Overview of IRP Project

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2015 INTEGRATED RESEARCH PROJECT BIANNUAL MEETING

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.

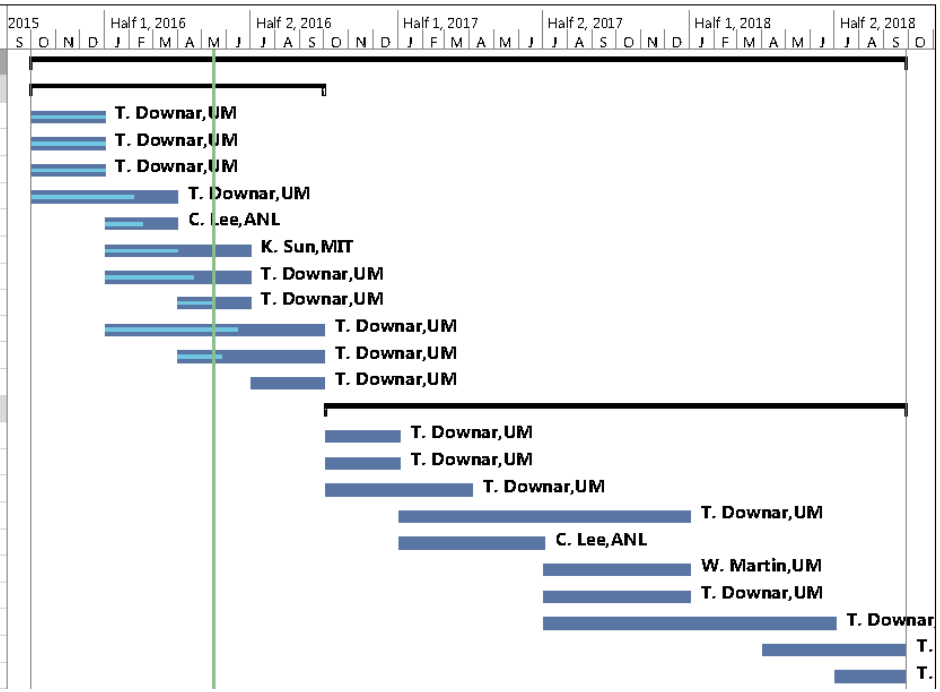
Project Objectives and Outcomes

- **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**

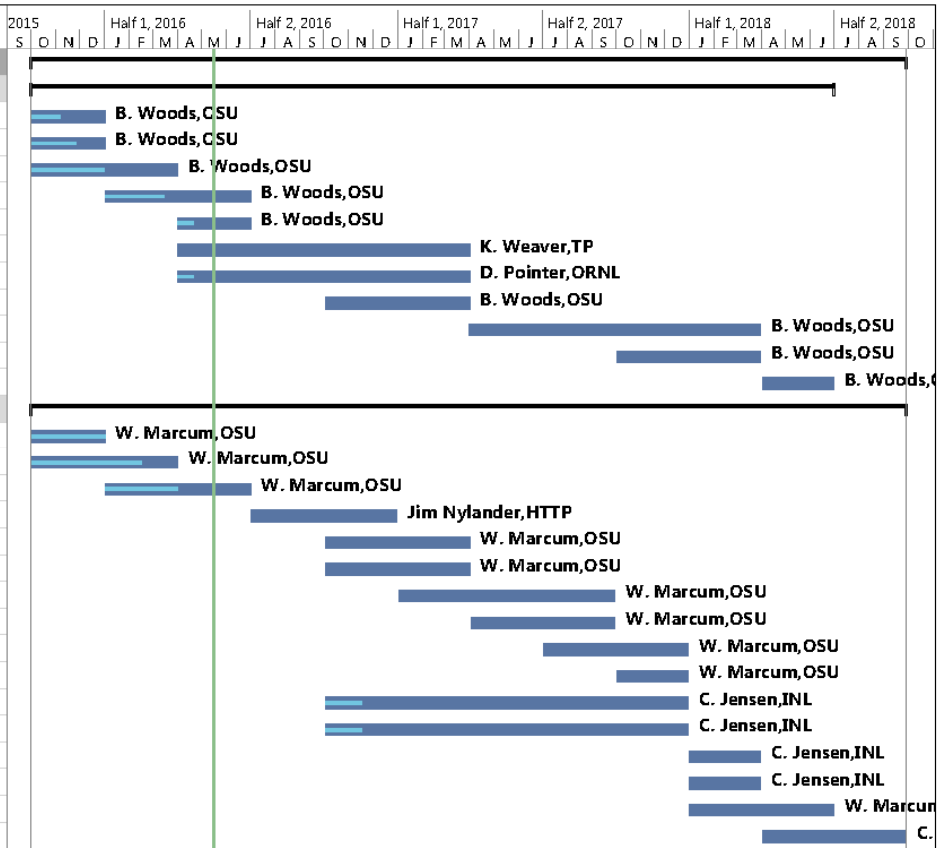
ID	Task Name
1	**1 Neutronics Benchmark Task Lead**
2	**1.1 Steady State (SS)**
3	1.1.1 Survey candidate problems
4	1.1.2 Preliminary SS modeling of candidate problems
5	1.1.3 Down-select to two problems for benchmark evaluation
6	1.1.4 SS modeling with deterministic U.S. NRC codes PARCS/AGREE
7	1.1.5 SS modeling with deterministic NEAMS code PROTEUS
8	1.1.6 SS modeling with Monte Carlo code OPENMC
9	1.1.7 Comparison of experimental data & model results
10	1.1.8 Benchmark level evaluation of selected problems
11	1.1.9 Evaluation of uncertainties in selected problems
12	1.1.10 Preparation of IRPhEP documentation
13	1.1.11 Submission of SS benchmark for peer review
14	**1.2 Transient (TR)**
15	1.2.1 Survey available TREAT TR data for benchmark problem
16	1.2.2 Preliminary TR modeling of candidate problems
17	1.2.3 Down-select to two problems for benchmark evaluation
18	1.2.4 Perform TR modeling with deterministic U.S. NRC codes PARCS/AGREE
19	1.2.5 Perform TR modeling with deterministic NEAMS code PROTEUS
20	1.2.6 Perform TR modeling with Monte Carlo code OPENMC
21	1.2.7 Benchmark level evaluation of selected problems
22	1.2.8 Evaluation of uncertainties in selected problems
23	1.2.9 Preparation of IRPhE Documentation
24	1.2.10 Submission of TR benchmark for peer review



Project Task Outline

- **Task 2 Status**

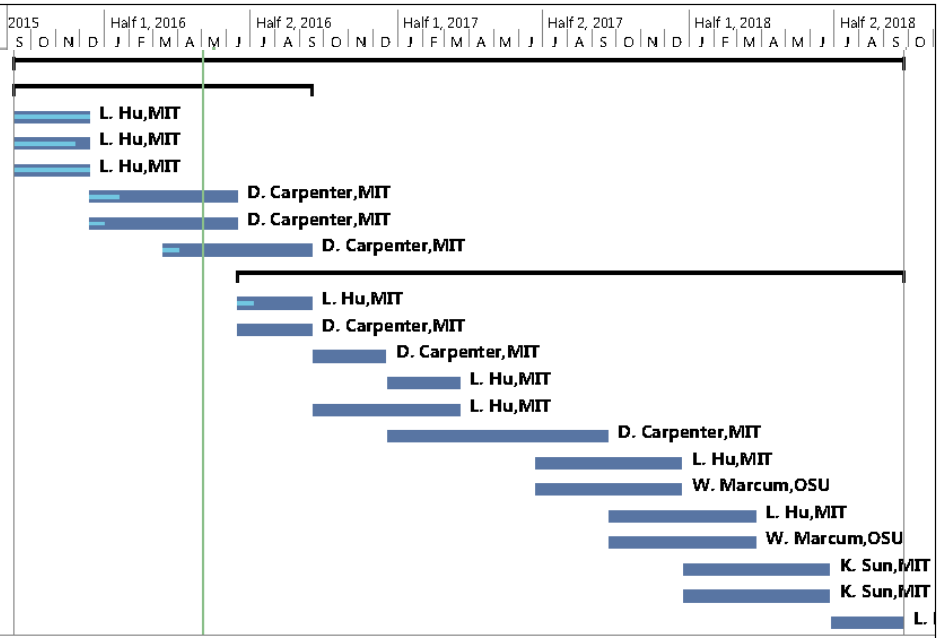
ID	Task Name
25	**2 Loop Thermal-Hydraulics Task Lead**
26	**2.1 Sodium Loop**
27	2.1.1 Survey literature of existing sodium test data
28	2.1.2 Select two candidate problems
29	2.1.3 Organize and document data for two candidate problems
30	2.1.4 Identify and review industry needs for sodium loop data
31	2.1.5 Down-select to one problem for benchmark evaluation
32	2.1.6 Preliminary modeling with industry tool Star CCM+
33	2.1.7 Preliminary modeling with NEAMS code Nek5000
34	2.1.8 Comparison of experimental data & model results for problem
35	2.1.9 Benchmark level evaluation of problem
36	2.1.10 Evaluation of uncertainties in selected problem
37	2.1.11 Submission of benchmark for peer review
38	**2.2 Water Loop**
39	2.2.1 Identify and review industry needs for water loop
40	2.2.2 Develop loop technical and functional requirements
41	2.2.3 Loop design
42	2.2.4 Loop fabrication
43	2.2.5 Loop shakedown
44	2.2.6 Define flow loop 'operations tests' and 'benchmark tests'
45	2.2.7 Operations test conduct
46	2.2.8 Synthesis of operations tests data
47	2.2.9 Benchmark test conduct
48	2.2.10 Synthesis of benchmark test data
49	2.2.11 Modeling of benchmark test with U.S. NRC code TRACE
50	2.2.12 Modeling of benchmark test with RELAP5-3D
51	2.2.13 Comparison of experimental data & model results for problem
52	2.2.14 Benchmark level evaluation of problem
53	2.2.15 Evaluation of uncertainties in selected problem
54	2.2.16 Submission of benchmark for peer review



Project Task Outline

- **Task 3 Status**

ID	Task Name
55	**3 Core Instrumentation Task Lead**
56	**3.1 Instrumentation Plan**
57	3.1.1 Review TREAT core design and test plans
58	3.1.2 Identify core parameter monitoring needs
59	3.1.3 Determine applicable flux/measurement range
60	3.1.4 Select TREAT core instrumentation
61	3.1.5 Identify instrumentation calibration requirements
62	3.1.6 Develop TREAT core instrumentation plan
63	**3.2 Initial Benchmark Evaluation**
64	3.2.1 Develop Benchmark experimental plan using the MITR
65	3.2.2 Select test instrumentation
66	3.2.3 Design test assembly for OSTR and MITR
67	3.2.4 Conduct experiment safety review and approval
68	3.2.5 Perform core analysis with MCODE
69	3.2.6 Assemble and test data acquisition systems
70	3.2.7 Perform steady-state experiments at MITR
71	3.2.8 Perform steady-state experiments at OSTR
72	3.2.9 Perform transient experiments at MITR
73	3.2.10 Perform transient experiments at OSTR
74	3.2.11 Analyze experimental data
75	3.2.12 Evaluate core analysis and instrumentation measurement uncertainties
76	3.2.13 Submission of detailed final instrumentation report



Project Timeline (Refer to Project Website)

- **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 (General)

- **Monthly Updates**
  - 1 to 2 sentence update on each primary subtask End of each month
    Submit to PI
- **Quarterly Reports**
  - Detailed task-by-task update End of each quarter
    Submit to PI
- **Final Report**
  - Compilation of all Project scope and outcomes 12/29/2018

Project Deliverables (Task Specific)

- **Neutronics Benchmark**
  - Submit SS Benchmark for Peer Review 09/30/2016
  - Submit TR Benchmark for Peer Review 09/30/2018
- **Loop Thermal-Hydraulics**
  - Submit TH Sodium Loop Benchmark for Peer Review 09/30/2018
  - Submit TH Water Loop Benchmark for Peer Review 09/30/2018
- **Core Instrumentation**
  - Submit TREAT Core Instrumentation Plan Draft 09/30/2016
  - Submit Detailed Final Instrumentation Report 09/30/2018

Thank You