

# Spent Fuel Management at Savannah River Site

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Crystal Gateway Marriott Hotel – Arlington, VA

# Outline

- Fuel inventory and future receipts
- Disposition status and options
- Extended storage mission
- Augmented monitoring and condition assessment program
- Summary

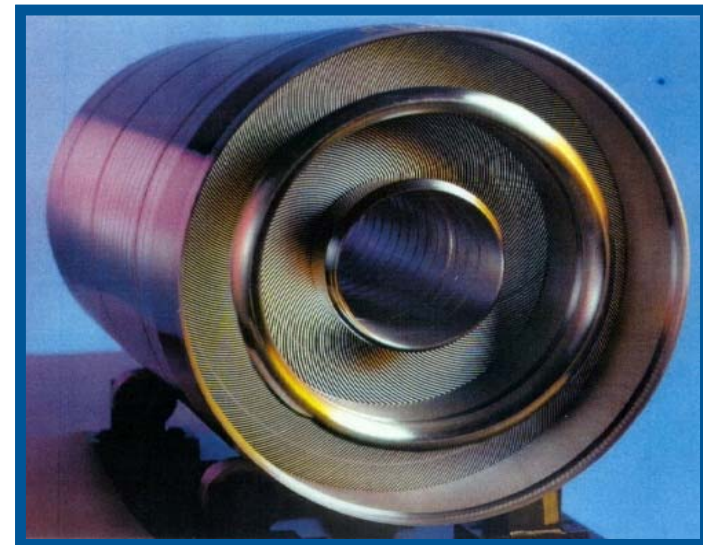


# L Basin Inventory

	# Assemblies
Aluminum-based fuels	~13,000
Higher Actinide targets	~200
Non-Al-based fuels	~2000
<b>TOTAL</b>	<b>~15,000</b>



Material Test Reactor (MTR) Fuels



High Flux Isotope Reactor (HFIR)

## Forecast Future Fuel Receipts

- **Foreign Research Reactors (FRR)**
  - Authorized through May 2019
  - Estimated 3,200 additional assemblies
  - Estimated 125 casks
- **Domestic Research Reactors (DRR)**
  - No defined end date
  - 40 - 100 assemblies per year
  - 5 - 20 casks per year



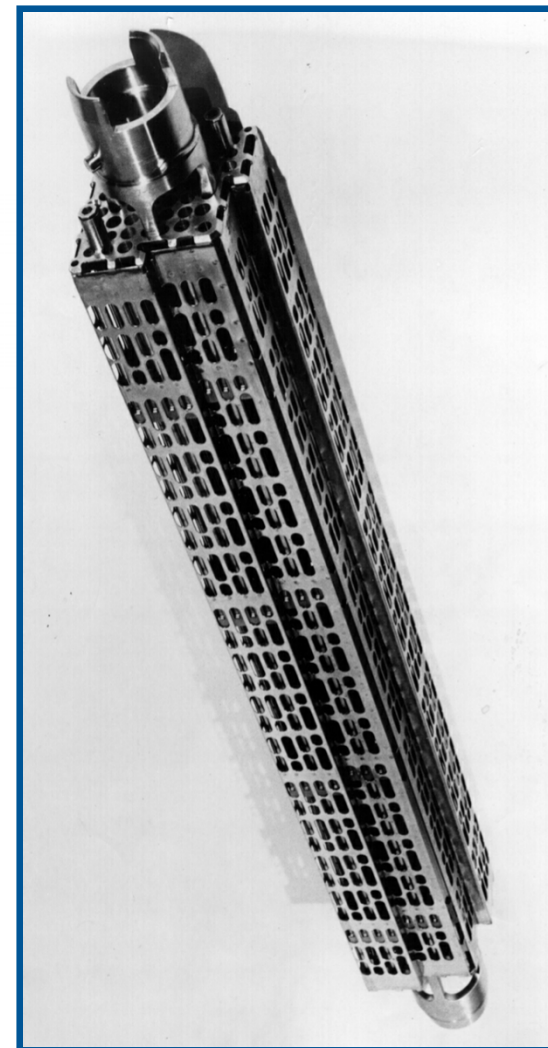
# Fuel Disposition

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- **Ongoing vulnerable fuel dissolution campaign**
  - Declad thorium/uranium fuel from Sodium Reactor Experiment (SRE)
  - Bare metal fuel with a sealed can providing single barrier from basin water
  - Co-processing selected high-aluminum MTR fuel; no uranium recovery
- **Aluminum-based fuels**
  - Prepared to ship standard MTR fuels to H Canyon for processing
    - *Down blend highly enriched uranium (up to 93% U-235) to lower enrichment for use in commercial power reactors*
    - *Awaiting DOE direction and NEPA action to proceed with this disposition alternative*
  - Other Al-based fuel types (e.g., HFIR) are also candidates for H Canyon processing
    - *Requires additional facility and transportation preparations due to irregular sizes and shapes*

# Fuel Disposition

- **Higher actinide targets**
  - Produced in Savannah River reactors
  - Isotopes of programmatic value
  - Exploring alternatives for recovery of rare isotopes
- **Stainless steel and zirconium clad fuels**
  - Many non-standard geometries and packages
  - Not compatible with current H Canyon process
- **Dry Fuel Storage Project**
  - Conceptual strategy developed in FY12



# Extended Safe Storage of Used Fuel

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- **Past planning basis**
  - All fuel receipts to be terminated during 2019
  - Facility to be deinventoried late 2019 via fuel exchange with INL and H Canyon processing; followed immediately by facility deactivation
  - Fuel and facility long-term viability assessments based on these key assumptions
- **Current planning basis**
  - FRR receipts to terminate in 2019; DRR receipts to continue indefinitely
  - Presently using mid 2030s deinventory as basis for infrastructure and system viability assessments
- **Re-evaluated fuel storage and basin viability for extended life**
  - Evaluation concluded extended safe storage possible; recommended activities to improve understanding of conditions and potential long-term degradation
  - Developed Augmented Monitoring & Condition Assessment Program (AMCAP)

# Augmented Monitoring and Condition Assessment Program (AMCAP)

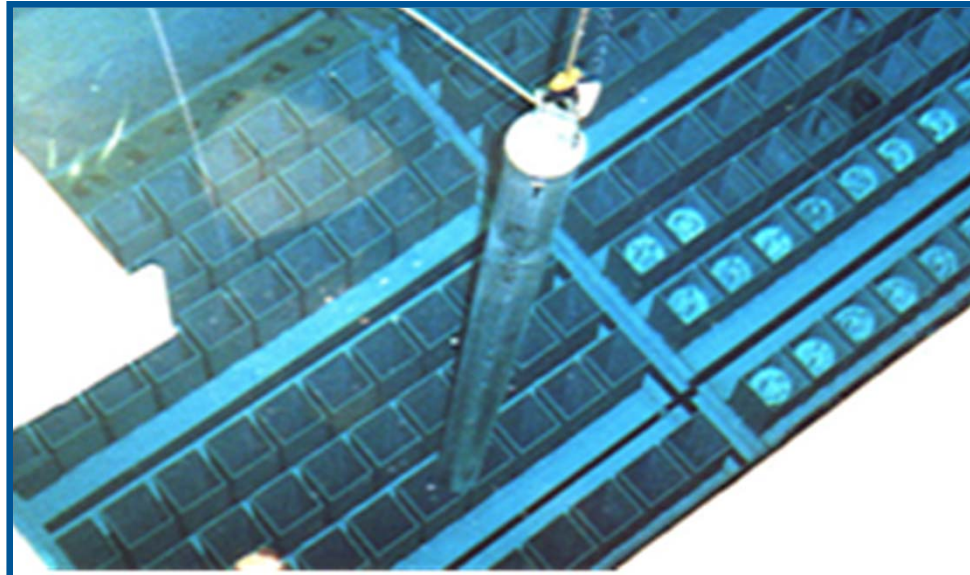
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- **Continue existing programs**
  - Basin water chemistry control program
    - *Stringent controls on water purity; minimize corrosion of fuel and storage fixtures*
  - Corrosion surveillance programs
    - *Corrosion coupon surveillance; predict corrosion rates of fuel and fixture materials*
    - *Microbial monitoring program*
  - Structural integrity program
    - *Periodic visual examination of basin floor & walls and accessible exterior walls*
- **Implement three additional programs to assess long term viability of:**
  1. Al-based fuels in standard storage configurations
  2. Isolation cans containing degraded/damaged fuels
  3. Basin structural integrity



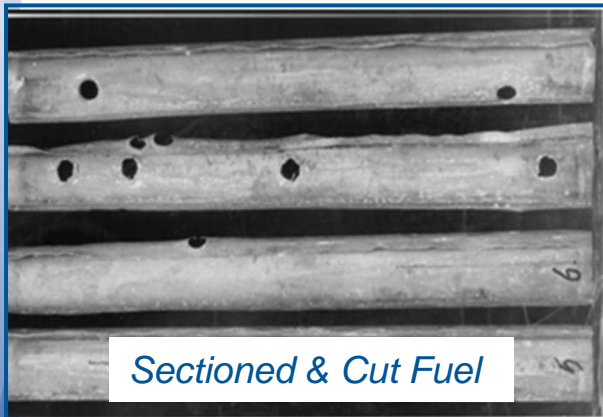
## AI-Based Fuels in Standard Storage Configurations - Description

- Standard storage configuration
  - Typically 4 to 5 assemblies placed in cylindrical tube, called a 'bundle'
  - Bundle has openings at ends; assemblies immersed in treated basin water
  - Bundles placed in vertical racks

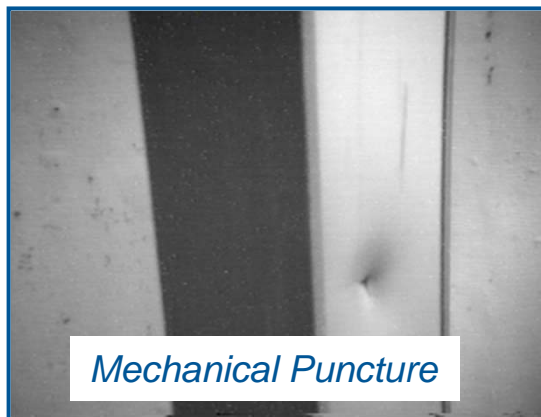


# AI-Based Fuels in Standard Storage Configurations - Concerns

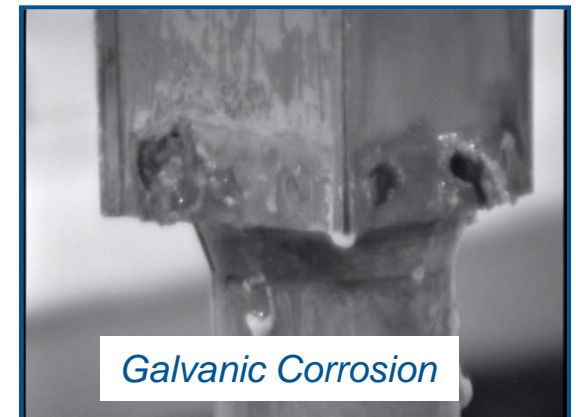
- **General corrosion of aging fuels**
  - L Basin began receiving research reactor fuels in 1997
  - Fuels stored at originating facilities or interim storage locations prior to receipt in L Basin; some dating back to 1961
- **Further degradation of fuels received in failed/degraded condition**
  - Assemblies cut, sectioned, or dismantled for experiments/tests
  - Cladding penetrated in handling
  - Corroded / degraded fuels



*Sectioned & Cut Fuel*



*Mechanical Puncture*



*Galvanic Corrosion*

## AI-Based Fuels in Standard Storage Configurations – AMCAP Plan

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- Establish in-service inspection program for bundled MTR fuel
  - Selection of fuels for inspection (complete)
    - *Fuels with known defects; various burnups*
  - Develop inspection equipment and procedures (in progress)
  - Sample water inside fuel bundle tubes before disturbing; evaluate localized water chemistry surrounding fuel (samples pulled; analyses in progress)
    - *Conductivity, pH, alpha, beta/gamma, chlorides, metals, microbes*
  - Perform baseline visual inspections; evaluate results
    - *Defined regions of interest for each assembly*
    - *Underwater cameras with reproducible geometry & lighting*
  - Periodic reexamination; trend changes

# AI-Based Fuels in Standard Storage Configurations – AMCAP Plan



< Pulling water sample from within bundle



Filling sample bottle >

## Isolation Cans Containing Damaged/Degraded Fuels - Description

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- Many different types of fuels in over 400 isolation cans
  - Fuel: uranium, plutonium, thorium, and blends
  - Fuel form: metals, oxides, silicides, various alloys
  - Cladding: zirconium, stainless steel, aluminum, declad
  - Fuel conditions: destructively tested, failed, intact
  - Containers: mostly aluminum, some stainless steel; vented or sealed
  - Storage configurations: mostly small containers placed in oversized cans or standard bundles
- Most were packaged about 50 years ago
- All were handled and shipped to L Basin from Receiving Basin for Offsite Fuels (RBOF) facility in early 2000s
- Some cans known to have failed in prior storage; overpacked for shipment and storage
- No existing capability to open these containers or inspect contents

# Isolation Cans Examples –



< Fuel Element Container (FEC)



K Can >

## L Basin Oversized Can (OSC)



- Eight inch diameter aluminum pipe
- Flanged lid with j-tube gas vent



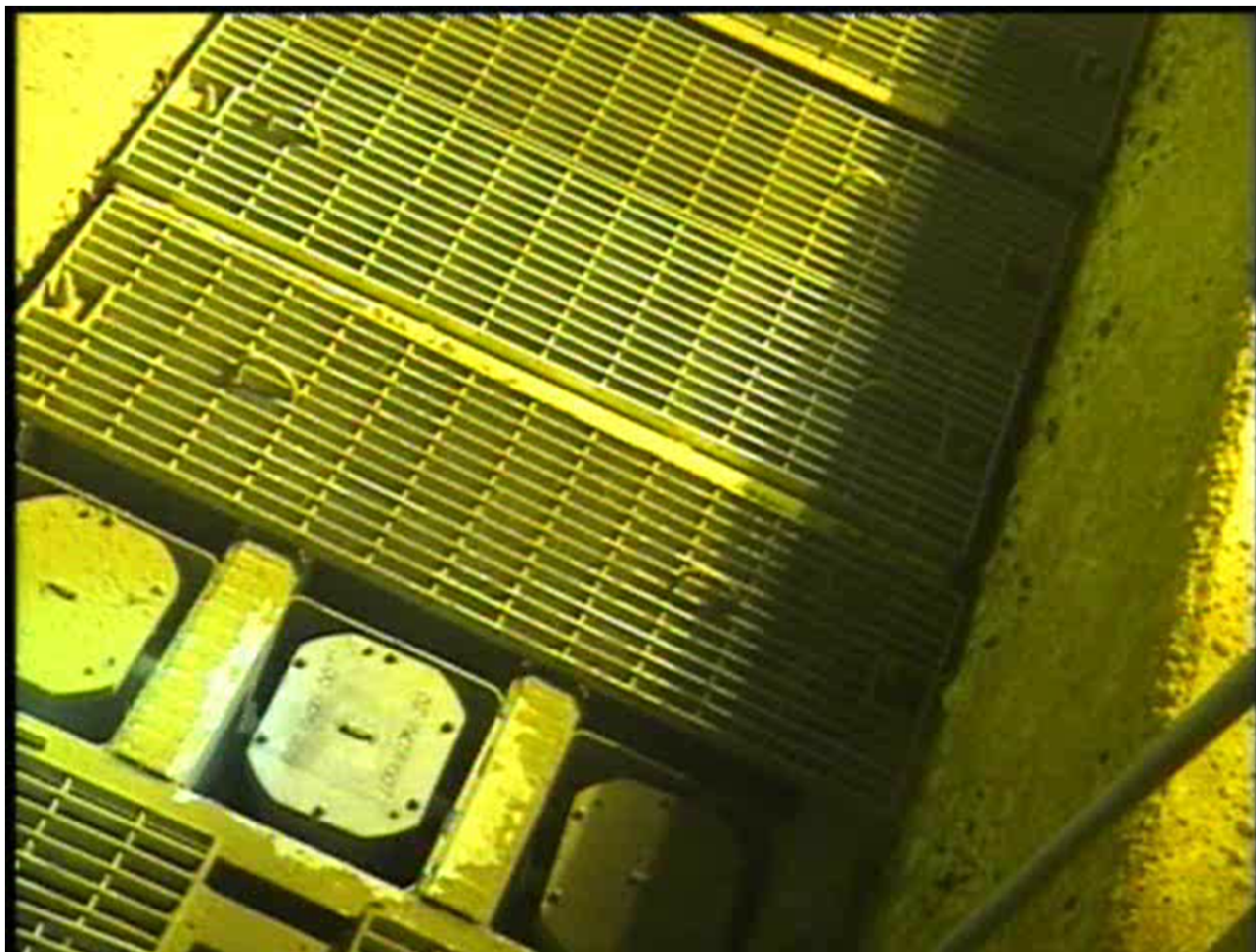
## Isolation Cans Containing Damaged/Degraded Fuels - Concerns

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- Water chemistry inside cans
  - No means to monitor or control
- Failure of inner cans allowing direct water contact with degraded fuel
- Integrity of outer cans; corrosion from within
- Continued degradation of known failed fuels and containers
- Increased difficulties in disposition
- Corrosion product gas accumulation / pressurization
  - Venting of gas bubbles
- Criticality (loss of geometry)



# L Basin Oversized Can – Gas Bubble Video Loop



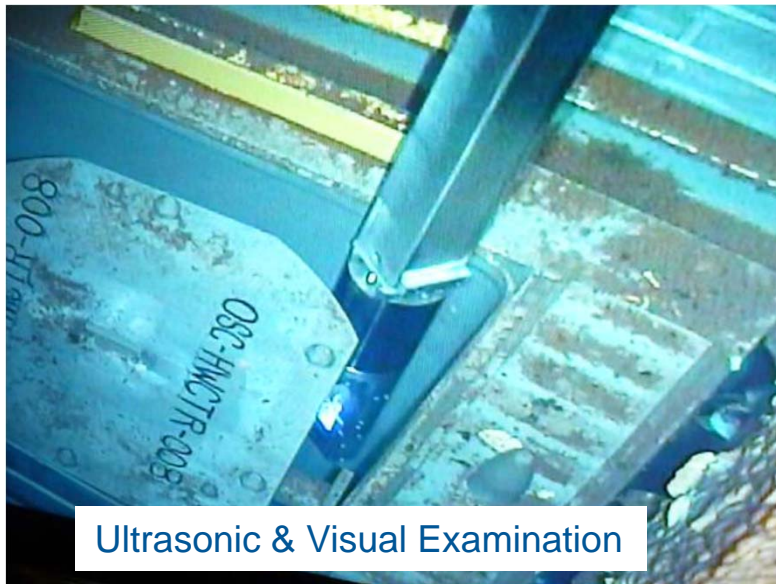
## Isolation Cans Containing Damaged/Degraded Fuels – AMCAP Plan

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- In-situ examination of L Basin oversized cans
  - Visual and ultrasonic examination of cans (complete)
- Corrosion and degradation evaluation of Isolation Can configurations
  - Compile details and history of isolation containers and contents (complete)
  - Evaluate configurations for degradation susceptibility (in progress)
  - Identify items for further study; bounding configurations/risks
    - *Continuing oxidation of degraded fuels*
    - *Integrity of containment, types and levels of containment*
  - Evaluate fuel isotope characteristics & alteration products
  - Develop and deploy indirect characterization methods

# Isolation Cans Containing Damaged/Degraded Fuels – AMCAP Plan

- Results of ultrasonic and visual examination of oversized cans
  - *Oversized cans in good condition*
  - *No thinning of container walls*
  - *No gas accumulation*
  - *Internal contents covered with water*
  - *Inner contents at anticipated elevation*
  - *No accumulation of sediment at bottom of cans*



Ultrasonic & Visual Examination



Visual Inspection of OSC in L Basin

# Basin Structural Integrity

## Description

- Steel reinforced concrete basin
- Approximately 3.4 million gallons
- Placed in service in 1954
- Epoxy coating reapplied in early 1980s

## Concerns

- General aging
- Effects of prolonged exposure to basin water



# Basin Structural Integrity – AMCAP Plan

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- Test concrete of similar age and operating history
  - Determine concrete sampling requirements (complete)
  - Identify suitable surrogate material (complete)
  - Collect samples (complete)
  - Test samples and evaluate results
    - *Strength of concrete*
    - *Condition of rebar*
    - *Effects at water interface*
- Update structural predictive models, if necessary
- Incorporate into revised structural analysis for L Basin

## Basin Structural Integrity – AMCAP Plan Progress

- Obtained concrete core samples from below water line in C Basin wall
  - *Integrated with basin dewatering and grouting activities*
- Cut to size for testing
- Shipped to Savannah River National Laboratory for storage and analysis



Core Drilling Rig



Concrete Core Sample

# Summary

- L Basin mission has been extended
- Continue foreign and domestic reactor fuel receipts
- Safeguard HEU for reduction of global threat
- Disposition fuels as directed
- Implement Augmented Monitoring and Condition Assessment Program to ensure safety of extended basin storage



