INL/RPT-22-66765-Revision-0

March 2022 Monthly Status Report for the Versatile Test Reactor

April 2022

Thomas Fanning

Changing the World's Energy Future

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Prepared for the
U.S. Department of Energy
Under DOE Idaho Operations Office
Contract DE-AC07-05ID14517

FY 2022 March Status

SOLVING ENERGY CHALLENGES THROUGH SCIENCE

Versatile Test Reactor

Project Highlights

Tom O'Connor, Federal Program Director

On March 15, 2022, President Biden signed into law: H.R. 2471, the "Consolidated Appropriations Act, 2022," which provides full-year funding through September 30, 2022, for projects and activities of the Federal Government. Unfortunately, no funding was provided for VTR, which is especially disappointing noting that the Energy Act of 2020, passed with the Consolidated Appropriations Act, 2021, fully authorized VTR.

VTR remains a critically needed nuclear energy research and development infrastructure capability for long-term innovation and global U.S. leadership of advanced nuclear energy technology. Current world events reinforce the realization that we cannot rely on international testing, or even high assay low enriched uranium. To regain needed momentum, President Biden's Fiscal Year (FY) 2023 request included $45 million for VTR. We look forward to working with Congress over the next few months to ensure adequate funding for this important program is included in the House and Senate marks and ultimately into the final FY 2023 appropriation.

In the meantime, we will continue working to issue the VTR Final Environmental Impact Statement, finalize the blanket master contract with the Bechtel National Inc. team and conduct other administrative actions to ensure that we are ready to move out smartly in FY 2023, noting that previously achieved critical decision milestones will not need to be revisited. Highest priority actions for FY 2023 will be focused on fuel feedstock supply and fabrication facility studies, site geological surveys, the performance of limited scope component risk reduction studies, including prototyping and testing, and identifying potential coordination opportunities with TerraPower's Natrium project.

As I have stated before, I am extremely disappointed in where we are today, a fact made even more frustrating by the great work this team has accomplished. I am confident that VTR funding will be restored, so I ask you rest up and stay well so that we can continue accomplishing great things together this Fall.

Kemal Pasamehmetoglu, Executive Director

With no new FY 2022 funding, the project initiated completion of all hold and restart documentation. The goal is to bring all on-going activities to a reasonable stopping point and archive all work in an easily retrievable way by the end of April 2022. All FY 2022 activities, including graduate student expenses under the Experiments Technical Integration scope, will be covered by uncosted funds carried over from prior year funding.

This is the final monthly report for the VTR project in FY 2022.

Thomas Fanning, Program Overview

Despite the recently completed budget change proposal (BCP) defining an updated schedule for the remainder of FY 2022, the project will move into a temporary hold phase until FY 2023 appropriations are provided. Initiation of new work has been canceled, and in-process activities will be quickly ramped down in a manner that preserves and archives the work completed to date.

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Versatile Test Reactor

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Technical Highlights

Sal Mascareñas, Reactor Technical Integration

Design Engineering Support

Prepared to perform clearing and grubbing activities, but work was put on hold due to the lack of FY 2022 funding. Prior to work being placed on hold, a draft work specification was created for the geotechnical scope which identified a licensed engineer to update and sign off on changes. The bore location drawing was being formally implemented in the Idaho National Laboratory (INL) Document Change Request (DCR) system but was placed on hold.

Obtained final signatures on an export license agreement between the United Kingdom Nuclear Decommissioning Authority (NDA) and DOE regarding access to documents and information pertaining to fuel transfer technology used at Dounreay.

Thomas Fanning, Nuclear Technical Integration

Fuel Design and Analysis

Identified and prioritized project hold scope for collaborating laboratories. Data analysis work on X521 irradiated sample transmission electron microscopy (TEM) characterization will be postponed. Final documents will be collected, project files consolidated, and publications already through review will be completed. Prepared plans to return special nuclear materials from characterization facilities to storage and to disposition characterization waste. Finalized a Ga assessment report, which will feed into follow-on manuscripts publishing the work, and prepared journal article outlines for Ga fuel characterization and modeling.

Finalized three documents: “Metallic Fuel Performance Benchmarks for Versatile Test Reactor Applications” for the special edition of *Nuclear Science and Engineering;* a VTR BISON repository report documenting the approach to code and input file control and distribution; and a report on thermomechanical assessment of VTR driver fuel utilization to high burnup (up to 20% FIMA).

Fuel Manufacturing

Began building fuel manufacturing equipment prototypes to start FY 2022 testing, including submitting models and design documents to the drafting team for final designs and submitting other final designs to fabrication shops, but efforts were quickly suspended due to the lack of FY 2022 funding. Finalized design documents,

including design information for the rod loader and the slug processor, migrated them to the VTR Confluence site, and updated the associated hold forms. Addressed all comments from the fresh fuel waste form and options report non-technical reviews and expect the report to be archived in early April.

Core Design

Accelerated the Pressure Drop Experimental Loop for Investigations of Core Assemblies in Advanced Nuclear Reactors (PELICAN) experiment for full-scale assembly testing to complete current tests in April. Focused the experimental campaign on full-length assembly testing under the most stringent flow conditions. Defined the list of measurements to be acquired and measurements are proceeding. This will allow reconstructing the entire axial pressure distribution profile, which in turn will allow calculating the loss coefficient for each axial region of the assembly. Running computational fluid dynamics (CFD) in parallel to generate numerical results to compare the experimental result in addition to using analytical models to establish a baseline using simplified models. The intent is to document this major achievement in a report, which will demonstrate the full potential of the PELICAN experiment for the VTR. Eliminated incremental tests for each subsection but would need to be performed after the VTR project resumes.

The REDuced Scale Hydraulic Inlet Plenum (REDSHIP) experiment had started into its procurement phase. All procurement items relative to REDSHIP have been either completed or cancelled this month. Received hardware was tagged and stored for potential use after the VTR project resumes.

Paused development of the OTTER code in its current, working demonstration state. Drafted the supporting manual and primer documents and finalized a suite of test cases to provide verification of the currently available functions. The intent is to place OTTER in a state that will make it easy to pick up and continue its development through other projects or after the VTR project resumes.

Finalized papers for the VTR special issue of *Nuclear Science and Engineering* and sent final proofs to the editor. Brought all other activities relative to the VTR core design to a stop, with draft reports being reviewed before archiving.

Safety Analysis

Began activities defined for the remainder of FY 2022 but shifted focus to pause and archive all activities. Specifically addressed remaining tickets in the VTR safety modeling and analysis repository to complete in-progress activities. One final modeling ticket remains to bring the model into compliance with the latest release version of SAS4A/SASSYS-1 rather than the beta version used for the previous safety analysis.

Submitted the final version of “Overview of the Versatile Test Reactor Safety Analysis,” to the FR22 conference and completed final revisions to the *Nuclear Science and Engineering* journal article “Modeling of Safety Basis Events in the VTR.” Presented “Development of equivalent circuit model for electromagnetic pump simulation in SAS4A/SASSYS-1” at the 19th International Topical Meeting on Nuclear Reactor Thermal Hydraulics (NURETH-19) Conference.

Safety Basis

Validation efforts for the Simplified Radionuclide Transport (SRT) source term analysis code should be complete by the end of April. Revisions to the code documentation align with modifications to the bubble transport and

uncertainty analysis functions of the code. Changes were made based on lessons learned from validation exercises. An update to the code vaporization function is also being implemented and documentation changes made as part of an improvement to the associated thermodynamic database.

Directed efforts to complete current work on SPCA-ANL by the end of April, including software updates, verification activities, and updates to the user's manual to address known issues.

Published journal article, "Development of Sodium Fire Analysis Code Capabilities for Versatile Test Reactor" for the special issue of *Nuclear Science and Engineering*. An additional article on the development and utilization of the VTR conceptual design probabilistic risk assessment (PRA) will also be published

Kevan Weaver, Experiments Technical Integration

University students will complete their work throughout the remainder of the academic/fiscal year, and a book of abstracts will be issued in August. "The Proper Orthogonal Decomposition Analysis of Flow Structures Downstream of Sudden Expansion" is being completed for a Texas A&M PhD thesis.