

Overview of IRP Project

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Project Objectives and Outcomes

- **Objective 1 –**

- A comprehensive evaluation of existing TREAT Facility neutronics data using the next generation reactor core neutronics codes. This will be performed in accordance with established guidelines per the International Handbook of Evaluated Reactor Physics Benchmark Experiments (IRPhEP).
- Yield a fully characterized reactor core with dynamic input and feedback from the U.S. Nuclear Regulatory Commission (NRC) (via advisory board member participation) which may be utilized to support the safety case for the TREAT Facility restart.

Project Objectives and Outcomes

- **Objective 2 –**

- A complete thermal hydraulic characterization of existing sodium loop experimental data will be performed and documented using American institute of Aerospace and Astronautics Association (AIAA) validation hierarchy paradigm.
- Result in a documented basis for developing future sodium flow loops to be utilized within the TREAT Facility; these bases will be created by the industry user that is planning on employing such flow loops within the TREAT Facility in the near future (TerraPower, LLC).

Project Objectives and Outcomes

- **Objective 3 –**

- The collection of and benchmarking against new experimental thermal hydraulic data of a representative TREAT Facility water flow loop using the six guiding principles of good validation experiments identified by Oberkampf.
- Produce a documented water flow loop design and demonstration that is representative of a prototypic configuration for the TREAT Facility to provide operational information and benchmarking data; and a fully benchmarked thermal hydraulic model of the water flow loop that may be utilized for future TREAT Facility water flow loop safety analyses.

Project Objectives and Outcomes

- **Objective 4 –**

- A comprehensive instrumentation plan for the TREAT Facility that objectively aligns with the technical and functional requirements resulting from accomplishing Objective 1 and supplemented by Objectives 2 and 3.
- A documented and demonstrated basis for the selection and arrangement of in-pile instruments within the TREAT Facility that satisfy the needs for both steady state and transient test conditions.

Project Task Outline

• Task 1 Status

Task ID [#]	Task Name	Year 1				Year 2				Year 3				Proposal Percent Complete	Actual Percent Complete
		Qtr 1	Qtr 2	Qtr 3	Qtr 4	Qtr 1	Qtr 2	Qtr 3	Qtr 4	Qtr 1	Qtr 2	Qtr 3	Qtr 4		
1	Neutronics Benchmark														
1.1	Steady State (SS)														
1.1.1	Survey candidate problems													100%	100%
1.1.2	Preliminary SS modeling of candidate problems													100%	100%
1.1.3	Down-select to two problems for benchmark evaluation	+												100%	100%
1.1.4	SS modeling with deterministic U.S. NRC codes PARCS/AGREE													100%	90%
1.1.5	SS modeling with deterministic NEAMS code PROTEUS													100%	90%
1.1.6	SS modeling with Monte Carlo code OPENMC													100%	100%
1.1.7	Comparison of experimental data & model results													100%	95%
1.1.8	Benchmark level evaluation of selected problems				+									100%	100%
1.1.9	Evaluation of uncertainties in selected problems													100%	100%
1.1.10	Preparation of IRPhEP documentation													100%	100%
1.1.11	Submission of SS benchmark for peer review					=								100%	100%
1.2	Transient (TR)														
1.2.1	Survey available TREAT TR data for benchmark problem													15%	15%
1.2.2	Preliminary TR modeling of candidate problems													15%	15%
1.2.3	Down-select to two problems for benchmark evaluation							+						5%	5%
1.2.4	Perform TR modeling with deterministic U.S. NRC codes PARCS/AGREE													0%	0%
1.2.5	Perform TR modeling with deterministic NEAMS code PROTEUS													0%	0%
1.2.6	Perform TR modeling with Monte Carlo code OPENMC													0%	0%
1.2.7	Benchmark level evaluation of selected problems										+			0%	0%
1.2.8	Evaluation of uncertainties in selected problems													0%	0%
1.2.9	Preparation of IRPhE Documentation													0%	0%
1.2.10	Submission of TR benchmark for peer review												=	0%	0%

Project Task Outline

• Task 2 Status

Task ID [#]	Task Name	Year 1				Year 2				Year 3				Proposal Percent Complete	Actual Percent Complete
		Qtr 1	Qtr 2	Qtr 3	Qtr 4	Qtr 1	Qtr 2	Qtr 3	Qtr 4	Qtr 1	Qtr 2	Qtr 3	Qtr 4		
2	Loop Thermal-Hydraulics														
2.1	Sodium Loop														
2.1.1	Survey literature of existing sodium test data	█												100%	100%
2.1.2	Select two candidate problems	█												100%	100%
2.1.3	Organize and document data for two candidate problems	█	=											100%	90%
2.1.4	Identify and review industry needs for sodium loop data		█	█										100%	100%
2.1.5	Down-select to one problem for benchmark evaluation			+										100%	100%
2.1.6	Preliminary modeling with industry tool Star CCM+			█	█	█	█							50%	5%
2.1.7	Preliminary modeling with NEAMS code Nek5000			█	█	█	█							50%	10%
2.1.8	Comparison of experimental data & model results for problem					█	█	+						5%	0%
2.1.9	Benchmark level evaluation of problem						█	█	█	█				0%	0%
2.1.10	Evaluation of uncertainties in selected problem								█	█				0%	0%
2.1.11	Submission of benchmark for peer review											=		0%	0%
2.2	Water Loop														
2.2.1	Identify and review industry needs for water loop	█												100%	100%
2.2.2	Develop loop technical and functional requirements	█	█											100%	100%
2.2.3	Loop design		█	+										100%	95%
2.2.4	Loop fabrication				█	█								50%	25%
2.2.5	Loop shakedown					█	█							5%	0%
2.2.6	Define flow loop 'operations tests' and 'benchmark tests'						█	+						5%	5%
2.2.7	Operations test conduct						█	█	█					0%	0%
2.2.8	Synthesis of operations tests data							█	█					0%	0%
2.2.9	Benchmark test conduct								█	█				0%	0%
2.2.10	Synthesis of benchmark test data								█	█				0%	0%
2.2.11	Modeling of benchmark test with U.S. NRC code TRACE					█	█	█	█	█				3%	10%
2.2.12	Modeling of benchmark test with RELAP5-3D					█	█	█	█	█				3%	10%
2.2.13	Comparison of experimental data & model results for problem										█			0%	0%
2.2.14	Benchmark level evaluation of problem										█			0%	0%
2.2.15	Evaluation of uncertainties in selected problem										█	█		0%	0%
2.2.16	Submission of benchmark for peer review												=	0%	0%

Project Task Outline

• Task 3 Status

Task ID [#]	Task Name	Year 1				Year 2				Year 3				Proposal Percent Complete	Actual Percent Complete
		Qtr 1	Qtr 2	Qtr 3	Qtr 4	Qtr 1	Qtr 2	Qtr 3	Qtr 4	Qtr 1	Qtr 2	Qtr 3	Qtr 4		
3	Core Instrumentation														
3.1	Instrumentation Plan														
3.1.1	Review TREAT core design and test plans	■												100%	100%
3.1.2	Identify core parameter monitoring needs	■												100%	100%
3.1.3	Determine applicable flux/measurement range	■												100%	100%
3.1.4	Select TREAT core instrumentation		■	+										100%	95%
3.1.5	Identify instrumentation calibration requirements		■	■										100%	95%
3.1.6	Develop TREAT core instrumentation plan			■	=									100%	100%
3.2	Initial Benchmark Evaluation														
3.2.1	Develop Benchmark experimental plan using the MITR				■									100%	90%
3.2.2	Select test instrumentation				■									100%	90%
3.2.3	Design test assembly for OSTR and MITR					■								15%	5%
3.2.4	Conduct experiment safety review and approval						■							0%	0%
3.2.5	Perform core analysis with MCODE					■	■							5%	10%
3.2.6	Assemble and test data acquisition systems						+	■						0%	0%
3.2.7	Perform steady-state experiments at MITR							■	■					0%	0%
3.2.8	Perform steady-state experiments at OSTR							■	■					0%	0%
3.2.9	Perform transient experiments at MITR								■	■				0%	0%
3.2.10	Perform transient experiments at OSTR									■	■			0%	0%
3.2.11	Analyze experimental data										■	■			
3.2.12	Evaluate core analysis and instrumentation measurement uncertainties										■	■			
3.2.13	Submission of detailed final instrumentation report											■	=		

Project Timeline

- **Neutronics Benchmarks**

- **Steady-State:** IRPhEP (Year 1)
- **Transient:** IRPhEP (Year 2 and 3)

- **Loop Thermal-Hydraulics**

- **Sodium Loop:** Benchmark (Year 1, 2 and 3)
- **Water Loop:** Experiment (Year 1, 2 and 3)

- **Core Instrumentation**

- **Instrumentation Plan:** Plan Draft (Year 1)
- **Initial Benchmark Evaluation:** Evaluation (Year 2 and 3)

Project Deliverables (Task Specific)

- **Neutronics Benchmark**

- Submit SS Benchmark for Peer Review
- Submit TR Benchmark for Peer Review

09/30/2016



09/30/2018

- **Loop Thermal-Hydraulics**

- Submit TH Sodium Loop Benchmark for Peer Review
- Submit TH Water Loop Benchmark for Peer Review

09/30/2018

09/30/2018

- **Core Instrumentation**

- Submit TREAT Core Instrumentation Plan Draft
- Submit Detailed Final Instrumentation Report

09/30/2016



09/30/2018

Thank You