Seminar 1b – Nuclear installation safety research – Session 1

Chaired by M. Adorni (NEA) / A. Kaliatka (LEI)

14:00 - 14:30 | No. 115

The MUSA PROJECT: Management and Uncertainties of Severe Accidents

L. Herranz (CIEMAT), M. Sonnenkalb (GRS), V. Sanchez-Espinoza (KIT), F. Mascari (ENEA) and O. Coindra (IRSN)

MUSA was founded in HORIZON 2020 EURATOM NFRP-2018 call on "Safety assessments to improve Accident Management strategies for Generation II and III reactors". On June 15th, 2018 obtains the NUGENIA label that recognizes the excellence of the project. The 4 years Consortium is formed by 29 Organizations (25% non EU) with an overall cost of € 5,768,452.50 (about 630 person months).

The main objective is to assess the capability of Severe Accident (SA) codes when modelling reactor/Spent Fuel Pool accident scenarios of GEN.II and GEN.III designs. Further goals are:

- Identification of Uncertainty Quantification (UQ) methodologies to be employed, with emphasis on the effect of both existing and innovative SA Management (SAM) measures on the accident progression, particularly those related to Source Term (ST) mitigation;
- Determination of the state-of-the-art prediction capability of SA codes regarding ST that potentially may be released to the environment, and to the quantification of associated code's uncertainties applied to SA sequences.

The achievement of the MUSA objectives is assured by a consistent and coherent work programme reflected in 7 technical Work Packages (WP), coordinated by the following organizations:

WP1 MUSA COordination (MUCO) - CIEMAT

WP2 Identification & Quantification of Uncertainty Sources (IQUS) - GRS

WP3 Review of Uncertainty Quantification Methods (RUQM) - KIT

WP4 Application of Uncertainty Quantification Methods against Integral Experiments (AUQMIE) - ENEA

WP5 Uncertainty Quantification in the Analysis and Management of Reactor Accidents (UQAMRA) - JRC

WP6 Uncertainty Quantification and Innovative Management of SFP Accidents (IMSFP) - IRSN

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WP7 COmmunication & REsults DISsemination (COREDIS) - UNIPI. A special attention will be about the knowledge transfer towards young generation, mainly through the production of learning modules and a mobility programme. These education activities will be carried out in a close collaboration with ENEN.

The project has an “innovative research agenda” in order to move beyond the state-of-the-art regarding the predictive capability of SA codes by combining them with the best available or improved UQ tools. By doing so, not only the prediction of timing for the failure of safety barriers and of radiological ST will be possible, but also the quantification of the uncertainty bands of selected analysis results, considering any relevant source of uncertainty, will be provided.

Finally, MUSA will be an open results project for its importance on forthcoming SA analyses and it will mean a better exploitation of research previously performed within the EU framework. Furthermore, over the years, reliable and experienced teams of modellers and analytical teams have been built-up, and MUSA is a unique opportunity to achieve real feedback among them, encouraging cooperation in research, innovation and young generation’s formation.

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14:30 - 15:00 | No. 116

Source Term Evaluation following MBLOCA and SBLOCA Scenarios in a generic KONVOI-1300 NPP by means of the ASTEC Code

F. Gabrielli (KIT), V. Sanchez-Espinoza (KIT), A. Stakhanov (KIT) and A. Hoefer (Framatome GmbH) and E.-M. Pauli (Framatome GmbH)

Efforts are going on at the Karlsruhe Institute of Technology (KIT), in collaboration with Framatome GmbH Erlangen, to assess a database of Source Term (ST) evaluations for different Severe Accident (SA) scenarios to be employed by real-time program systems, i.e. JRODOS (KIT) and MOCABA (Framatome) to improve the decision making in SA events in Nuclear Power Plants (NPPs). Since such occurrences are still characterized by high uncertainties, in order to fulfill this goal, reference SA code in conjunction with Uncertainty and Sensitivity (U&S) tools, i.e. URANIE, are employed, a generic German KONVOI-1300 NPP being considered.

Such activity is triggered by the participation of KIT and Framatome to the EU Management of Uncertainties in Severe Accidents (MUSA) Project (2019-2023), and to the German WAME project (2019-2023) in the frame of the activity 'Maintaining Competence in Nuclear Technology' of the Federal Ministry of Economics and Technology (BMWi).

The first step of the KIT and Framatome strategy is the assessment of reference input decks for the generic KONVOI-1300. Having this in mind, the latest release (v2.2_b) of the Accident Source Term Evaluation Code (ASTEC), being developed at IRSN, is employed. The code aims analyzing the complete SA scenario from the initiating event until radioactive release from the containment in Gen. II and Gen. III water-cooled reactors.

The generic input deck available in the ASTEC release, originally developed by KIT, GRS, and IRSN, has been critically reviewed and updated in order to be able to compute the transport of Fission Products (FPs) from the vessel to the containment and then to the environment.

The paper is focused on the analysis of the ASTEC v2.2_b results mainly concerning the FPs release to the containment and the ST following a Medium Break Loss-Of-Coolant Accident (MBLOCA, 12" break on the cold leg) and a Small Break LOCA (SBLOCA, 2" break on the cold leg) accident scenario in a generic KONVOI-1300 plant. The main volatile, semi-volatile, and non-volatile FPs are considered in the study.

The results reveal a different distribution of the FPs in the plant regions, depending on the scenarios. The differences are discussed in this paper.

This work, therefore, represents a solid basis for the on-going further steps: performing U&S analyses and assessing the ST database to be used by the tools devoted to decision support system for nuclear emergency management.