FY 2022 January Status

SOLVING ENERGY CHALLENGES THROUGH SCIENCE

Versatile Test Reactor

Project Highlights

Thomas Fanning, Program Overview

Although the funding future for VTR has not gained clarity, the Project continues to execute technical work scope, mostly focused within the national laboratories. The Project is currently planning work scope through the end of Fiscal Year (FY) 2022 focused on 1) core, fuel, and safety, 2) Geotech investigation, and 3) specific experiment capabilities. Once the Blanket Master Contract (BMC) is signed with the Engineering, Procurement, and Construction (EPC) subcontractor and funding is received, work will also pick back up with the design and engineering.

Six topics of collaboration between the United States (US) Department of Energy (DOE) and Commissariat à l'Énergie Atomique et aux Énergies Alternatives (CEA) were previously identified, and two topics between the two agencies were approved. The remaining four topics have been approved by DOE's Office of Nuclear Energy (NE) and have been submitted for review by the Office of International Affairs before being sent to the State Department for approval.

Five milestones were completed, concluding the planned scope for the first four months of FY 2022. The milestones include a report on the VTR fuel manufacturing process, a summary of the Licensing Modernization Project (LMP) approach for the VTR, a status report on full-length assembly fabrication and testing in the PELICAN loop, updated safety analyses based on late FY 2021 design decisions, and the first draft of a manual for the updated SPCA-ANL sodium fire analysis code. Additional details are provided in the technical highlights.

Periods of performance for contracts between Battelle Energy Alliance (BEA) and the other partner National Laboratories have been extended to the end of FY 2022 to facilitate ongoing work. VTR work packages are being updated through budget change proposals (BCPs) to schedule work for the remainder of FY 2022 assuming continued funding with a flat budget. Work packages will include placeholders for work commencing under the EPC contract.

The Fuel Design and Fabrication Strategy and Technical Review meeting is scheduled for February 22 and 23. The two-day meeting will provide a detailed overview of the fuel manufacturing process, priorities, and major focus areas to support site selection and schedule requirements.

Nuclear Design

The VTR Fuel Design and Analysis team continued VTR fuel analysis tasks and X521 U-Pu-Zr-Ga characterization. Results of transmission electron microscopy (TEM) examination of irradiated U-Pu-Zr-Ga are being compared to those of unirradiated diffusion couples. Unirradiated X521 U-Pu-ZrGa archive samples will be retrieved for examination to further assess how much Zr might be pulled from solid solution due to Ga interaction and to assess associated impact on solidus (melting) temperature. Tasks to be added under further continuing resolution funds were considered.

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VTR Plant Engineering

Site preparation for the VTR geotechnical investigation continued at the Materials and Fuels Complex (MFC). The geotechnical investigation is scheduled to start field work in spring/summer 2022. Site preparation includes clearing and grubbing of the existing surface area to support drilling and test pit excavation and the installation of a power supply for the subcontractor's site mobilization trailers.

VTR Experiments

VTR experiments development continued planning work during FY 2022 continuing resolution, and work continued with the universities for student support. Additional details are provided in the technical highlights.

Upcoming Events:

VTR Fuel Design and Fabrication – Strategy and Technical Review Meeting, February 22 – 23, 2022 (Virtual)

NURETH-19, 19th International Meeting on Nuclear Reactor Thermal Hydraulics, March 2022, Brussels, Belgium (Virtual conference)

Atlantic Council Workshop, March 14, 2022 (Washington, DC)

IAEA International Conference on Fast Reactors and Related Fuel Cycles (FR22), April 2022, Vienna, Austria

Social Media

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Technical Highlights

Sal Mascareñas, Reactor Technical Integration

Design Engineering Support

Continued site preparation for the VTR geotechnical investigation at MFC, with field work scheduled to begin in spring/summer 2022. Site preparation includes clearing and grubbing of the existing surface area to support drilling and test pit excavation and the installation of a power supply for the subcontractor's site mobilization trailers.

Continued working to establish an export license with the operators of the Dounreay plant in the United Kingdom. The license is intended to allow access to fuel handling equipment information to learn about the design and operation of the Dounreay systems to inform the VTR systems design.

Thomas Fanning, Nuclear Technical Integration

Fuel Design and Analysis

Continued VTR fuel analysis tasks and X521 U-Pu-Zr-Ga characterization. Results of transmission electron microscopy (TEM) examination of irradiated U-Pu-Zr-Ga are being compared to those of unirradiated diffusion couples. Unirradiated X521 U-Pu-ZrGa archive samples will be retrieved for examination to further assess how much Zr might be pulled from solid solution due to Ga interaction and to assess associated impact on solidus (melting) temperature. Tasks to be added under further continuing resolution funds were considered.

Fuel Manufacturing

Issued a comprehensive fuel manufacturing status and summary report, which fulfills the associated milestone. Issued a scrap processing report evaluating options to configure MFC facilities to accommodate an updated scrap processing system design originally scoped for Savannah River National Laboratory (SRNL) siting. Released a review draft of another report, examining various options for the fuel manufacturing scrap waste form and disposal options, in consultation with Waste Isolation Pilot Plant (WIPP) subject matter experts (SMEs). Made substantial progress in evaluating a new scenario for the manufacturing process model, completing a full set of model inputs and assumptions for a Savannah River Site-sited fuel manufacturing process, with model results and an accompanying report expected in February. Issued a Functional and Operational Requirements (F&OR) document for the rod loading and welding glovebox. Developed a draft scope description for FY 2022 under a full-year continuing resolution (CR) funding scenario.

Core Design

A prototypic fuel bundle and all other components internal to the hex-duct have been successfully inserted and secured inside the hex duct sections for the Pressure Drop Experimental Loop for Investigations of Core Assemblies in Advanced Nuclear Reactors (PELICAN) test loop. Through this process, it was identified that tolerances and clearances included as part of the VTR assembly computer-aided design (CAD) drawings may be too tight and can lead to difficulties fitting the bundle inside the duct. These observations will be documented.

Continued hardware procurement for the REDuced Scale Hydraulic Inlet Plenum (REDSHIP) experiment with a focus on identifying viable manufacturers for the test section of the experiment. However, procurements will not be placed without clarity of FY 2022 funding.

Safety Analysis

Completed development of the new electromagnetic (EM) pump component model in SAS4A/SASSYS-1. The development includes updates to the SAS4A/SASSYS-1 User Guide and Theory Manual and will be included in SAS4A/SASSYS-1 Version 5.5. Completed an update to the VTR safety analysis which incorporates changes and refinements to the secondary heat transport system and use of the new EM pump model. This work provides analysis of protected and unprotected versions of the transient overpower, loss of heat sink (LOHS), and station blackout (SBO) transients as well as additional transient scenarios analyzed in support of VTR probabilistic risk analysis (PRA) and design activities. Drafted a report describing results of improvements to the coupling between SAS4A/SASSYS-1 and computational fluid dynamics (CFD) codes to better support pausing and restarting long-running simulations needed to assess protected loss of flow transients. Results reported with the updated version of the code confirm that the coupling is robust across restarts.

Sodium Fire Hazard Analysis and Software Verification & Validation (V&V)

Completed an initial draft of a user's manual for the Spray Pool Combustion Analysis (SPCA)-ANL sodium fire analysis code to fulfill the associated milestone. Conducted sensitivity analyses using (SPCA)-ANL to determine the relative importance of certain factors on simulation results. Investigated flame and sodium emissivity for simulated pool fire tests. This effort is being used to identify priorities for future work scope.

Probabilistic Risk Assessment/Safety Basis/Licensing Modernization Project (LMP)

Finalized and submitted for review INL/RPT-22-65633, *Utilization of the LMP Methodology in Support of the VTR Conceptual Safety Design Report*, which documents the Licensing Modernization Project (LMP) process utilized for development of Conceptual Safety Design Report (CSDR) inputs. This report closed milestone "Summary of VTR LMP Approach." Once reviews are complete, the report will be publicly released to aid the advanced reactor industry in the use of the LMP process to support licensing submissions. Continued validation efforts of the simplified radionuclide transport (SRT) mechanistic source term code with a new assessment of the bubble transport models based on Japanese experimental data obtained by the US as part of the bilateral Civil Nuclear Energy Research and Development Working Group (CNWG) agreement. Results of the validation efforts are being added to the SRT validation documents. Developed potential activities for FY 2022, focusing on tasks to position the project to quickly resume risk-informed, performance-based activities.

Kevan Weaver, Experiments Technical Integration

Continued The VTR experiments development area continued to plan for the FY22 continuing resolution, and work continued with the universities for student support. Highlights from work performed by North Carolina State University are shown below.

Activities at North Carolina State University include digital engineering (DE), building information management (BIM), and virtual design and construction (VDC) activities. Researcher work included interoperability solution demonstration using VTR models (structural & piping), building-piping-equipment analysis, and integration of this solution with Deep Lynx.