Integral and Separate Effects Test Program for the Investigation and Validation of Passive Safety System Performance of SMR-160

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Program: First of a Kind Nuclear Demonstration Readiness Projects

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ABSTRACT:

SMR, LLC is developing an innovative Small Modular Reactor called the SMR-160 that will provide 160 MW(e) of safe, dependable, carbon-free power to global energy markets, while creating thousands of well-paying U.S. engineering and manufacturing jobs, growing this nation's economy and supporting the revitalization of Camden, NJ. The SMR-160 is designed for unconditional safety and represents a product solution optimized for security, minimum land use, affordability, and utilization of diverse passive safety features. Planned for operation by 2026, the SMR-160 offers an innovative next-generation solution for advancing safe and competitive commercial nuclear power both in the United States and worldwide. SMR, LLC has over six (6) years of direct reactor facility design experience, supported by world-class organizations in the nuclear industry that have been providing experience and expertise in design, licensing, construction, commissioning, and operations. Decades of this design experience is being made available to insure the success of this project.

SMR, LLC's proposed project will yield a uniquely configurable set of testing platforms to demonstrate SMR passive safety system performance, accelerate the SMR-160 and other SMR designs to market, and help license these designs with the U.S. NRC and international regulators. Multi-purposed and flexible by design, the planned test platforms will provide significant benefit to other advanced reactors employing passive and natural-circulation concepts. In coordination with expert collaborators, this project will produce a database of experimental data for direct application to validation of the SMR-160 power plant primary and safety systems, and with extensible application to other natural circulation light water reactor designers. Industry will directly benefit through the resulting extension of these phenomenological databases necessary to validate system concepts and increase confidence in the system analysis codes used throughout plant design. These are the principal objectives for the proposed project:

(1) Identify and develop required experimental benchmarks for key phenomenological data as part of a CSAU methodology. This data will support validation of safety analysis system codes for design and licensing and confirm the performance of natural-circulation based passive systems.

(2) Compare RELAP5-3D (Reactor Excursion and Leak Analysis Program) and GE Hitachi's TRACG[1] codes for analysis of natural circulation concepts. For SMR-160, the proprietary TRACG code will be utilized for plant licensing, while the RELAP5-3D code is available to most advanced reactor developers and is more commonly used throughout design. Code comparisons will assess the applicability and accuracy of each code for advanced reactors, particularly for natural-circulation concepts, and provide for better quantification of design uncertainties.

[1] GEH Nuclear Energy Report NEDE-32176P, Revision 4, *TRACG Model Description,* January 2008.

(3) Provide initial and on-going thermal-hydraulic experimental benchmark data to support development of the RELAP7 nuclear reactor system safety analysis code as part of INL's MOOSE (Multi-Physics Object-Oriented Simulation Environment) framework.

(4) Provide flexible, multi-purposed experimental platforms for next generation natural-circulation reactor concepts, instrumentation development, human factors engineering, and advanced instrumentation and controls, and extension to key phenomenological experimental databases. As a first application, these platforms will support the acceleration of SMR-160 design finalization.

Work will be performed by four major participants, each providing unique expertise and capability. SMR, LLC is responsible for project integration, RELAP5-3D evaluation model development, and design and implementation of test platforms. Idaho National Laboratory is responsible for leading PIRT activities, scaling analysis, test selection, and RELAP-based code evaluations. Global Nuclear Fuels, affiliate of GE Hitachi, is responsible for TRACG-based code evaluations, and supporting PIRT activities, scaling analysis, and test selection. Mitsubishi Electric Corporation is responsible for plant simulator development. The project is proposed to be completed in four phases over three years, commencing with test selection and progressing through design and fabrication of test platforms, commissioning, and finally execution of planned tests. The proposed project is a critical part of the overall roadmap for deployment of SMR-160 small modular reactors, supporting an essential element of plant licensing for system performance and computer code validation, as depicted in Figure 1.

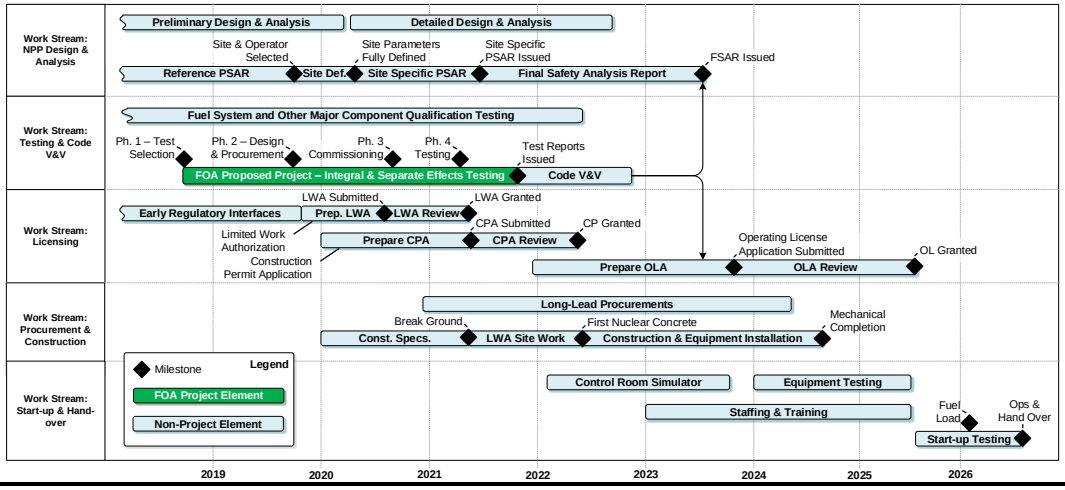

Figure 1 - SMR-160 Roadmap for Commercialization

The resulting test platforms established through this project are intended to be re-configurable with respect to instrumentation, major component scaling, and operating conditions, providing long-term use benefits as a state-of-the-art light water reactor test facility. Foremost, this project addresses a common challenge associated with new and advanced reactor technologies – the ability to demonstrate a validated basis for safety analysis without extensive operating history. For the SMR-160, this is achieved by expanding the validation envelope of GE Hitachi's TRACG code, which is part of the GESTAR licensing methodology. As important, through benchmark to analogous codes and experimental data, the capability and applicability of RELAP5-3D can be significantly expanded in support of other advanced reactors and the industry at large, while accelerating deployment of the next-generation simulation tool RELAP7. Other long-term benefits of the project are significant, with the facility providing a flexible vehicle for testing of concepts, hardware, and codes for the next generation of reactors and other industry initiatives.