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# Phase 1 Summary of Management Activities – Advanced Construction Technology Initiative Project

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# REVISION LOG

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# ACRONYMS

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| ACTI | Advanced Construction Technology Initiative |
| DOE | U. S. Department of Energy |
| GEH | GE-Hitachi |
| INL | Idaho National Laboratory |
| NRC | U.S. Nuclear Regulatory Commission |
| NRIC | National Reactor Innovation Center |

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# Phase 1 Summary of Management Activities - Advanced Construction Technology Initiative Project

## 1. INTRODUCTION

With the end of the year approaching, it is essential to review the National Reactor Innovation Center (NRIC) management activities undertaken over the course of the Advanced Construction Technology Initiative (ACTI) project. The ACTI project was launched to support a transformation in nuclear energy construction, management, and deployment costs, enabling nuclear energy to be an important contributor to future energy systems. This transformation will increase the confidence of investors, energy system planners, policymakers, and ultimately consumers in regard to nuclear energy's ability to meet future needs. It thus represents a critical element of advanced nuclear energy system demonstration. Any development and/or demonstration project(s) must consider regulatory requirements for commercial nuclear implementation and will incorporate strategies for developing regulatory experience and reviewing any new technologies. GE Hitachi (GEH), a leading player in the nuclear industry who offers a range of products and services such as nuclear reactor design, fuel supply, and decommissioning solutions, submitted a proposal for the ACTI project and was awarded the contract for Phase 1.

## 2. PROJECT SCOPE AND OBJECTIVES

The primary purpose of the ACTI project is to demonstrate advanced construction and/or deployment technologies, processes, or approaches that, if implemented in nuclear energy projects, would have a major impact on nuclear energy construction costs and schedules. The project consists of two phases: Phase 1: Detailed Design and Phase: 2 Demonstration.

### 2.1 Phase 1: Detailed Design

In this phase, GEH worked to develop a detailed, site-specific design package sufficient for constructing a reactor containment building, including identifying any needed subcontracts, permits, and approvals.

The detailed design also included scoping estimates and activities for constructing a demonstration containment building, as well as testing, demonstrating, and decommissioning the Demonstration Site.

### 2.2 Phase 2: Demonstration

If awarded, this phase would include reactor containment building construction, testing, and (potentially) decommissioning activities. In this phase, GEH will carry out all construction, testing, and decommissioning activities, including:

- Construction of the Demonstration System – As part of the construction demonstration, a detailed accounting of costs, activities, lessons learned, and operational savings—if

applicable—shall be provided. A construction report detailing the construction process—along with any associated innovations and cost savings and the benefits thereof—shall be developed.

- Testing Activities – The objective of the construction demonstration is to ultimately develop systems and technologies to support the nuclear construction industry. To this end, demonstration and testing activities shall be performed to prove to regulators and the construction industry that such activities are applicable in the nuclear construction industry. Essential to the demonstration is the participation of regulators and/or standards organizations on the demonstration design and testing.
- Decommissioning Activities – The Demonstration Site shall be placed in a decommissioned state acceptable to the construction location owner.

# 3. TEAM FORMATION AND COLLABORATION

A project team was formed—consisting of experts from various disciplines—and included staff from GE Hitachi, NRIC, the U.S. Nuclear Regulatory Commission (NRC), and various subcontractors. Communication channels were established to facilitate collaboration, ensuring that everyone remained informed as well as aligned with the project vision.

# 4. DESIGN ACTIVITIES

The management team dedicated considerable effort to collaborating with GE Hitachi and overseeing the design activities for the construction technologies being developed/designed. Research was conducted to evaluate the feasibility and benefits of each technology prior to incorporating it into the demonstration plan.

## 4.1 Design Reviews

NRIC participated in design reviews throughout various stages of the project. During the Phase 1 90% Design Review completed by the ACTI project in March 2022, potential stakeholders recommended design changes to better support the first users of the building techniques, and those design optimizations are now being evaluated in terms of cost/schedule impacts. During the review, the updated Construction Plan, Demonstration Testing Plan, and Decommissioning Plan were presented. As part of the review, the list of expected permits, impact assessments, and needed reviews/approvals were submitted to NRIC. A video of the mini digital twin design was completed for the Phase 1 90% design review. The digital twin design was led by the University of North Carolina at Charlotte, and the team consisted of staff from the Electric Power Research Institute, the Nuclear Advanced Manufacturing Research Center in the United Kingdom, and Purdue University. In its Bowen Laboratory, Purdue University conducted stress and strength testing of the Steel Bricks™ system. The NRC rotational candidate presented an overview of NRIC to the NRC Commissioners, focusing on his work dedicated to the ACTI project.

# 5. STEEL COMPOSITE SPECIMEN TESTING

At Purdue University, the project team completed performance testing of the prototype Steel Bricks™. Various stakeholders—including representatives from NRIC, NRC, and the Canadian Nuclear Safety Commission—attended the testing.

Steel composite walling systems will be used in the demonstration portion of the project. Testing of the Steel Bricks™ was carried out to confirm their performance under design-basis and beyond-design-basis loading conditions. Fourteen Steel Bricks™ scaled prototype specimens were constructed and tested under various loading conditions (e.g., out-of-plane shear, bi-axial tension, in-plane shear, in-plane + out-of-plane shear, and missile impact testing) relevant to containment (i.e., pressure-retaining) and non-containment applications.

All the prototype tests were completed successfully. In all the testing scenarios and under all the various loading conditions, the performance of the specimens met or exceeded the design criteria. Test results confirm the conservatism and applicability of the design equations used.

The Steel Bricks™ will help facilitate deployment of future reactors by allowing small modular reactor developers to prefabricate their reactor containment structures, thus saving time and money during the design and construction phases of the reactor development process.

# 6. PERFORMANCE TRACKING AND REPORTING

Performance tracking and reporting for the ACTI project involved systematic monitoring and the transparent communication of milestones, key metrics, and progress indicators. This process encompassed the defining of relevant performance metrics aligned with project goals; setting up regular reporting intervals; and collecting accurate, up-to-date design progress, project schedule, and cost management data. These data were then analyzed to assess deviations from the plan, identify potential setbacks, and foster informed decision making. The resulting insights were communicated via monthly progress reports that highlighted any achievements, challenges, and future outlooks. Thus, this performance tracking and reporting ensured that stakeholders remained well informed of the project's progress.

# 7. CONTRACT MANAGEMENT

Effective contract management has been critical in ensuring the ACTI project's success, and has encompassed clearly defining the contract scope, contract negotiations, awarding and execution of the contract, performance monitoring, change management, risk mitigation, quality assurance, and compliance enforcement. These activities ensured effective collaboration between GEH and NRIC. Eight change requests to the contract were received, reviewed, and either approved and incorporated or otherwise rejected.

## 7.1 Cost Management

Project financial tracking and reporting for the ACTI project involved oversight of financial resources and transparent communication of budgetary information. This process encompassed setting a detailed budget plan that accounted for various activities of the project, along with associated expenditures. Regular tracking of actual spending against the budget was conducted, with a focus on identifying any variances and determining their underlying causes. These data were then presented monthly, detailing budget utilization. Customer invoices were also reviewed, scrutinized, and approved by the appropriate project personnel. By maintaining a financial tracking and reporting system, the project ensured effective cost control and alignment with financial goals.

## 7.2 Change Management:

The dynamic nature of the ACTI project necessitated that a change management process exist within contracts. All scope, schedule, or requirement changes were documented, evaluated for impact, and formally approved. This ensured that modifications were made with a clear understanding of their implications on the project outcomes and budget. Any scope deviations made by GEH without requesting formal permission from NRIC resulted in a rejected funding increase request. After these rejections, it was reiterated to GEH that all scope deviations must be formally requested via a change request, and that permission is only granted via approval of the request.

# 8. PROJECT MANAGEMENT

Management activities for the ACTI project revolved around collaborating with private industry to foster integration of the new technologies into the nuclear construction industry. These activities encompassed defining clear project objectives, assembling cross-functional teams in possession of diverse ranges of expertise, establishing efficient communication channels, allocating resources, closely monitoring project progress, managing potential risks, adapting to change, management reporting, and ensuring stakeholder engagement. Both internal (NRIC only) and external (with GEH and NRC) weekly meetings were held to ensure adequate communication of project status, assign action items, and resolve identified issues.

# 9. CHALLENGES ENCOUNTERED

Though the ACTI project achieved notable progress, certain challenges were encountered along the way. The most notable hurdles included GEH changing the scope mid-project, without formally notifying NRIC. This caused significant schedule delays and budget overruns, for which GEH is now liable.

# 10. FUTURE OUTLOOK

Looking ahead, the management team is committed to building on the ACTI project's progress. GEH has committed to fixing communication issues, involving NRIC in more of the necessary decision making, and ensuring successful execution of Phase 2.

# 11. CONCLUSION

The ACTI project has thus far been successful in demonstrating the robust design and performance of concrete steel composites and verifying the benefits they hold for the nuclear construction industry. Issues were encountered throughout Phase 1 of the project, but corrective actions have been taken to ensure the success of Phase 2. As the project moves forward, the team remains committed to innovation and excellence, ensuring that the nuclear construction industry continues to evolve and adapt to future challenges.

## Year Summary for ACTI:

**October 2022:**
Compile information for the Year End Summary.

**November 2022:**
Issues related to fabricating the prototype delayed the ACTI project by 60 days and will affect the milestones covered in this work package.

**December 2022:**
The 75% Design Review was held. The projected monitored costs, deliverables, and schedule for the ACTI project.

**January 2023:**
NRIC received a Davis Bacon Record Decision of "Non-Covered" for Phase 2 of the ACTI project. The ACTI project scope of work was updated in terms of the Phase 2 deliverables and to support development of the Phase 2 contract and proposal. The NRIC Technical Program Manager supported GEH in developing the Phase 2 proposal, along with monitoring the project cost and schedule.

**February 2023:**
Reviewed documents to be presented at the ACTI Phase 1 Design Review.

**March 2023:**
Work during March focused on contract negotiations, the compiling of presentation-related content, and the definition of the project scope of work.

**April 2023:**
Work during April focused on the preparation of presentations to be given at the NRIC program review. Work also focused on the transition to a new project manager.

**May 2023:**
Completed the NRIC program review and the transition to the new project manager. No additional accomplishments, due to additional GEH delays in determining the optimal configuration for demonstration.

**June 2023:**
The project was further delayed by GE Hitachi switching to a new modular walling design, Diaphragm Plate Steel Composite. GE Hitachi made progress on becoming more current with their subcontractor invoices.

**July 2023:**
The project continues to be delayed by GE Hitachi switching to Diaphragm Plate Steel Composite. GE Hitachi made progress on becoming more current with their subcontractor invoices. GE Hitachi is developing several estimates at different funding levels in order to better understand best path forward for Phase 2.