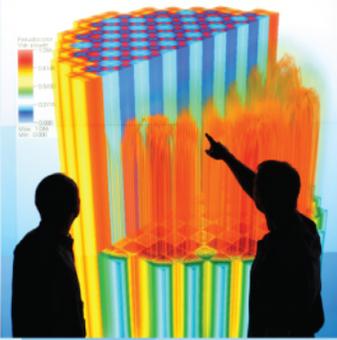


Power uprates
and plant life extension

CASL-U-2011-0281-000



Engineering design
and analysis



L3:THM.CFD.P3.03

Summary of THM Meeting with EDF

Science-enabling
high performance
computing

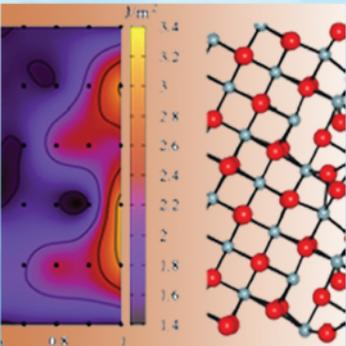


Robert Lowrie

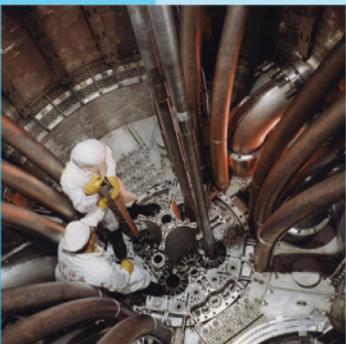
Los Alamos National Laboratory

August 24, 2011

Fundamental science



Plant operational data



CASL-U-2011-0281-000



U.S. DEPARTMENT OF
ENERGY

Nuclear Energy

Summary of THM Meeting with EDF

On August 24, 2011, Rob Lowrie (THM FA Lead) met with Olivier Marchand (EDF) at ORNL. Marchand leads R&D efforts at EDF. The focus of this meeting was to begin potential collaborations between CASL and EDF in the area of thermal hydraulics.

Marchand went through two presentations on their Saturne [1] and Neptune [2] codes. Saturne is viewed as primarily single phase, and also as a research platform. It is openly available. Neptune is their multiphase development platform, and it is unlikely that CASL will be granted access to this code.

Summary of comments made by Marchand (we must emphasize that these are as interpreted by Lowrie):

- EDF would like Neptune to be open, but Areva and CEA do not.
- Marchand does not see TransAT as a serious participating code, but instead, views its inclusion is part of the European collaboration. EDF does not use TransAT. As a side note, in talking with Annalisa Manera (U-Mich), in her experience with NURESIM, the French pushed their own codes quite heavily. Consequently, it may not be a surprise that Marchand might feel this way about TransAT.
- In terms of multiphase flow development, EDF is concentrating on the following “challenge problems”:
 - Pressurized Thermal Shock (PTS). Includes COSI and Topflow experiments. The first 5 years of multiphase flow development was spent on PTS.
 - DNB/CHT is the next area of focus, and it sounded like they’re just getting started here. Marchand thinks it's unrealistic for CASL to make an "improvement" to DNB at end of 5 years, at least in the area of multiphase CFD.
 - Marchand believes improvements in multiphase CFD will not improve CRUD issues; there’s too many other uncertainties and that CRUD is not really a good focus for multiphase CFD.
- PTS modeling remains a challenge. Marchand note that with their current 6-equation-type models, if the closure parameters are tuned to match at the hot-cold leg junction, then they miss the well-mixed flow downstream, and vice versa. Improvements in modeling are definitely needed, NOT just in determining closure parameters (see also ITM comment below).
- Saturne and Neptune have approximately 10 or 20 people working on each code.
- ITM work funded by EDF is viewed as **very** fundamental research. Like CASL, the idea is to upscale.

- Marchand was asked the typical size of problems run by EDF. In terms of cell counts: 10^9 very much research, maybe 10^{10} . Engineering 10^6 to 10^7 .
- 99% of CFD calculations are transient (PTS, DNB, etc.). Some of these may be stationary flows, but it appears they spend little time trying to get steady-state convergence with RANS.
- Absolutely no development of sub-channel is done at EDF. Although sub-channel is certainly used, its development is viewed as complete.
- Neptune used a 6-equation model, but CEA (Abgrall, Saurel) is also looking at 7-eqn at a low level and EDF supports these efforts.
- EDF plans for coupled neutronics: None planned for Neptune or Saturne. No Although Marchand admitted it might be important for DNB, it was clear he believed such coupling was not that important in general, and did not see it as a needed focus.
- EDF plans on FSI: Viewed as very important in steam generator tubes (SGT), but that this also requires two-phase flow and will be investigated further in the future. For GTRF, they found solution for fuel, and view this as a “solved problem.” So instead, the priorities are on SGTs. On related note, EDF is also much more concerned with FAD (obviously, a different type of structural response).
- Mentioned Salome environment, but didn’t try to oversell it (this is similar to the CCA effort in DOE). Mentioned the MED data format (both a file and memory format). Using this for VERA might permit better collaboration in the future.

Potential future collaborations

We discussed several potential collaborations, including:

- Documentation / information exchange? Models and test cases.
- Experimental plans and existing data
- Benchmark definitions / comparisons
- Software tools, such as mesh transfer, particularly if we’re willing to interface with Salome.
- Code comparison workshop. Discuss and compare best practices.

Next Steps

The original plan was to meet again at the NURETH-14 conference. Unfortunately, DOE-NE denied Lowrie’s travel, so a future meeting will need to be scheduled. This meeting has yet to be arranged.

References

[1] *Code_Saturne*: EDF’s general purpose CFD software

[2] NEPTUNE_CFD Multi-phase local CFD