Proposed RES Activity Support for FY17

Neutronics and Kinetics

Work in the area of neutronics and kinetics will be limited due to the available contract support. Progress in both gas-cooled and sodium fast reactors can be made through the continuation of currently active projects and in-house work:

2.3a Develop fine group library and group structure that is applicable to Sodium Cooled Fast Reactors. This task will depend on running the AMPX nuclear data system for U.S. data (ENDF) and integrating the library fully within SCALE so that it can be called by the relevant sequences (TRITON/NEWT and TRITON/Shift)

2.3b Upgrade PARCS so that it can take as input cross section partial derivatives with respect to core geometric expansions (axial and radial). These partial derivative changes would account for gross core dimensional changes. This effort would include coding, testing, and documentation.

Projected Resources: [ ]

Fuel Performance

Work in the area of fuel performance limited due to the preliminary nature of fuel products intended for new reactors, and due to limited experience level with in house staff. Efforts in FY17 will seek to increase the knowledge level of in-house staff, and to assist in selection of appropriate tools for future fuel analysis and code development.

Revised scope for FY17:

1. (Element of 2.8c, 2.11c) Work with a contractor to modify FAST (FRAPCON/FRAPTRAN merged code) to decouple the physics from the numerical solution for ease of future changes, maintenance and implementation of new reactor physics and geometries. (Requires NEW contract and Ian P.)
2. (Element of 2.8b, 2.11b) Extract available material properties and correlations relevant to advanced reactor designs from DOE and other existing data sets (e.g., codes, summary reports) and implement into FAST. (Ian P.)
3. Develop a summary report for NRC staff on operating experience of HTGR and Sodium-Cooled Advanced Reactor technologies. The report would be either a set of slides from a seminar taught by a contractor, DOE or would be developed in-house (Michelle B. and Harold S.). The report would cover challenges, lessons learned, documentation of sources and safety demonstrations specific to the fuel, including:
    a. (2.7a, 2.10a) Fuel design, functional requirements and characteristics
    b. (2.10b) Knowledge of the relationship of fuel performance to thermal-fluid and plant perform
    c. (2.7b,2.10c) Identification of conceptual Anticipated Operational Occurrences, Design Basis Accident and Beyond Design Basis Accidents
    d. (2.7c,2.10d) Knowledge of the front and back-end of the fuel cycle strategy

e. Identify potential shortcomings in fuel performance code(s) due to the lack of experimental information and formulate a plan for future development.

Projected Resources: [ ]

Thermal-Hydraulics

Work in thermal-hydraulics is intended to identify a code or code suite suitable for analysis of each of the various design types. PIRT related efforts and code selection will be initiated (in conjunction with neutronics, fuel performance, and severe accident phenomena) in order to outline the necessary modeling capabilities and expected dominant physical processes.

Revised scope for FY17:

2-17a–rev: Review existing information on SFRs and identify to the extent possible the physical phenomena that are expected to be dominant in new designs. Identify accident scenarios of interest to licensing and outline necessary code capabilities for confirmatory analysis.

2-19a-rev: Review existing information on MSRs, both fixed fuel and liquid fuel, and identify to the extent possible the physical phenomena that are expected to be dominant in new designs. Identify accident scenarios of interest to licensing and outline necessary code capabilities for confirmatory analysis.

2-17b-rev: Review the available codes for GCR, SFR, and MSR analysis. Identify a preliminary code suite for each class of reactor design for confirmatory analysis of design basis events and anticipated operational occurrences considered likely for licensing. The code suite is to include the capabilities for neutronics, fuel performance, system thermal-hydraulics, subchannel analysis, and coolant chemistry as appropriate for each design class.

Projected Resources: [ ]

Severe Accident Phenomena

Work in severe accident phenomena is intended to identify a code or codes for analysis, and new phenomena to be considered. (PIRTs were developed for gas cooled reactors as part of NGNP and some this effort may be complete, so most effort will be on SFRs. MSR work will be limited, if any occurs at all, due to the preliminary nature of the designs and staff knowledge level.)

Revised Scope for FY17:

2.20b-rev: Review severe accident work performed for NGNP, and confirm that development planned for MELCOR should continue. Identify major development efforts for FY18 and FY19, and any new initiatives to ensure MELCOR is capable of GCR confirmatory analysis.

2.22a-rev: Review the capabilities of MELCOR and SIMMER for SFR confirmatory analysis for severe accidents. Select a code for future development, and identify models most necessary for the development efforts.

2.25a-rev: Review the capabilities of MELCOR for molten salt reactor analysis. Propose a preliminary plan for severe accident analysis of fixed core MSRs and liquid fuel MSRs.

Projected Resources: [ ]

Offsite Consequence Analysis

Offsite Consequence Analysis is an area that will be important as additional details on the various designs of advanced non-light-water reactors (LWRs) are presented to the staff for licensing reviews. Each reactor type and design could possibly have different design basis accident (DBA) and severe accident source terms compared to those for the current fleet of large LWRs. Offsite consequence analysis is also important given the expectation that advanced non-LWR applicants may seek relaxed emergency planning zone sizes and potentially other offsite capabilities.

2.60a: Investigate what previous work has been done in development of source terms for DBAs and severe accidents and characterize the range of potential offsite consequences for the different non-LWR technologies.

Projected Resources: [ ]

Materials Research

Work in materials is largely generic, and can proceed. Work proposed for FY17 (and FY18) that can be addressed are:

2.29a: Assess the performance needs and issues for structural materials to be used in non-LWRs, such as HTGR, SFR, and MSR. Including, for example, material behavior of concrete under sustained elevated temperatures (especially for HTGR designs) for structures in the proximity of the reactor vessel, and material performance and requirements for concrete-based reactor pressure vessels (HTGR designs) (temperature, pressure and radiation) Identify major materials issues related to non-LWRs. Adopt PIRT –like process.

2.29b: Identify the need for additional materials test data for developing confirmatory assessment tools.

2.30c: Assess existing regulatory guidance applicable to non- LWRs.

Projected Resources: [ ]

I&C

Instrumentation and Controls is an area that will become important as additional details on the various designs are presented to the staff. Each reactor type, assuming high temperature

operation may result in a harsh environment for instrumentation. Therefore, some initial work is warranted. For FY17 work to be limited to MSR application:

2.70a: Identify new instruments and actuators needed in advanced reactors but not used in LWRs. Identify issues of instruments and actuators in specific harsh environmental conditions in advanced reactors (non-LWRs). Adopt PIRT –like process. (Literature review, collaboration and information sharing with DOE/NE, vendors, international partners, contract support). Deliverable: Assessment Report

Projected Resources: [ ]

Human and Organizational Factors - - - - ON HOLD.

Non-LWRs are expected to take advantage of ongoing technological developments (e.g., advanced human-system interfaces (HSIs), portable devices, automation, remote operations) to support all operational phases (at power, shutdown, emergency) to reduce operating costs, increase efficiency, perform in new operational modes (e.g., flexible power) while ensuring safety and security.

2.70a: Investigate if previous work has been done in human performance for non-LWR designs

Projected Resources: [ ]

PRA

Probabilistic Risk Assessment needs a higher priority than originally considered based on comments from the technical experts and the December 2016 public meeting on advanced reactors. Some effort early on will be needed to help identify risk-significant accident scenarios and provide policy guidance. Work suggested for FY17:

2.80a: Investigate what previous work has been done in PRA for non-LWR designs

2.80b: Perform scoping study to understand if any work identified above can be used again or if gaps still exist

2.80c: Evaluate if new PRA policy will be needed to support non-LWR designs, including risk surrogates

2.80d: Identify any other relevant technological trends in PRA methods, models, tools, or data collection

2.80e: Identify guidance documents that would need to be updated to support the reviews

Projected Resources: [ ]

Internal & External Hazards - - - - ON HOLD

Internal and external hazards is an area that can be started in FY17 without contract resources. This will help the staff identify long range issues. For FY17:

2.90a: Investigate what previous work has been done in external hazards for non-LWR designs. (This will only be partly completed in FY17, with an additional [ ] staff-hours needed in FY18.)

Projected Resources: [ ]

FY17 Product

A progress report with multiple chapters. Each will summarize the efforts completed or underway in each of the functional areas for FY17. The report is to provide a broad overview of RES activity and reference any reports or documents produced as part of those efforts. (Some chapters may be empty at this point, but that will be to emphasize that the work is on hold pending additional funding or more specific design information.) Each should indicate high priority tasks for the following year(s), and note any emerging or significant technical challenges.

Resource Summary

Functional Area	Division	Estimated Staff-Hours	Estimated Contract $
Neutronics & Kinetics	DSA	[ ]	[ ]
Fuel Performance	DSA	[ ]	[ ]
Thermal-Hydraulics	DSA	[ ]	[ ]
Severe Accident Phenomena	DSA	[ ]	[ ]
Offsite Consequences	DSA	[ ]	[ ]
Materials Research	DE	[ ]	[ ]
Seismic and Structural Research	DE	[ ]	[ ]
Instrumentation & Controls	DE	[ ]	[ ]
Human and Organizational Factors	DRA	[ ]	[ ]
Probabilistic Risk Assessment	DRA	[ ]	[ ]
Internal & External Hazards	DRA	[ ]	[ ]
Total Projected Resources	RES	[ ]	[ ]