



MAXSIMA

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DELIVERABLE D1.4 Minutes of the third RP general meetings

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Methodology, Analysis and eXperiments for the “SafetyIn MYRRHA Assessment”

EC project officer: Mykola DZUBINSKY



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Summary: This deliverable reports the progress of the technical work done. The progress was discussed on the 6th semi-annual review meeting in Karlsruhe, Germany, on 19 October 2016.

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The progress of the work of four technical work packages of MAXSIMA was discussed during the 6th semi-annual review meeting, held at KIT in Karlsruhe, Germany on 19 October 2016. After an introduction by the Project Coordinator (Marc Schyns, SCK•CEN), the following Work Packages were discussed:

- WP2: Safety Analysis in support of MYRRHA
- WP3: Core Component Safety
- WP4: Steam Generator & Cooling Safety
- WP5: Fuel Safety

I. WP 2 Safety analysis in support of MYRRHA

D. Castelliti reporting.

As newly nominated MAXSIMA Work Package 2 Leader, Diego Castelliti organised (in replacement of Baudouin Arien who retired) the 8th WP2 Technical Meeting on the afternoon of Tuesday 18th October. The minutes of the meeting can be found on the MAXSIMA website in the folder documents/WP2 meetings. This WP2 meeting has been organised in parallel to the general MAXSIMA review meeting to allow extended and thoughtful discussions on WP2 topics such as reactor models, assumptions for safety analyses, comparison between different computational tools, etc.... During the MAXSIMA TRM meeting, the conclusions of the WP2 meeting have been presented.

Task 2.1 Neutronic and shielding analysis in support of safety studies

The Task 2.1 activities have been finished , with both Deliverables D2.1 and D2.2 submitted and uploaded on the MAXSIMA website.

Task 2.2 Transient analyses using system codes

The Task 2.2 activities are planned to come to an end in March 2017. Since last 7th WP2 Technical Meeting (CIEMAT, June 2016), the Uncertainty + Sensitivity (U + S) methodology proposed by GRS and used in Task 2.2 has been applied to three specific transients:

- Overcooling with Primary Pumps trip
- Protected Double Loss Of Flow Accident
- Protected Partial (3oo4) DHR-1 isolation

Both the deterministic and the U + S analysis of these transients have shown satisfactory results and good agreement between participants. It has to be remarked how this has been the first application of an Uncertainty Quantification methodology on MYRRHA safety analysis.

The code coupling (COBRA + MCNP) proposed by CIEMAT for a coupled subchannel simulation in Steady State and transient conditions has proven to be promising but needs to be developed further: an Unprotected Loss of Flow and a Reactivity Insertion will be simulated.

Task 2.3 Severe accident analyses

The Task 2.3 activities have been planned to be finished in September 2016 (M46). The first draft for the final Deliverable D2.6 has been prepared by KIT (Andrei Rineiski, Xue-Nong Chen) and will be reviewed and completed by SCK•CEN (Francesco Belloni), who will add his contribution. Completion is foreseen by November 2016 (M48).

II. WP 3 Core component safety

K. Litfin reporting.

Task 3.1 Thermal hydraulic fuel assembly blockage experiments

Julio Pacio (KIT) presented the status of the thermal hydraulic fuel assembly blockage experiments. The first measuring campaign for the small blockage scenario C1 and E1 was successfully completed and the results on pressure drop and temperature were presented. It was shown that the pressure drop is only relevant at a local level and that the temperatures stay far below critical conditions. The presented 'Karlsruhe Blockage Equation' permits the extrapolation to MYRRHA conditions. Results of the second campaign are expected soon. An amendment to Deliverable D3.2, the blockage concept in natural convection was provided by ENEA and it was decided to integrate it to D3.4, the final deliverable of this task.

Task 3.2: Safety rod system tests in Heavy Liquid Metal

Graham Kennedy (SCK•CEN) presented the status of the control rod system tests in heavy liquid metal. The control rod assembly was successfully completed and 3 experimental measurement campaigns were performed in the COMPLIT facility. The results on the control rod displacement were presented and it was shown that the control rod is fully inserted within the required time of 1 second at nominal flow rate and within 1.22 seconds for the worst case, the no flow SCRAM insertion. A preliminary report of the results was provided to CRS4 as input to task 3.4.

Task 3.3 Fuel Blockage Simulation

Heleen Doolaard (NRG) presented the results of the numerical simulations of fuel assembly blockage. The inlet blockage studies were finished and the draft report was reviewed by the project partners. The results of the blockage experiments were received and post-test simulations started.

Task 3.4: Numerical analysis of the MYRRHA control rod system

Manuela Profir (CRS4) presented the simulation of control rod systems. The CFD model representing the MYRRHA control rod system was completed using the Volume of Fluid (VOF) model for the reproduction of the MYRRHA configuration and the overset mesh method for the reproduction of the Control Rod two-way coupling (TWC) motion.

The model predicts quite well the behaviour and the insertion time of the CR, in agreement with the experimental results provided by task 3.2. Post tests simulations were performed for further comparisons and calibration of the boundary conditions.

III. WP 4 Steam Generator and cooling safety

A. Del Nevo reporting.

The main objectives of this work package are related to the studies on safety aspects related to leakage or rupture of steam generator in the reactor vessel.

Task 4.1 SGTR Propagation

The work progress was presented by Alessio Pesetti (ENEA). He showed the pre-tests calculations by SIMMER-III and SIMMER IV codes, executed for designing the test section and the experiments. CIRCE facility in the SGTR configuration is now assembled and he showed in

detail the photos of the components, position of instrumentations and the different phases of the assembly of the test section.

He concluded that:

- The ultrasonic water flow meter is going to be implemented and then few minor details shall be completed before the commissioning tests will start.
- The tests and the experimental campaign will be completed by end 2016 and the deliverable will be available by February 2017.

Task 4.2 SGTR Bubble Characteristics

Alessandro Del Nevo (ENEA) reported on this task. He stated that a large delay has been accumulated. This delay was due to the refurbishment of the facility and of the experimental hall which will host other facilities, besides LIFUS5/Mod3. The delay was linked with the procurements (orders and contracts) from November 2015 up to June 2016 for unpredictable reasons (i.e. new ENEA procedures, new administrative software, new national procurement code, etc.). Efforts were done and are in progress to recover the accumulated delay. Then, he described how the experiment is designed and the procedure for the execution of the experiments. He concluded that the tests and the experimental campaign will be completed and documented by end of April 2017.

Task 4.3 Bubble transport validation

Dmitry Grishchenko (KTH) described the Task 4.3. He pointed out the technical challenges and approach pursued to accomplish the task. He detailed the principles of low pressure bubble generation, the facility design and the current status of the facility construction.

In brief:

- the manufacturing and assembly of the facility is currently finalized;
- the commissioning tests are planned to be finished before the end of the year;
- first results of experiments will be provided at the end of 2016 beginning 2017: deliverable by end of February 2017.

IV. WP 5 Fuel Safety

C. Roth reporting.

Task 5.1 Transient testing of MYRRHA fuel

Csaba Roth (ICN) presented the status of preparation of transient experiments on MYRRHA type fuel segments to be done in the TRIGA-ACPR reactor in Romania. Irradiation capsule tests have been accomplished. The tests proved the equipment functionality, neutron characteristics and validated the working procedures.

Brian Boer (SCK•CEN) presented the final stage of test fuel segments fabrication. The fabrication has been finished and the transport is delayed due to the need of container re-certification.

Task 5.2: Fuel coolant compatibility up to 1700°C

This task has been finished by issuing the final deliverable. Teodora Retegan (Chalmers) presented a summary of the works carried out. No interaction between LBE and MOX fuel has been observed during the experiments.