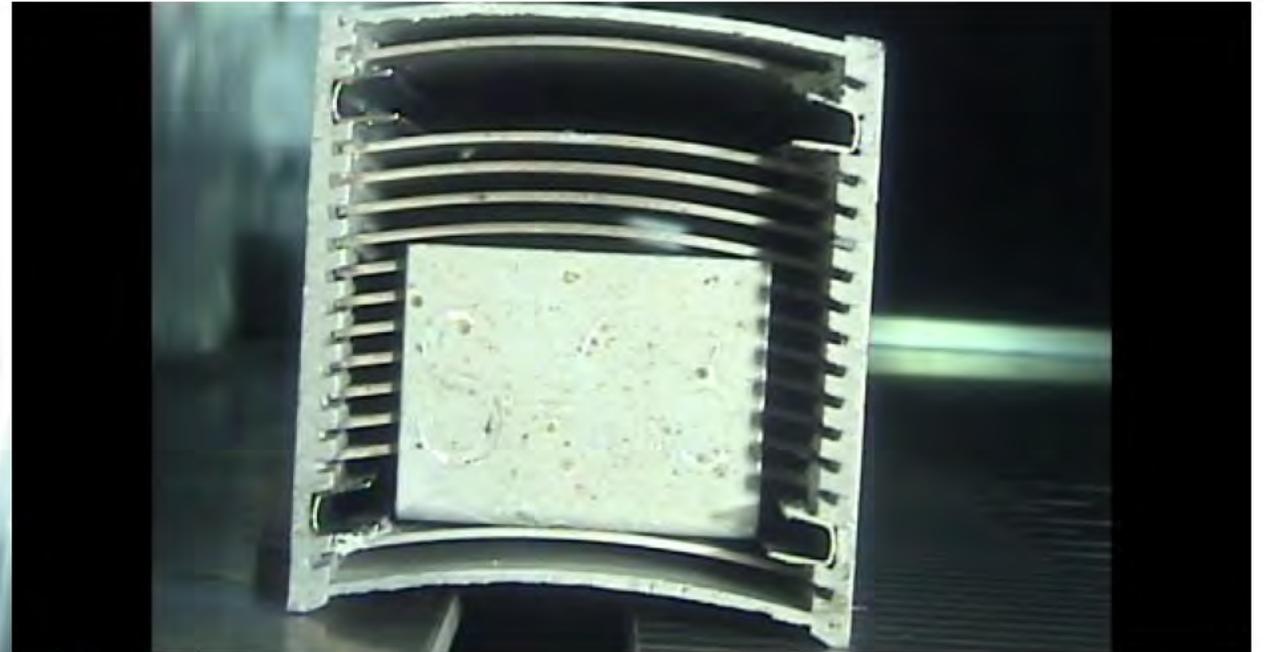
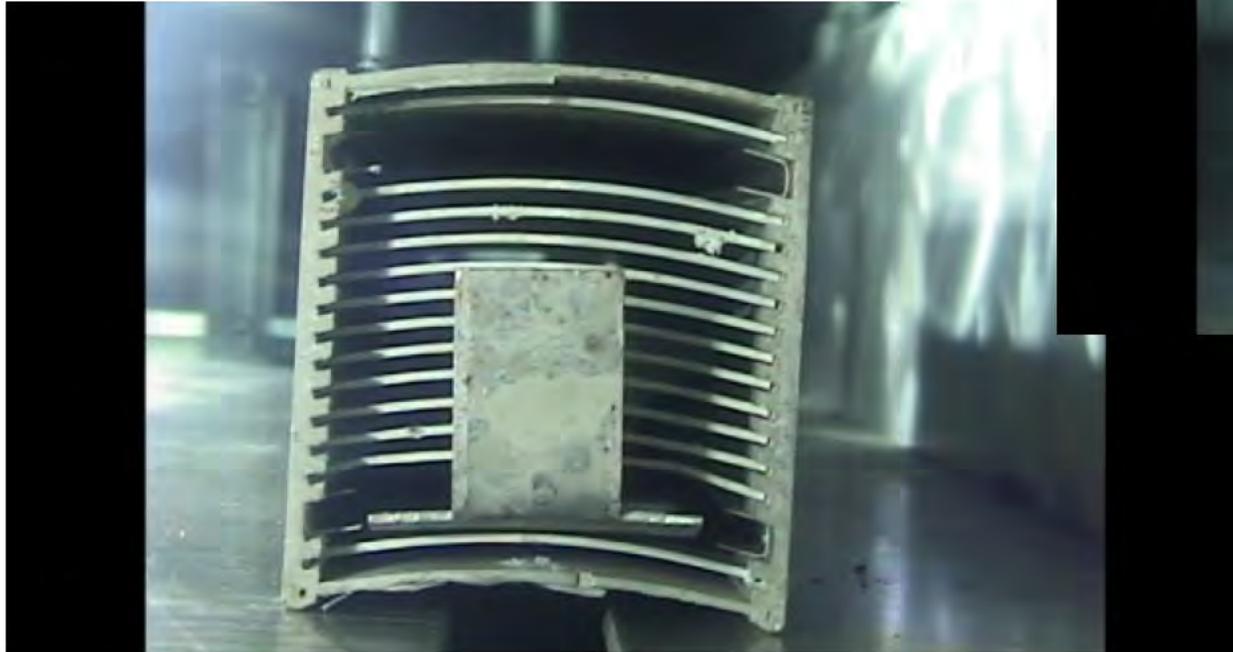


Crevice corrosion product on fuel plate ↑

# AMCAP – Aluminum Based Fuels: Baseline Inspection Results

- January 2019 Inspection – RA-3  
Assembly S-113

Cropped bottom end ↓



Top end ↑

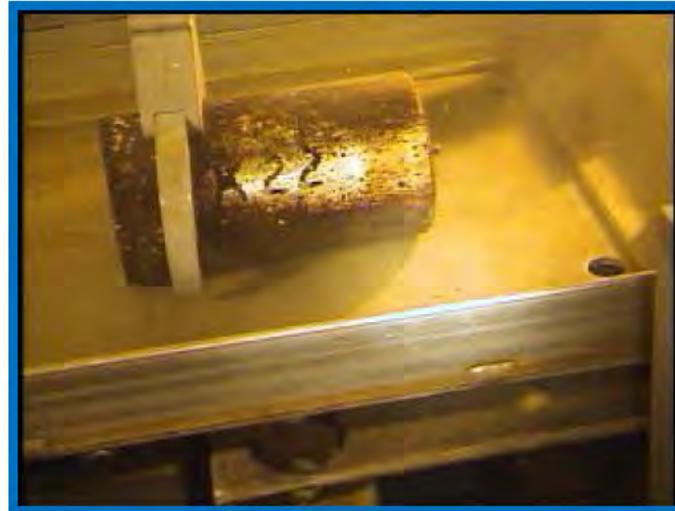
## Non-Aluminum Fuels

- **Three basic storage configurations**
  - Fuel directly placed in bundles
  - Fuel in cans in bundles
  - Fuel in Oversized Cans (OSC);
    - *Directly in OSC or in cans inside the OSC*
- **Variety of can designs**
  - Aluminum / stainless steel
  - Vented / non-vented
  - Isolation / non-isolation



Three types of bundles ↑

Typical fuel can ↓



Oversized Can ↓



## AMCAP – Non-Aluminum Fuels

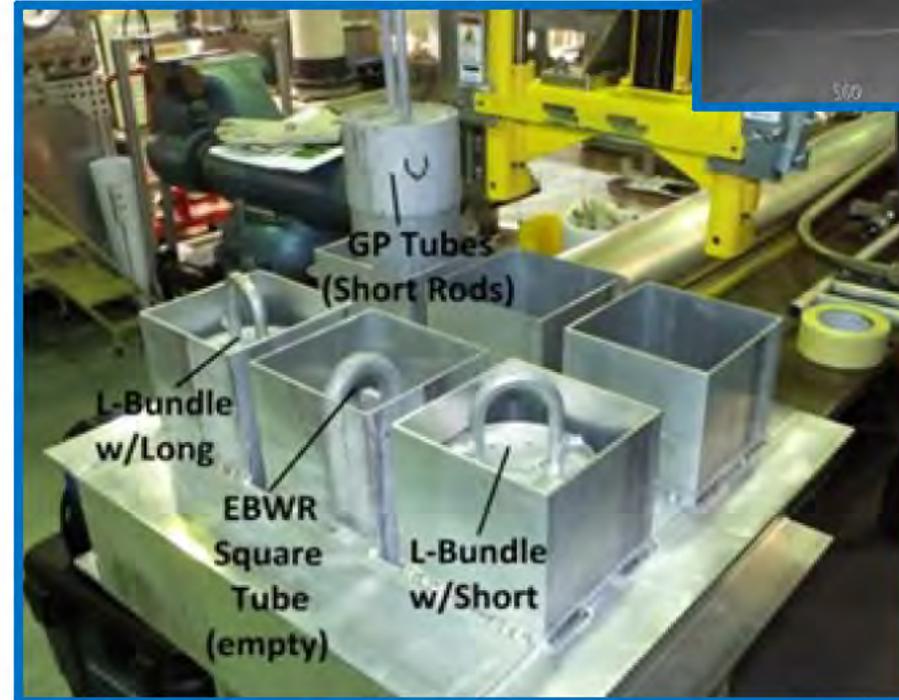
- **In-situ examination of Oversized Cans**
  - Visual and ultrasonic examination (complete; no anomalies)
- **Evaluation of fuels and storage configurations**
  - Compile details & history of configurations and contents (complete)
  - Evaluate configuration for degradation susceptibility (complete)
  - Identify configurations for further study
    - *Degradation mechanisms*
      - Original fuel condition
      - Presence of galvanic couples
    - *Type & integrity of containment*
    - *Levels of containment*
    - *Consequences*
      - Impact to general safety criteria
    - *Address all three basic storage configurations*
  - Develop and deploy indirect characterization methods

Underwater examination of Oversized Can ↓



## AMCAP – Non-Aluminum Fuels: Current Status

- **FY18**
  - Select specific configurations for study
  - Establish requirements for inspections
  - Develop non-destructive examination (NDE) approaches for each configuration
  - Define acceptance criteria
- **FY19**
  - Mock-up NDE
    - *Refine inspection methods*
    - *Qualify examination systems*
- **FY20+**
  - Execute examinations & evaluate results
  - Establish ongoing in-service inspection program



↑ Videoprobe image in rack mock-up

← Bundles in rack mock-up

## AMCAP – Basin Structural Evaluation (Complete)

- **Verified structural integrity by evaluation of concrete aging**
- **Compressive strength microstructure analysis**
  - Compressive strength exceeded design criteria
  - No significant aging mechanisms
    - *Chemical attack*
    - *Leaching*
    - *Alkali-Silica reaction*
    - *Cracking due to shrinkage*
    - *Freezing/thawing*
    - *Radiation effects*
- **No change in material property input to basin structural analysis**

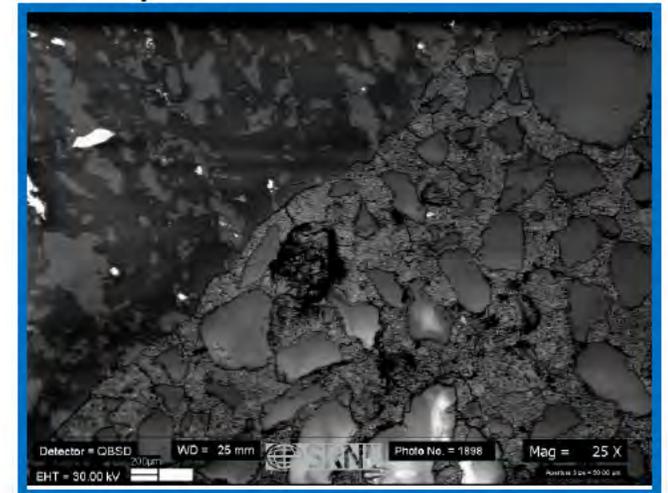


← Coring from C basin



↑ Compression strength test

Photomicrograph of sample ↓



## Conclusion

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- **Continuing to work the AMCAP activities**
  - Aluminum-based fuel inspections
  - Non-aluminum fuel examination technology development
- **No findings that challenge extended safe storage of spent fuel in L Basin**

