Fourth COBRA-TF (CTF) User's Group Meeting - CTF-4

Erlangen, Germany

May 8-9, 2017

Hosted by
Hosted by AREVA GmbH
Germany

Announcement and Proposed Program

Background and Purpose of 4th CTF User's Group Meeting

The fourth COBRA-TF (CTF) User's Group (UG) Meeting (CTF-4) will be held on May 8-9, 2017 in Erlangen, Germany, and will be hosted by AREVA GmbH. It is a follow-up of the previous CTF UG meetings. The CTF-3 meeting was held on June 1-2, 2016 in Villigen, Switzerland, and was hosted by PSI. The CTF-2 meeting was held on May 20-21, 2015 in Madrid, Spain, and was hosted by UPM. The CTF-1 meeting was held on May 14-15, 2014 in Garching by Munich, Germany, and was hosted by GRS. The CTF-4 meeting will be held in conjunction with other meetings (in the same week) in order to facilitate coordination and sharing of work. The meetings concerned are:

- *May 8-9, 2017* – Third OECD/NEA Sodium Fast Reactor (SFR) Uncertainty Analysis in Modelling (UAM) benchmark meeting (SFR-UAM-3)
- *May 8-9, 2017* – Fourth COBRA-TF User's Group Meeting (CTF-4)
    - M*ay 9, 2017* – 3:30 pm (15:30) - The Primary Coolant Loop Test Facility (PKL) visit
- *May 10-12, 2017* - Eleventh OECD/NEA Light Water Reactor (LWR) Uncertainty Analysis in Modelling (UAM) benchmark meeting (UAM-11)
- *May 10-11 (morning), 2017* - AER Working Group D meeting (VVER dynamics and safety)
- *May 11 (afternoon) - May 12, 2017* - Second OECD/NEA Time-Dependent Neutron Transport (C5G7-TD) benchmark meeting (C5G7-TD-2)
    - *May 12, 2017* – 2 pm (14:00) and 3 pm (15:00) – AREVA Fuel Laboratory visit.

COBRA-TF is a thermal-hydraulic simulation code designed for LWR vessel analysis. It uses a two-fluid (hence the "TF" designation), three-field modeling approach. The original COBRA-TF code was developed as a thermal-hydraulic rod-bundle analysis code in 1980 by Pacific Northwest Laboratory under sponsorship of the Nuclear Regulatory Commission (NRC). It was subsequently implemented in the COBRA-TRAC code system and further validated and refined as part of the FLECHT-SEASET 163-Rod Blocked Bundle Test and analysis program. Over the past several decades, the COBRA series of codes has been used extensively throughout the nuclear industry, resulting in many variants of the code being created and validated.

CTF is the shortened name given to the version of COBRA-TF being developed and improved by the Reactor Dynamics and Fuel Modeling Group (RDFMG) initially at the Pennsylvania State University (PSU), and currently at the North Carolina State University (NCSU). In the last decade, CTF has been extensively validated for Pressurized Water Reactor (PWR), Boiling Water Reactor (BWR), VVER, Small Modular Reactor (SMR), and research reactor applications. Improvements have included development of models, enhancing computational efficiency, as well as improving software quality and associated Quality Assurance (Q&A) procedures and documentation of CTF. Modifications and validation of CTF to analyze advanced fast reactors as well as spent fuel pools and dry storages is underway. As a result, CTF has become state-of-the-art sub-channel code for reactor thermal-hydraulics bundle and core analysis.

CTF have been distributed under code and collaboration agreements to different organizations, which resulted in further improvements, modifications, verification & validation activities and applications. The CTF has been included in two large projects – U.S. Department of Energy (DOE) Consortium for Advanced LWR Simulation (CASL) (as the basic thermal-hydraulic core feedback model) and European Commission (EC) NUclear REactor SAFEty simulation platform (NURESAFE) (as a BWR, PWR and VVER core thermal-hydraulic transient analysis tool). CTF has been collaboratively developed as part of the CASL program joint participation from U.S. national research laboratories, private industry, and research universities. CASL mission is to provide leading edge modeling and simulation capabilities to improve the performance of currently operating LWRs. Within CASL, CTF has become an important component of VERA, a "Virtual Environment for Reactor Applications", Core Simulator (CS).

In order to leverage and combine all non-proprietary developments, improvements, modifications and error fixes as well as the available verification and validation database and application experience of CTF from different organizations and activities, it was decided to establish a CTF User Group (UG) under the leadership of Prof. M. Avramova, RDFMG/NCSU in order to provide and maintain the so-called "gold-standard" of CTF. RDFMG/NCSU is the keeper of the gold-standard CTF and taking on the responsibility of maintaining and merging all developments and modifications. RDFMG/NCSU works to bridge the gap between the CASL program, the NURESAFE program and other activities (from other organizations) related to CTF. Such unified and up-to-date code version, supplemented with extended verification and validation suite and application guidelines based on previous documented experience, will be useful to all CTF users in the future. RDFMG works to implement non-proprietary features developed in different projects in a single, gold-standard, and state-of-the-art version of CTF for the entire nuclear industry to benefit. The gold-standard version of CTF uses GIT source control and is hosted on GITHUB to be accessible by all members of CTF UG. The code can be run in serial or parallel modes and is being distributed via a code agreement/license to interesting parties. The information for CTF UG is provided at:

https://www.ne.ncsu.edu/rdfmg/cobra-tf/

The CTF-4 meeting will involve all interested users with objective to discuss on the progress in achieving a common version and to review the contributions from different organizations to the common version (including code development, improvement, verification and validation, uncertainty quantifications, and applications). The meeting will be conducted following the agreements reached at the CTF-1 meeting to have one annual meeting of the CTF UG to present, discuss and coordinate activities related to CTF.

Scope and Technical Content of the Meeting

The topics to be addressed at the workshop include:

- Review of the CTF UG activities after the CTF-3 meeting;
- Discussion of status and recent additions to the CTF UG – activities, coordination, etc.;
- Discussion on updates of the common CTF version, GITHUB access, source control, maintenance, testing, etc.;
- Discussion on updates of coding guidelines and Software Quality Assurance Requirements for CTF;

- Discussion of updates of Verification and Validation (V&V) matrix as well as coverage matrix of CTF. Proposals for further expansion of V&V matrix and coverage matrix;
- Discussion of recent uncertainty quantification studies of CTF;
- Discussions of CTF model improvements/additions;
- Discussions of using high-fidelity models to inform low-fidelity models in CTF;
- Overview of CASL activities with CTF;
- Overview of NURESAFE activities with CTF;
- CTF modifications and applications to PWRs;
- CTF modifications and applications to BWRs;
- CTF modifications and applications to VVERs;
- CTF modifications and applications to SMRs;
- CTF modifications and applications to research reactors;
- CTF modifications and applications to FBRs and MSRs;
- Discussion of multi-physics and multi-scale activities involving CTF;
- Discussions of transient applications of CTF;
- Presentations on other activities with CTF as well as experience and expertise of different organizations in CTF model developments, efficiency improvements, verification and validation efforts and applications;
- Defining a work plan and schedule for CTF UG activities.

The proposed meeting program is attached as Annex 1.

Organization of the Meeting

The meeting is organized around the discussion of CTF UG and its activities. The participants are requested to present their expertise and experience in CTF developments, improvements, verification and validation, uncertainty quantification and applications.

Participation in the Meeting

The participation in the meeting is open to all former, current and future developers and users of COBRA-TF (CTF) for different applications.

Organization and Program Committee of the Meeting

An Organization and Program Committee has been nominated to make the necessary arrangements for the CTF-3 meeting and to draw up the final program, etc. The members of the Program Committee are:

Maria Avramova – *Co-Chair and Coordinator of CTF UG*
North Carolina State University, USA

Peter Pohl - *Co-Chair and Local Host*
AREVA GmbH, Germany

Robert Salko – *Coordinator of CASL CTF activities*

Oak Ridge National Laboratory, USA

Yann Perin - *Coordinator of NURESAFE CTF activities*
Gesellschaft fuer Anlagen und Reaktorsicherheit (GRS) mbH, Germany

Proposed Program of the Meeting

The proposed program was drawn up by the Program Committee and is enclosed as Annex 1.

Language of the Benchmark Workshop

The official language of the CTF-4 meeting is English.

Proceedings of the Meeting

A summary of the CTF-4 meeting will be published by the RDFMG/NCSU after the meeting. The summary will be distributed free of charge to the participants in the meeting. The presentations will be available free of charge to the participants to download from participants' restricted area after the CTF-4 meeting.

Contacts and Registrations

A common registrations webpage is made available for the participants to UAM-11, AER-D, CTF-4, C5G7-TD-2, and SFR-UAM-3 workshops:

http://www.oecd-nea.org/confdb/confdb/conf?id=235

Inquiries about registrations can be directed to:

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Please send the titles of your presentations to the CTF UG Coordinator and Chair of CTF-4 UG meeting: Prof. Maria Avarmova (mnavarmo@ncsu.edu).

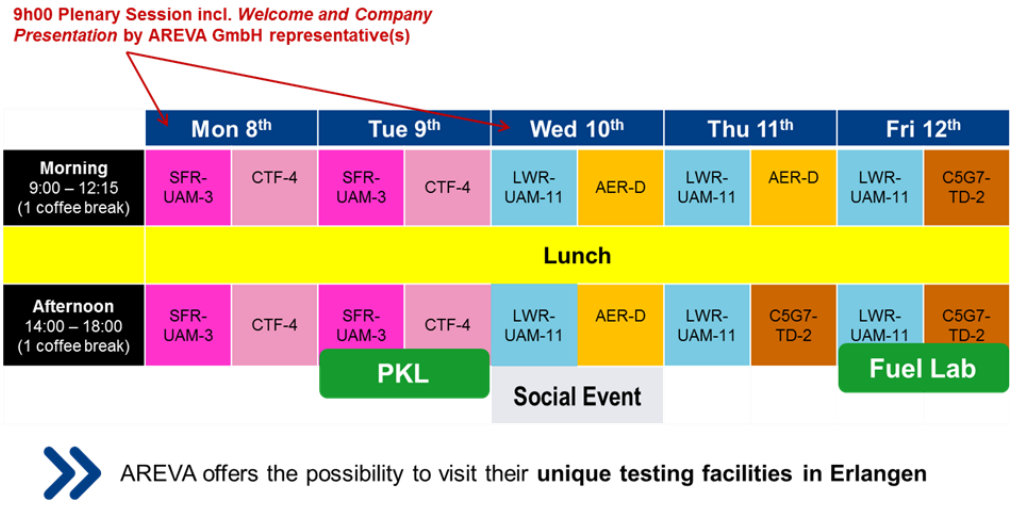
Workshop Location

The meeting place for the five workshops during the week of May 8-12, 2017 is the AREVA GmbH in Erlangen, Germany. The information for local organisation (including hotels) is provided at the following AREVA GmbH web-site:

http://de.areva.com/EN/customer-4316/wprs.html

The program and schedule of the meetings is shown below:

Workshop / Meeting		
SFR UAM	May 8th/9th	Third OECD/NEA Sodium Fast Reactor (SFR) Uncertainty Analysis in Modelling (UAM) benchmark workshop
CTF UGM	May 8th/9th	Fourth COBRA-TF (CTF) User's Group Meeting (UGM)
LWR UAM	May 10th/11th/12th	Eleventh OECD/NEA Light Water Reactor (LWR) Uncertainty Analysis in Modelling (UAM) benchmark workshop
AER	May 10th/11th	AER Working Group D meeting (VVER dynamics and safety)
C5G7-TD	May 11th/12th	Second OECD/NEA C5G7 Time-Dependent (TD) Neutron Transport benchmark workshop



AREVA offers the possibility to visit their **unique testing facilities in Erlangen**

Visit of a selection of AREVA's laboratories, research and testing facilities

1. The **Primary Coolant Loop Test Facility (PKL)**
   - is unique worldwide, enables tests to be conducted on the thermohydraulic behavior of pressurized water reactor plants under accident conditions. The studies and research projects provide important information for plant safety.
2. The **Fuel Laboratory**
   - Technology & Prototyping:
     - The prototyping lab supports local and global projects by producing test samples of fuel assembly (FA) components, prototypes, sample FA, FA components for lead test FA and non-standard reloads. The lab executes mechanical design tests and develops manufacturing and inspection technologies.
   - Test Rig
     - Supports the global and local projects by providing areas for customer and staff training. Together with customers and authorities the lab performs acceptance tests of all Fuel Services equipment (e.g. inspection, repair and sipping technics) under realistic NPP conditions.

ANNEX 1

Fourth COBRA-TF User's Group Meeting (CTF-4)

Host Organization

AREVA GmbH

Erlangen, Germany

May 8-9, 2017

PROPOSED PROGRAM

CT01-24: Session code

Day 1: May 8, 2017

CT01. Introduction and opening remarks – AREVA GmbH, OECD/NEA

CT02. Review of the CTF User's Group activities after the CTF-2 meeting – M. Avramova, NCSU

CT03. Discussion of status and recent additions to the CTF User's Group – activities, coordination, etc. – K. Ivanov, NCSU

CT04. Updates on CTF Infrastructure and SQA – R. Salko, ORNL

CT05. Implementation of pressure correction term and modeling of water faucet verification problem – R. Salko, ORNL

CT06. Benchmarking of CTF and VIPRE-01 for two-phase flow – R. Salko, ORNL

CT07. Updates on residual formulation implementation in CTF and associated verification studies.

CT08. Presentations on recent uncertainty quantification studies of CTF.

CT09. Presentations on CTF model developments and improvements/additions.

CT10. Implementation of a hi2lo approach for capturing higher fidelity grid heat transfer effects in the CIPS challenge problem – R. Salko, ORNL

CT11. Presentations on CFD informed models for CTF.

CT12. Presentations on improved fuel rod modeling in CTF.

Day 2: May 9, 2017

CT13. Summary of NURESAFE activities with CTF – Y. Perin, GRS

CT14. CTF modifications and applications to PWRs. PWR full-core simulations.

CT15. CTF modifications and applications to BWRs. Development of a BWR preprocessor. BWR-related modifications in CTF for BWR core calculations on channel and subchannel level.

CT16. CTF modifications and applications to VVERs.

CT17. CTF modifications and applications to SMRs.

CT18. CTF modifications and applications to research reactors.

CT19. CTF modifications and applications to FBRs and MSRs.

CT20. Development of coupled transient simulation capabilities in VERA-CS – R. Salko, ORNL

CT21. Presentations on multi-physics and multi-scale activities involving CTF.

CT22. Presentations on CTF efficiency improvements and parallelization.

CT23. Presentations on other activities with CTF as well as experience and expertise of different organizations in CTF model developments, efficiency improvements, verification and validation efforts as well as design and safety applications.

CT24. Defining a work plan and schedule for CTF UG activities.