



NRIC

National  
Reactor  
Innovation  
Center



# National Reactor Innovation Center Advanced Construction Technology Initiative

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NRC Regulatory Information Conference  
TH23: Constructing Our Energy Future

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# NRIC is a DOE-NE program, launched in FY2020



## *NRIC Accelerates Nuclear Reactor*

### *Demonstrations*

- Authorized by the Nuclear Energy Innovation Capabilities Act (NEICA)
- Partner with industry to bridge the gap between research and commercial deployment
- Leverage national lab expertise and infrastructure
- Manage demonstrations to success



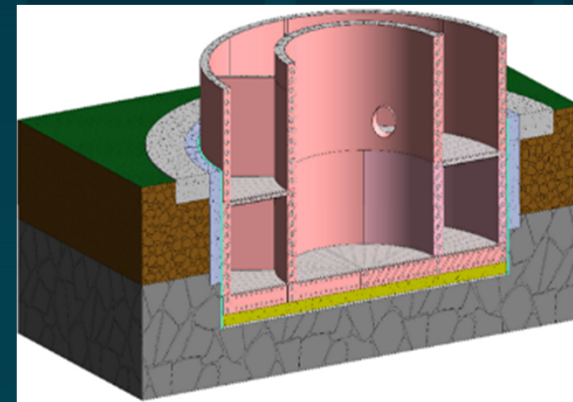
# Empowering Innovators

- Demonstration Test Beds
- Experimental Facilities
- Virtual Test Bed
- Cost and Markets

- Planning Tools
  - NRIC Resource Team
  - NEPA guidance
  - Demonstration Resource Network (<https://nricmapping.inl.gov/>)
  - Siting Tool for Advanced Nuclear Development

# Advanced Construction Technology Initiative (ACTI) Project 1

- Purpose -
  - Demonstrate advanced construction technologies/processes that can significantly improve economics and schedule duration of nuclear build projects for SMRs
  - Enable commercial deployment by 2030
- **General Electric Hitachi Nuclear**
  - Technology Areas:
    - Vertical shaft excavation techniques
    - Steel Bricks™- Steel Concrete Composite Modules
    - Advanced monitoring & digital twin technology
  - Two Phase Project:
    - Phase I: Prototype and test Steel Bricks™, optimize design of demonstration
      - Started Jan 2022 with ~ DOE-NE 70% and GEH Team 30% cost share
    - Phase 2: Scaled demo unit construction, testing and decommissioning
      - 2 or 3 years, subject to availability of funds and successful Phase I

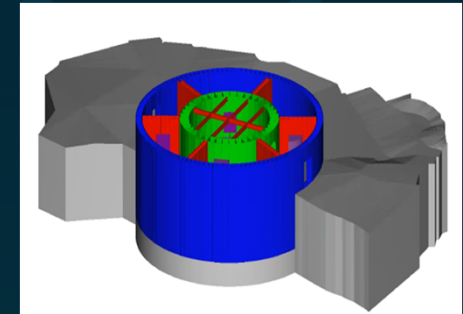


Steel Bricks is a trademark of Modular Walling Systems Holdings Limited (MWS)



# Team Members & Roles

- General Electric Hitachi Nuclear Energy (GEH)
- EPRI – Digital Twin, and NDE techniques
- Nuclear Advanced Manufacturing Research Centre (NAMRC) – Advanced Sensors
- University of North Carolina @ Charlotte (UNCC) – Digital Twin
- Purdue University – Steel-Concrete Composite prototype testing
- Modular Walling Systems Holdings Limited (MWS) – Steel Brick™
- Caunton Engineering & Aecon Wachs – Steel Brick™ Fabricators
- Black & Veatch – Boring Technology, Construction, & Site Selection
- Tennessee Valley Authority (TVA) – Industry Partner
- Ontario Power Generation & Duke Power – SME's
- NRC Rotational Employees



# NRC Collaboration

- Congress recognized the importance of agency coordination in the Nuclear Energy Innovation Capabilities Act
- DOE/NRC MOU to “coordinate DOE and NRC technical readiness and sharing of technical expertise and knowledge on advanced nuclear reactor technologies and nuclear energy innovation, including reactor concepts demonstrations, through the [NRIC].”
  - NRIC Rotations



Fred Sock  
Office of Nuclear Regulatory Research



Allen Fetter  
Office of Nuclear Reactor Regulation

- Monthly Coordination Calls – DOE/NRC/NRIC



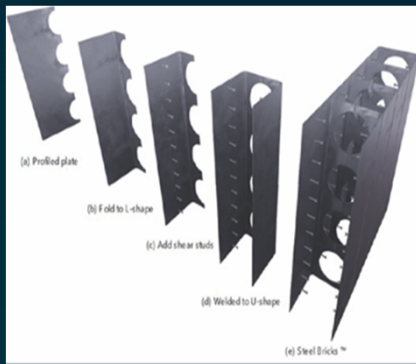
# Vertical Shaft Construction

- Reduce costs associated with excavation,
  - Potential to reduce the amount of excavation and engineered backfill needed by 1 million cubic feet
  - Demonstration project includes:
    - Secant and pile construction
    - Inspections, and testing of safety-related backfill
- Conceptual design for scaled demo structure
  - Diameter of 110 feet
  - Shaft depth 20 feet
  - Height above grade 6 feet
- Sensors will be installed to measure impacts of construction activities to provide empirical data



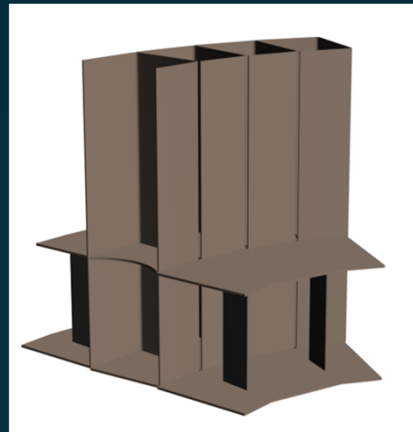
# Steel Brick™ Concept

Next generation Steel Concrete Composite modules, for Seismic Category 1 structures installed in a radial configuration



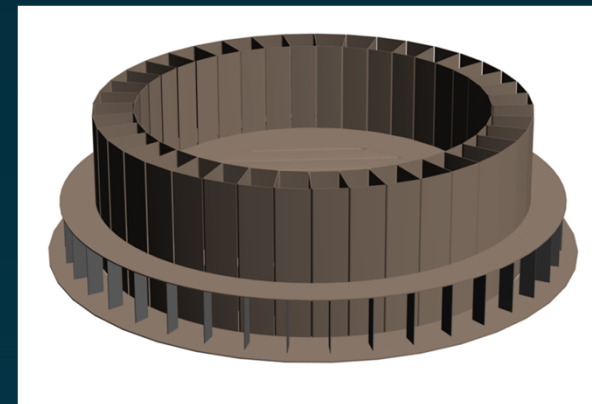
Steel Brick™ Fabricated at Shop

*Concurrent wall fab and excavation  
Reduced schedule duration*



Steel Brick™ Modules Shipped to site

*Reduced onsite work  
Improved quality  
Less rework*



Assembled in field, outside of pit,  
lowered into pit





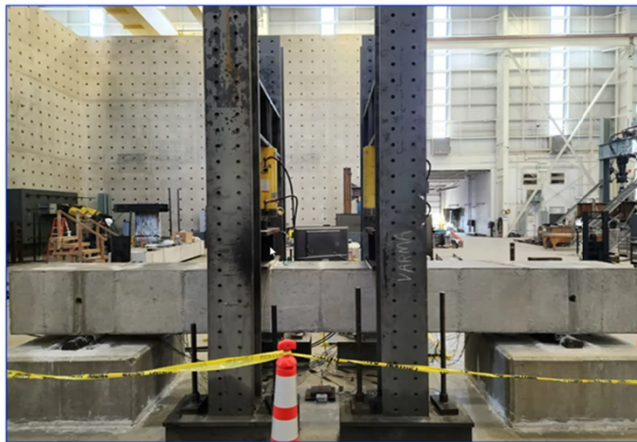
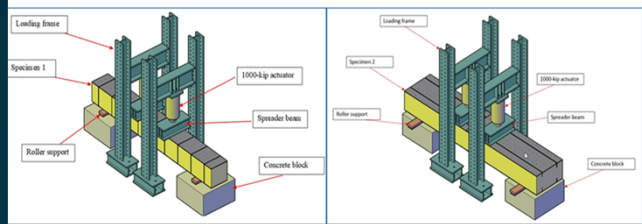
- Steel Brick™ prototypes at Purdue from Cauntion Engineering.
- Filled with Concrete and imperfections for Stress Testing and Non-Destructive Examination
- Measure strength of splices/connections - generate data for digital twin and regulator acceptance as containment application



Picture of East Side of Test Setup

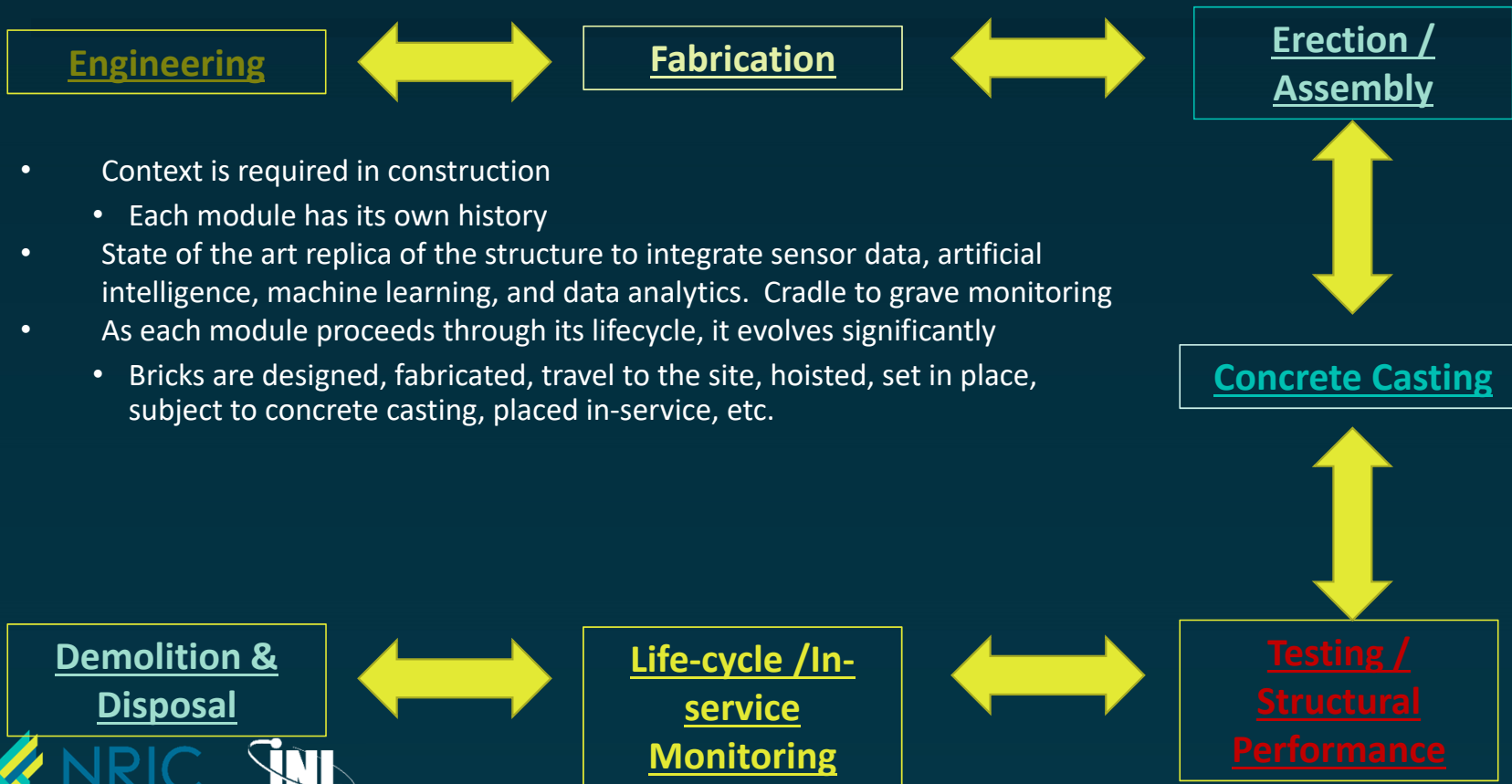


Test Setup and Specimen Drawings



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# Digital Twin for ACT Project

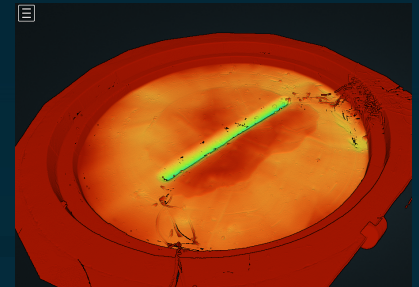


# Nuclear Regulatory Engagement

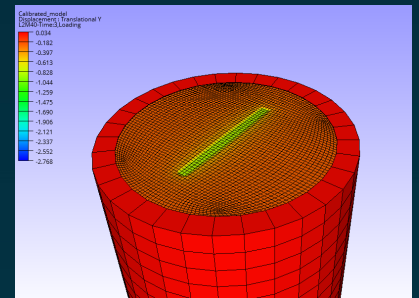
- NRC Rotational and CNSC representatives participate in weekly ACT Technical Discussions and Design Reviews to gain knowledge about the technologies and their demonstration.
- Test results from NRIC Phase 1 SteelBrick™ prototypes at Purdue Lab will be used by GEH to support the technical basis and conclusions in the Licensing Topical Report NEDC-33926P/NEDO-33926, BWRX-300 Steel-Plate Composite Containment Vessel (SCCV) and Reactor Building Structural Design to be submitted to NRC and CNSC in Q2 2023.
- NRC and CSNC will attend the NRIC Phase 1 SteelBrick™ prototype testing planned at Purdue Lab in March 2023.
- NRC and CSNC representatives will be able to visit the demonstration site during installation of the SteelBricks™ during Phase 2.
- GEH and EPRI produced Nuclear Regulatory and Construction Standards Report #007N3451 November 2022.

# ACTI Phase 2 Scope

- Select US fabricators of Steel Brick™
- Fabricate Steel Brick™ and sub-assemblies and ship to site for final assembly into modules and rings
- Site mobilization and completion of all required permits
- Excavate vertical shaft
- Install demonstration-scale Steel Brick™ containment and reactor building
- Deploy the sensors and Digital Twin
- Test the structure and collect data
- Perform regulator style of inspections
- Issue reports and lessons learned at various stages of construction and testing



Point Cloud & Sensor  
Data Update Models  
for Better Decision-  
Making in  
Construction



The successful outcome of NRIC ACT Project 1 is that at the end of Phase 2 the technical readiness level of the demonstrated technology shall be TRL-6 or above



Thank you!

