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# INTEGRATION OF LEGACY MATERIALS FROM THE ANNULAR CORE RESEARCH REACTOR INTO A NEW REGULATING ROD

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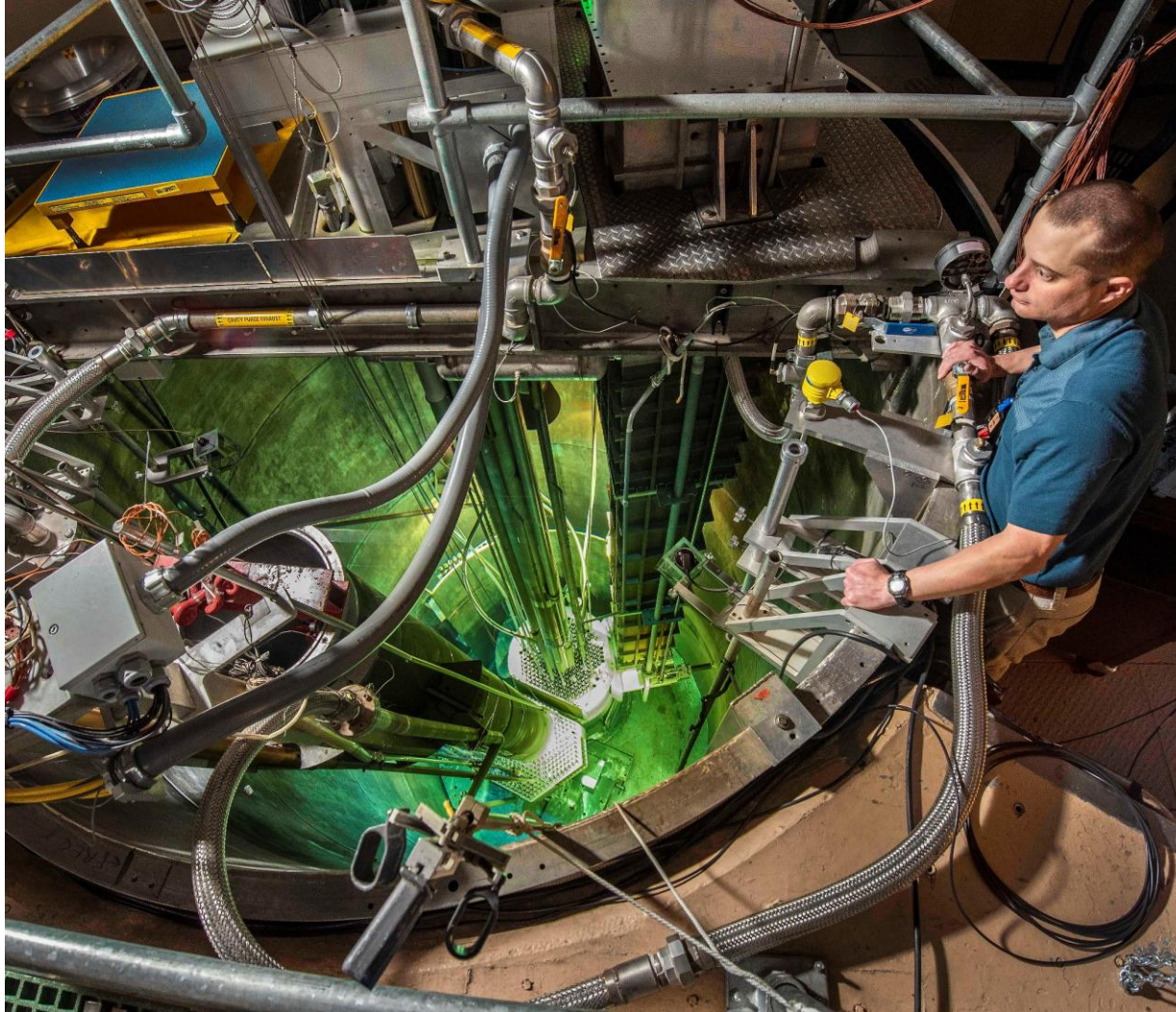
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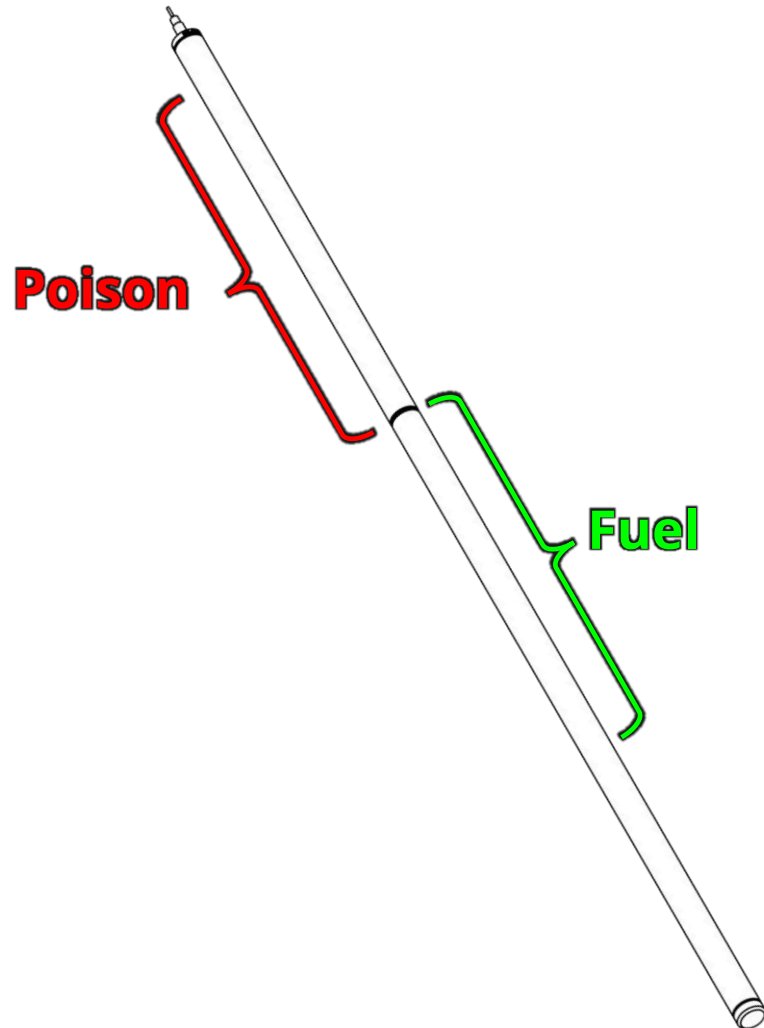
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# ANNULAR CORE RESEARCH REACTOR (ACRR)



- Pool-type research reactor located at Sandia National Labs in Albuquerque, NM
- Operational modes
  - Steady-state
  - Pulse
  - Tailored transients
- Designed to support various research
  - Neutron/gamma effects
  - Materials irradiation
  - Transient and safety testing
- Distinctive features
  - 9-inch dry central cavity
  - 20-inch dry fueled-ring external cavity
  - Epithermal neutron flux
  - Spectrum-tailoring capability

# REACTOR HARDWARE CONTEXT



**Fuel-followed regulating rod**

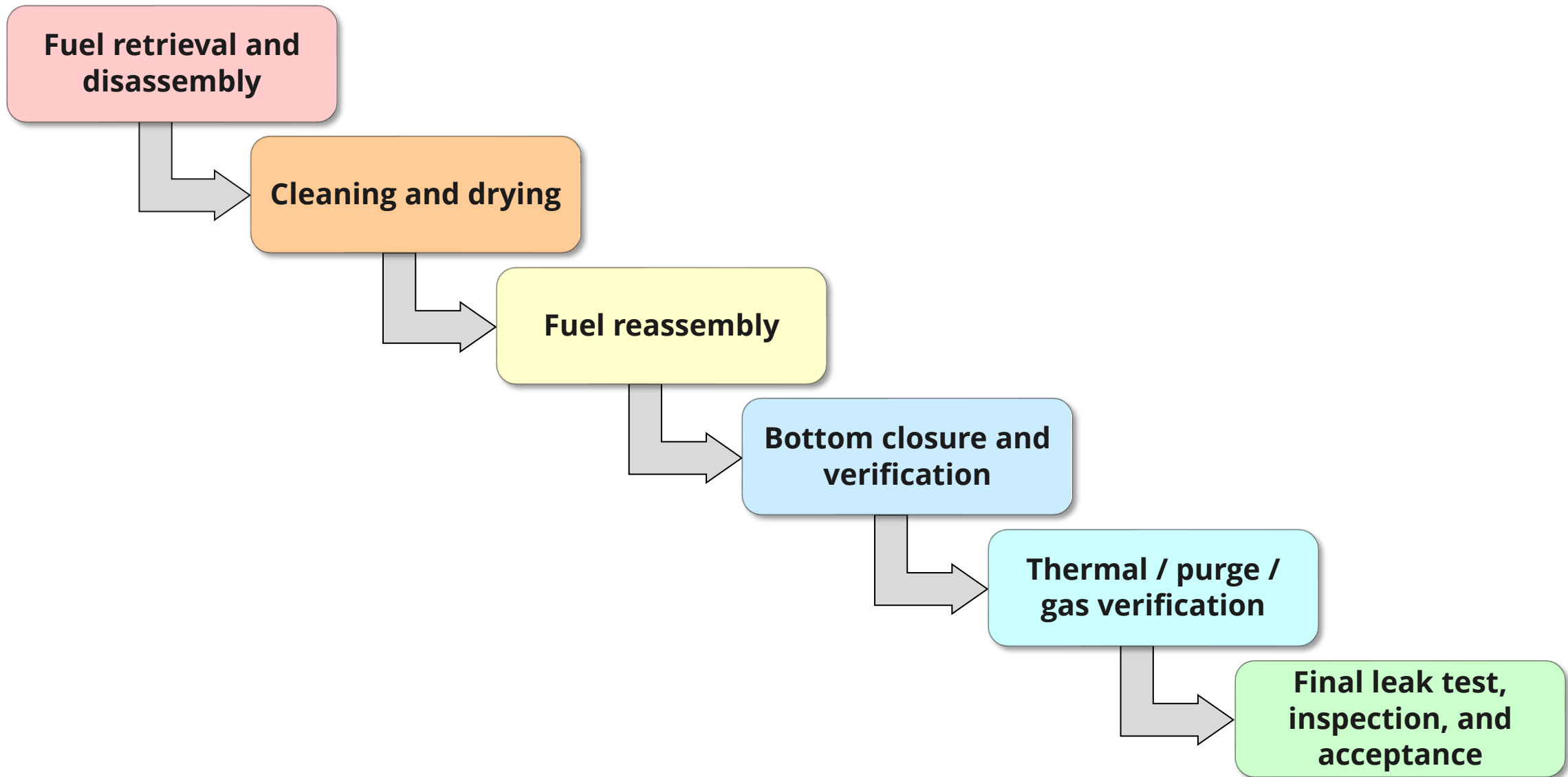
- ACRR uses multiple types of fuel assemblies
  - Fuel elements
  - Instrumented fuel elements
  - Fuel-followed regulating rods
    - Control rods
    - Safety rods
- Regulating rods are longer than stationary fuel elements because they integrate:
  - Fuel-bearing section
  - Additional internal hardware
  - Poison-bearing sections, depending on configuration
- This presentation highlights production of a **fuel-followed safety rod**

## OBJECTIVE

- Demonstrate a practical method for integrating legacy ACRR reactor materials into newly manufactured regulating rod hardware
- Develop and execute a coordinated fabrication, inspection, and acceptance process suitable for this hardware class
- Capture process lessons relevant to future fabrication and refurbishment activities



# RECLADDING / REASSEMBLY PROCESS OVERVIEW



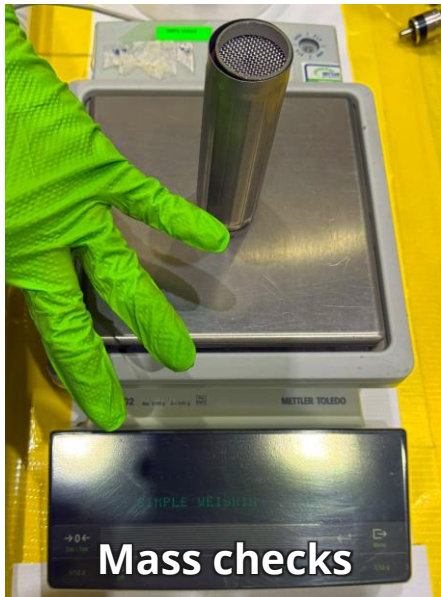
# CLEANING AND REASSEMBLY DEVELOPMENT



Ultrasonic cleaning



Vacuum oven drying



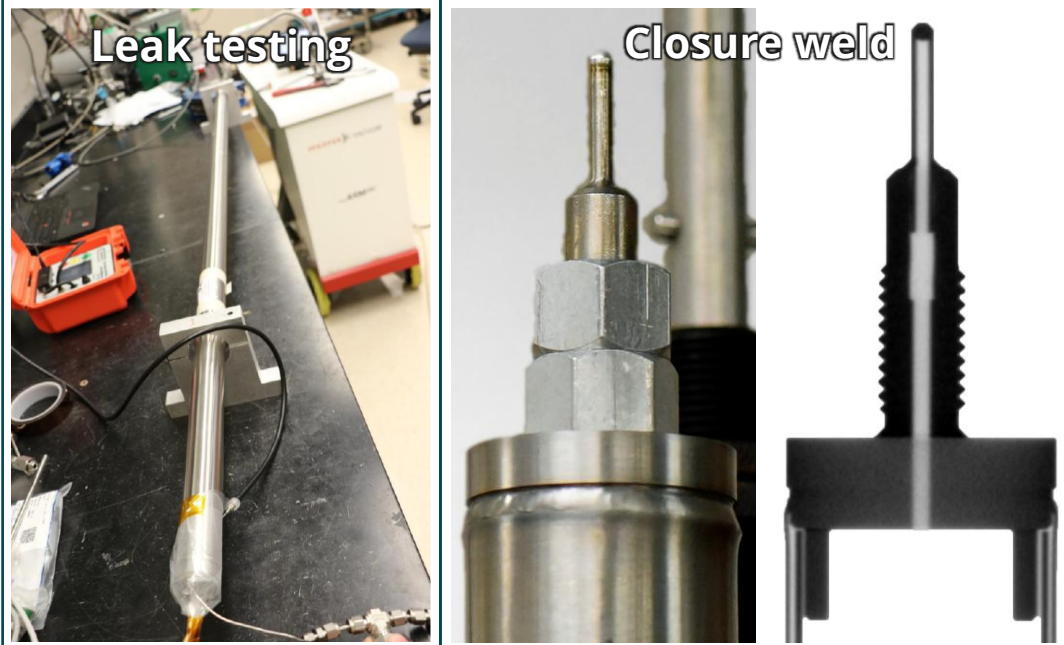
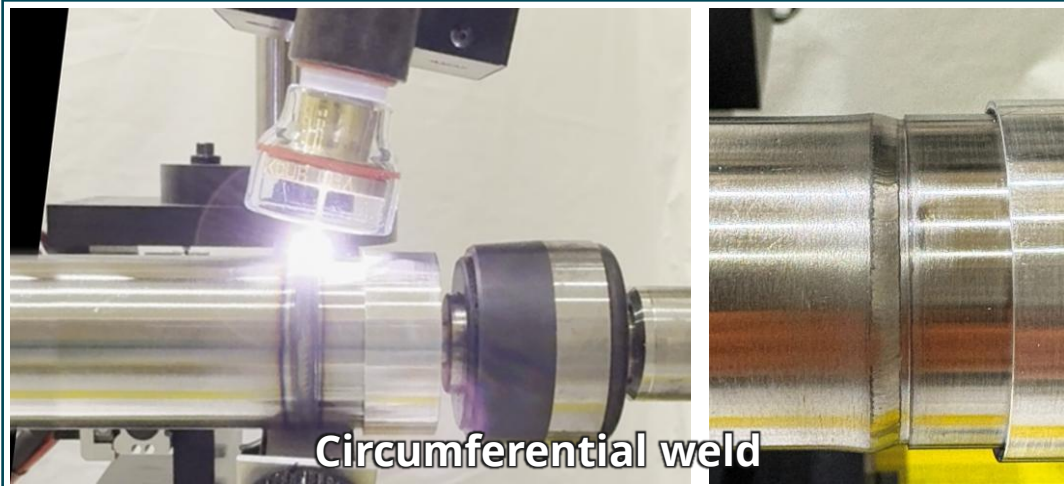
Mass checks



Fuel reassembly

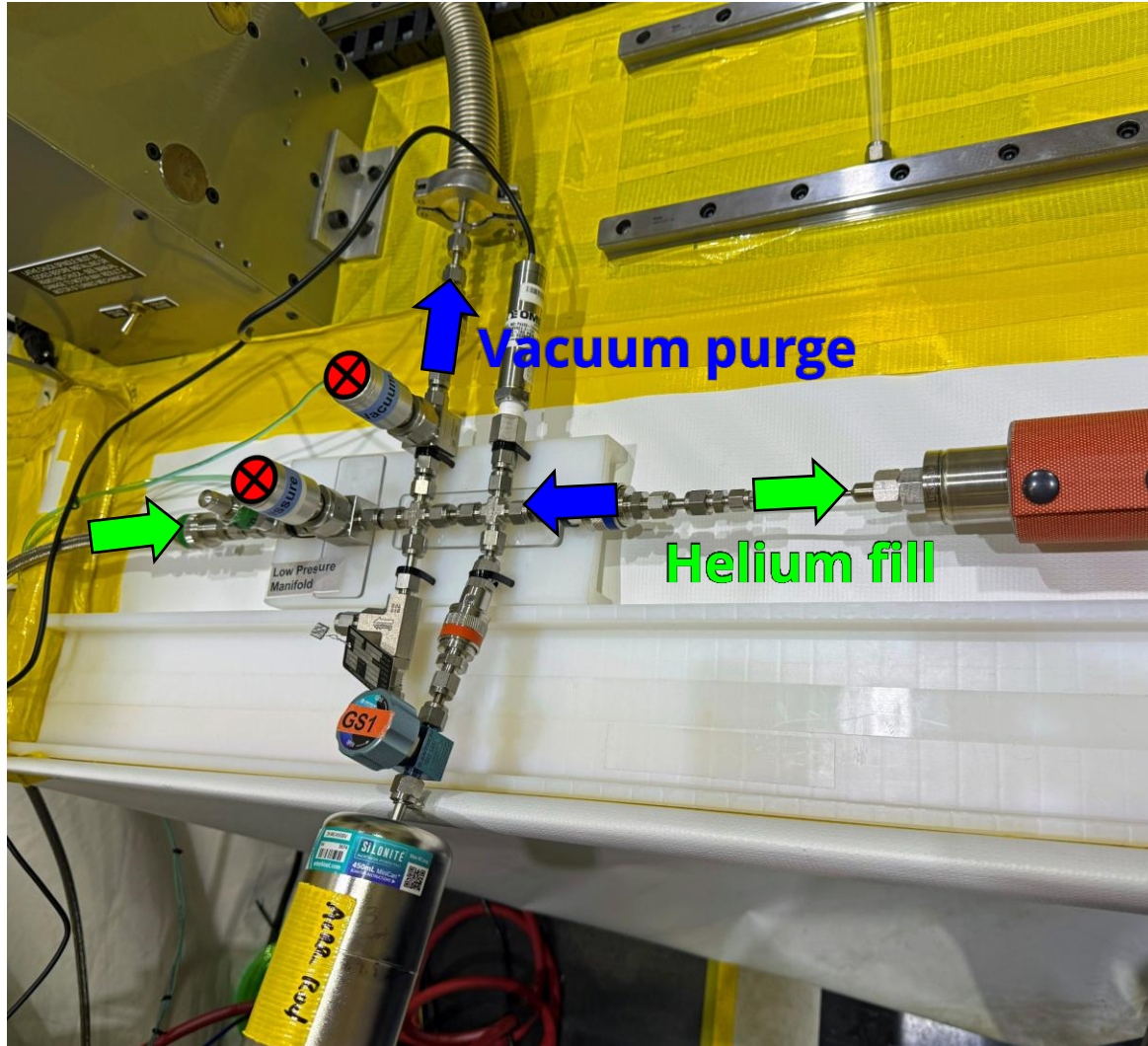
- Cleaning and drying steps were developed for the legacy components prior to reassembly
- Process development emphasis
  - Compatibility with existing materials
  - Repeatability
  - Minimization of unintended damage or residual contamination
- Mass checks and follow-on analytical observations were used as process checks
- Reassembly required controlled handling and careful fit-up of nested internal components

# WELDING AND PRESSURE BOUNDARY DEVELOPMENT



- Closure welding methods were developed and refined for the replacement hardware
- Key objectives
  - Repeatable weld geometry
  - Acceptable leak tightness
  - Controlled distortion
- Verification activities
  - Leak testing
  - Overpressure testing
  - Closure verification
  - Nondestructive examination

# GAS BACKFILL VERIFICATION APPROACH



- Thermal cycling and purge steps
  - Reduce residual water and volatile species
- Gas samples were collected before final closure
- Final analytical checks
  - Confirmed high-purity helium backfill
  - Low residual impurity levels
- Direct verification of the final internal gas condition

# INSPECTION AND ACCEPTANCE



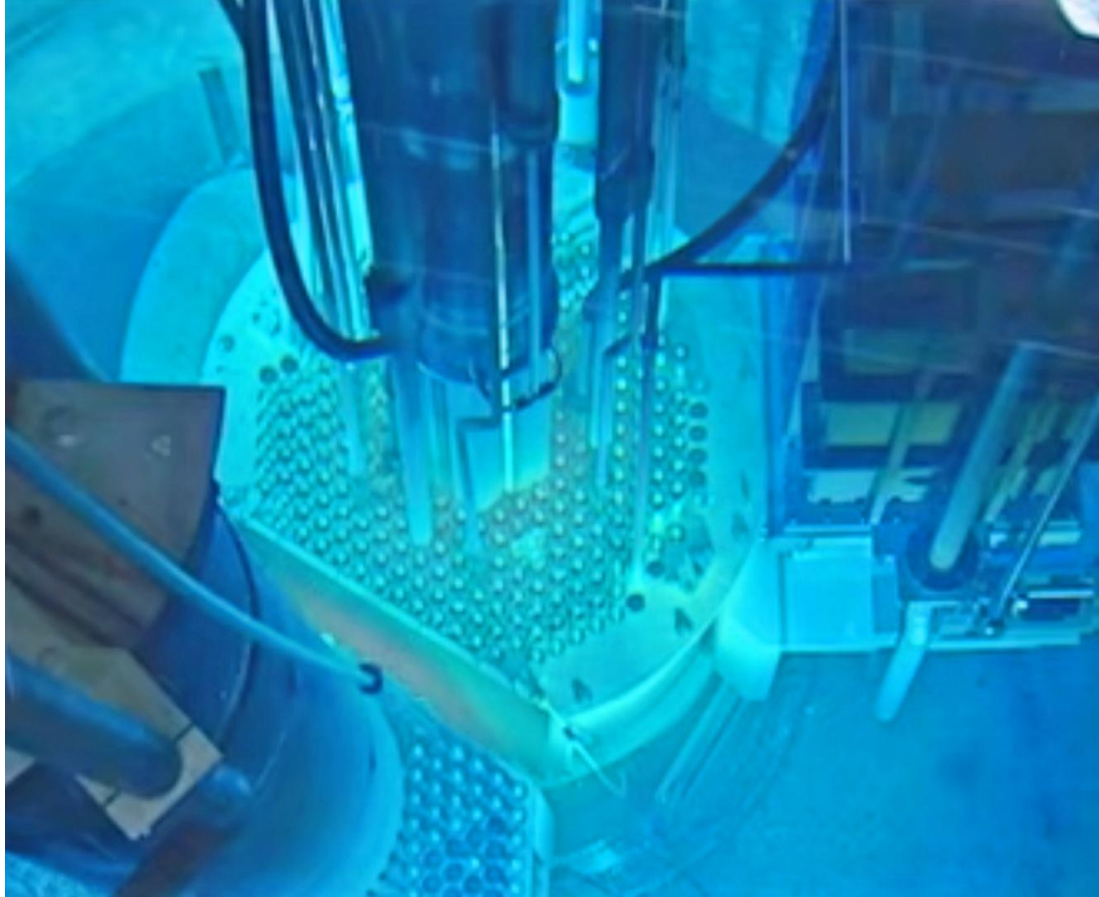
- Dimensional verification
- Weld visual inspection
- CT examination
- Leak testing
- Acceptance documentation
- Outcome: Assembly ***passed*** acceptance checks

# LESSONS LEARNED



- Integration of engineering, welding, operations, and NDE was essential
- Rehearsals and process walkdowns improved execution quality
- Fixture, tooling, and conformance had outsized importance
- Coordinated fabrication and quality engineering reduced execution risk
- Campaign established a reusable process basis for similar future work

# RELEVANCE TO RESEARCH REACTORS



- Example of integrating modern fabrication and inspection methods with legacy reactor hardware
- Useful case study
  - Specialized component refurbishment
  - Method qualification
  - Cross-disciplinary execution
- Relevant to:
  - Aging management
  - Hardware sustainment practices
  - High-consequence reactor support campaigns

## SUMMARY



- Legacy ACRR materials successfully integrated into newly manufactured regulating rod hardware
- Campaign demonstrated a practical fabrication, inspection, and acceptance path
- Established a reusable process basis for future fabrication and refurbishment work
- Illustrates how research reactor organizations can adapt modern methods to legacy hardware challenges