
Q5 MEETING SUMMARY

“Computational and Experimental Benchmarking for Transient Fuel Testing”

FY 2016 NE-IRP

Bi-annual Meeting

MEETING ATTENDEES

<u>Participant</u>	<u>Organization</u>
1. John Strumpell	Areva
2. Changho Lee	ANL
3. Suibel Schuppner	DOE
4. David Hill	Hill & Associates
5. John Bess	INL
6. Colby Jensen	INL
7. Dan Wachs	INL
8. Nicolas Woolstenhulme	INL
9. Jim Parry	INL
10. Mark Dehart	INL
11. Josh Daw	INL
12. Doug Burns	INL
13. Lin-Wen Hu	MIT
14. David Carpenter	MIT
15. Kaichao Sun	MIT
16. W. David Pointer	ORNL
17. Wade Marcum	OSU
18. Emory Brown	OSU
19. Tommy Moore	OSU
20. Yikuan Yan	OSU
21. Mike Steer	TerraPower
22. Kevan Weaver	TerraPower
23. Tom Downar	UM
24. Volkan Seker	UM
25. Michael Corradini	UW

SUMMARY

Placeholder

Day 1

1 GREETINGS (DAVID MONCTON)

- Opening Statements by David Moncton. He congratulates the community effort of the many Universities involved with the restart of TREAT.

2 LOGISTICS (LIN-WEN HU) (8:43 AM)

- Tracy has the information related to logistics of the meeting
- Dinner at 6 PM at Legal Seafood
- Tour on Wednesday for the MITR

3 GOALS OF MEETING (WADE MARCUM) (8:48 AM)

- Around the room greeting from each member
- Aligning goals with what will be used in industry
- Focus of this work is performing benchmarks
- Michael Corradini will present later, on the UW led IRP project
- Details of the meeting agenda presented

4 UPDATE ON THE TREAT RESTART AND TRANSIENT TESTING PROGRAM

Dan Wachs gives a report on the TREAT Restart and Transient Testing Program at INL. DOE is investing heavily in testing infrastructure. They are getting ready to start a new water loop in ATR in the next few months. INL is putting focus on collaborating with Universities to foster new generation of researchers to support the facilities. First critical operation estimated Nov. 17th. Anywhere from 6 months to 1 year ahead of schedule. Looking to have ATF-CAL tests, reactor characterization, ... done by FY18. Infrastructure development investment is prioritized on current objectives: ATF & LWR Burnup extension, Microstructural evolution, fast reactor and Gen-IV concepts. Challenges exist in instrumentation package development for Multi-SERTTA. Hodoscope recovery status.

Detectors refurbished, DAS design, collimator assessment, electro-mechanical system recovery, modeling and simulation.

5 UPDATE ON INL MODELING AND SIMULATION (MARK DEHART) (~9:45 AM)

- Operation can begin without modeling and simulation, but no predictive capabilities without
- M&S will allow for better results of running the reactor as well as increasing the efficiency of the work flow. Will also allow better utilization of the reactor.
- Focus of MAMMOTH are validation, methods development, and deployment
- Development of methods to handle 3D effects of cross section.
- MAMMOTH results are comparable to the M8-CAL experiment (missed peak power by approximately 10% (Within noise))
- MAMMOTH being used to predict the transient correction factor
- Overall 3D effects are a challenge and are important to capture to improve modeling capabilities
- Used for designing as well as post test analysis
- Coupled physics allows for feedback solutions as well as high order solutions in key regions and low order solutions in more homogenous regions
- Discussion of the key parameters to match for code improvements and the range of uncertainty
- MAMMOTH being used for non-safety related pre-operational work. Conservative tools being used for safety related work
- Hope to be a QA'ed code in 2 years
- Reproducing M8-CAL experiment used to show that capabilities are restored and to have confidence in results

6 UPDATE ON US-LED IRP PROJECT (MICHEAL CORRADINI)

- Minutes lost due to technical difficulty

7 OVERVIEW OF OSU LED IRP PROJECT (WADE MARCUM) (11:05 AM)

- Presentation of the percentage completion of each task was made
- Connection monthly from the task leads to the advisory board with power point presentations instead of just a report
- Much work has been made, but looking forward, we are in a good position to complete our objectives

8 TASK 1 PROGRESS OVERVIEW (TOM DOWNAR)

- Minutes lost due to technical difficulty

9 TASK 2 PROGRESS OVERVIEW (WADE MARCUM 11:47 AM)

- Much of the work is nearing completion on the task 2.1 problem specification report
- Availability of drawings was the key hold-up
- Drawings are now available
- Solidworks model of the test section nearing completion as well
- Nek5000 training underway. With the Problem description report complete, modeling will begin full force
- TRTL design to bound all TH attributes
- ASME NQA-1 Program for TRTL has been developed. Not in contract. Done to add confidence in the results
- University sponsored infrastructure improvement for electrical power needs because of this project
- Design is complete except for DAS
- Paratherm used instead of water on secondary side to remove boiling
- Hardware procured and fabrication has begun
- RELAP5-3D and TRACE results for water loop completed
- Task 2.2 on track and ahead of schedule on most topics

10 TASK 3 PROGRESS OVERVIEW (LIN-WEN HU)

- Minutes lost due to technical difficulty

11 BREAKOUT SESSION MINUTES (TASK 2)

11.1 Tommy Moore

- Pressure results are not in HOP 1-6A. Is it necessary?
- Flowmeter reliable is questionable, thus report suggests using system code results instead.
- Needs to work more on exact locations of thermocouples.
- Drawings from Nic contain details on rod holding pins
- Question arise to the importance of thermal mass of flanges
- What are the figures of merit for the benchmark? Do the TCs above the perforated flow tube need to be included? Might be better to not model the holes, but rather model it as a porous media. Feature is not in mkIII (says Nic). Be better to smartly list the assumptions rather than attempt to mesh that.
- Nic has handed over documents.
- Position of rods in flow tube (leaning etc) does not matter since the conductivity of the sodium is much higher than steel.
- It is important to capture referenceable geometry. Difference between releasing paper drawings vs Solidworks model. Recommendation to create 2D drawings for referencing.
- Recommendation to have collaborator do checking on model and subsequent drawing for translation accuracy.
- Probably not include gamma heating since there are too many unknowns. The obvious one is gamma heating in the sodium, but will be determined when the model is wrong.
- Structural hexahedral mesh made in GridPro from Mike. A high-quality mesh can be made for this geometry relatively easily. Top and bottoms will present issues. Mike will deliver the full mesh.
- Focus on the flow field in each individual segment for NEK (run each section separately).
Run in one piece in STAR
- Need to get time scheduled sooner rather than later with Dave Pointer for NEK training.
(Wait until you have the geometry in hand)
- Nic raised the question of what information from the CFD (though not comparable to data from HOP – 1-6A) should be available for future design purposes. Journal vs Report etc etc etc.

- What is the flow rate?
- For an open flow loop, pressure doesn't matter.
- Assume TC14 as inlet.
- When you go through the exercise of making the drawings. Put TCs in there even if they aren't explicitly given.
- Manifold doesn't matter since the wire wrap is so tight. If the test section is as hydraulically stiff as it might be, the flow field will be established within 1 wrap.
- Might even be easy enough to model the wire wraps and square.
- 3 flow tubes and their transitions at the ends is what is important.
- Action Items. Geometry. Schedule meeting for four early December. Get Solidworks model done with iso-drawings.
- Goal for Terra power is to make simple model to see what matters in STAR with ORNL.
- Need to include axial profile in pins. Very important. Mesh clad, inside of clad apply relative power heat flux
- WHERE IS ZERO. STATE IT. Where is the bottom of the fuel column EXPLICITLY.

11.2 Wade Marcum (3:00 pm)

- Logistics for the High Bay with TRTL and NRTL is completed. Control Room accessible without being in the high bay
- Structure under construction
- Discussion of pressure transmitters with Nic
- 24 thermocouples that can be placed in the test section
- Instrumentation plan of thermocouples, pressure transducers, and flow meters were recalled
- Updates on changes to design since the last meeting. High pressure tubing
- A few psi pressure loss through the system in TWERL is likely to occur in the eventual TWERL design
- TWERL instrumentation may eventually be intrusive to flow. Wait and see once it is funded again.
- Updates since last meeting
 - Thermal fluid now on secondary side to not have flashing during transients

- Heater rod design tested and confirmed to work so far
- Are you worried about the thermal conductivity of the potting material high enough to have the right shape of thermal flux
- Shop drawings presented
- What accidents should we run in TRTL? What does ATF want?
 - If you can wait a few months, Nic will have a better answer
 - Wade would like it before March
 - Report won't say ATF likely, but will have the information relative to TREAT
 - Nic thinks this timeline is achievable
- Assuming nominal operating conditions for a PWR
- Can AREVA provide sleeves in a timely manner (ATF or non-ATF even)
 - One should be available pretty easily
 - Readily available for production stuff
 - ATF stuff may be in production soon
 - 4' and a few inches length

11.3 Emory Brown 4:31 pm

- Detailing the design of the TRACE model
- Near and long term update the pump model for head vs flow curve
- Near and long term update model for the spring and ball valve
- Near and long term update on the heated mass in the heater rods
- Results comparing RELAP5-3D and TRACE
- For 100kW comparison, RELAP hits CHF while TRACE does not. Still being investigated
- Problem Description Report still in development
- Parameters of Interest?
 - Will be worked on this year
 - System mass flux, chf tracking, temperature profile, etc.
- Ahead of schedule due to Emory's hard work
- Two more potential advisors for TRACE assistance
- Can the model be verified by a flow test of the ball and spring valve?
 - Unlikely, not in budget and a new experiment would need to be made

Day 2

12 STAKEHOLDER OUTCOMES: TASK 1 (JOHN BESS) 9:37 AM

- The Quest for TREAT Benchmarks
- The Benchmark is currently at 200 pages and likely to be 400 pages by the time it is completed
- Final benchmark likely available internationally March 2018
- Not knowing Boron content in the fuel is the largest part of uncertainty
- Deterministic results are comparable to monte carlo results and likely to get better with more refined model
- Void spacing is the biggest challenge for deterministic codes. Development underway to handle this problem
- TREAT template for benchmark reports will be developed for future benchmarks
- Path forward:
 - MCM and M8CAL benchmarks for IRPhEP
 - Transient Benchmarks
- Upcoming TREAT workshop could be a good place to continue transient benchmark discussion

13 STAKEHOLDER OUTCOMES: TASK 2 (WADE MARCUM)

(2.1) Focus on handling parameters of interest and geometries to support benchmark. Short term action items: Solidworks model will be updated with new information from Nic. Take model and attempt to mesh it (Mike Steer and Dave Pointer). Expecting early December timeframe. (2.2) Focus on progress of the OSU experimental loop. Discussed some of the changes in the loop design since last meeting such as heater design and blowdown valve. Posed the open question of what parameters from the stakeholders are of interest. (2.2.11) Summary of the problem description report and model comparisons between RELAP5/TRACE. Discussion about model parameters that are not explicitly known and how to resolve these differences between the models.

14 STAKEHOLDER OUTCOMES: TASK 3 (COLBY JENSEN) 10:50 AM

- Instrumentation plan draft is completed
- Work is driven by the test specimens that will be in TREAT
- Using state of the art instrumentation
- Flux and temperature are the two parameters of the highest interest
- Measuring the uncertainty could be a great opportunity for the instrumentation
- Possible benchmark evaluation in TREAT in 2018
- Work with other IRP tasks, MAMMOTH team, and other testing programs to choose the most comprehensive instrumentation plan
- Emphasis on testing instrumentation and ensuring that it is working properly (testing in a reactor other than TREAT) before placing it in TREAT

15 ADVISORY BOARD DISCUSSION (11:12 AM)

- Kevan Weaver
 - Task 1
 - The progress this far is looking good
 - Hodoscope channel modeling work is looking good
 - Task 2
 - Data gathering is a bigger issue than just this project
 - Task 3
 - Try as hard as we can to use advanced instruments
 - Overall: Things are going very well. Lines up well with their transient testing goals
- David Hill
 - The sodium loop data issue is surprising
 - HEDL TS1 may be a better experiment
 - Greenback document exists
 - This is a Mark III loop
 - Progress is really good
 - Needs to be close coordination between TREAT restart and IRP group
- John Strumpell
 - Proprietary issue needs to be sorted out

- Shouldn't be as hard as it is
- Seems very well organized
- Keep trying to stay on schedule
- For the ahead of schedule restart, make sure that the tasks that could put us behind schedule are identified and taken care of
- Dan Wachs
 - Integral to the overall restart of the TREAT reactor
 - Impact of the IRP is helping lots of tasks at INL because of the quality of the work
 - Done a great job at meeting required goals, but also looking to future work beyond this IRP (OSU loop and Instrumentation Plan)
 - Exemplary example of how an IRP should work

16 ACTIVITIES BEFORE NEXT MEETING (WADE MARCUM) 11:28 AM

- Task 1: Develop transient benchmark report
- Task 2: Complete Problem Description Report and begin blind modeling
- Task 2: Focus on shakedown testing of the water loop
- Task 3: Update instrumentation plan
- Task 3: continue design of test assembly and test plan
- Monthly updates for each task
 - Power points are new