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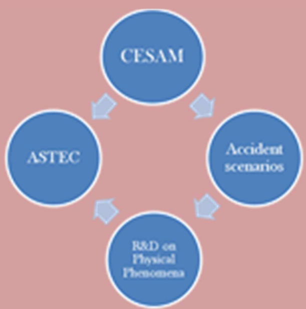


ASTEC Newsletter

Accident Source Term Evaluation Code

Introduction

This is the fourth issue of the ASTEC Newsletter that is published in the frame of the CESAM project of the FP7 of the European Commission. CESAM started in May 2013 for the duration of 4 years. The third newsletter was published in June 2015.

The main event of the project since June 2015 was the 3rd CESAM Technical Workshop organized in March 2016 by JRC/Petten in Alkmaar, the Netherlands, jointly with the 7th ASTEC User's Club meeting.

In the meantime, the CESAM project did a considerable progress since the 2nd Workshop in Bologna.

In this Newsletter Nr.4, selected contributions related to model development, code validation and plant applications are described.

In addition, important work done outside CESAM e.g. in the frame of the ASTEC Users Group and the code extensions and applications for SFR are also presented and discussed.

Compared to the last year, considerable progress in the plant analysis and improvements in the code stability and bugs reduction was achieved. This progress is demonstrated by the plant scenarios calculations and the validation work that were done in this period.

Last but not least, it is worth to mention that the major ASTEC version 2.1 that was delivered to the CESAM partners in April 2015 was then further consolidated for plant applications in 2 steps, i.e. through the release of two subsequent patch versions respectively in November 2015 and May 2016, along with the achievement in March 2016 of a completely updated documentation for code users.

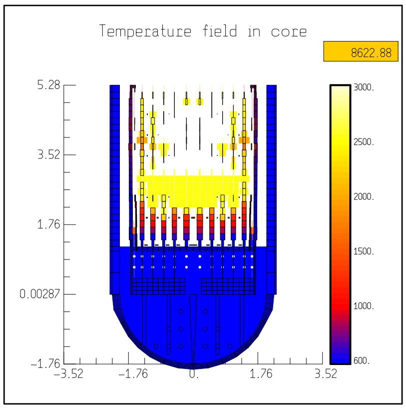
Finally, an updated list of relevant papers elaborated within and outside the CESAM project is given at the end of the Newsletter.

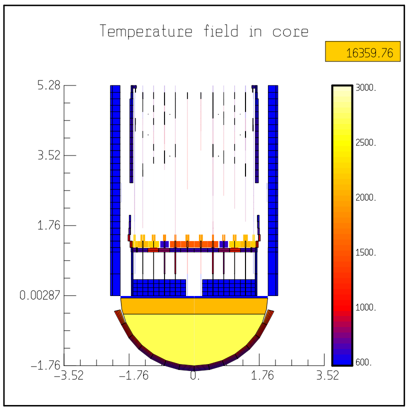
ASTEC New Model Capabilities

As underlined in the CESAM Newsletter n°3, the ASTEC V2.1rev0 *v*ersion that was released to the CESAM partners in March 2015 constituted the first stable version of the V2.1 series allowing performing plant calculations.

Then, several patch versions have been successively set-up at IRSN, up to the delivery to CESAM partners of the ASTEC V2.1.rev0.3 *v*ersion in November 2015, thus providing CESAM users with a consolidated V2.1rev0 version for the realization of ASTEC complete plant calculations. This V2.1rev0 third patch version notably accounted for the feed-back from V2.1rev0 first plant applications performed by CESAM partners but not only; it indeed also benefited from the set-up at IRSN of a dedicated reactor scale test matrix for ASTEC V2.1, covering the different types of NPPs currently under operation (or under construction) in France (PWR 900 MWe, PWR 1300 MWe and EPR).

This French NPPs test matrix, designed to be used from now at IRSN for a regular testing of any ASTEC V2.1 new programming, is composed of a dozen of representative plant severe accident sequences. Among these SA complementary scénarios, the 2’’ cold leg SBLOCA sequence applied to a 3-loop PWR900 MWe is chosen to illustrate hereafter the core degradation processes as calculated with ASTEC V2.1.rev0.3 (see the 2 figures below).





Furthermore, significant efforts were also paid at IRSN to update in early 2016 the V2.1 reference documentation for users while continuing assessing the ASTEC V2.1 series at plant scale through the regular regression testing supported by the abovementionned reactor scale verification matrix. Accordingly, a new patch version could be successfully frozen by IRSN in April 2016, providing all ASTEC users (*i.e not only CESAM partners*) with a consistent ASTEC V2.1 consolidated package. It is worth noting that this V2.1rev0 fourth patch version also included a set of physico-numerical improvements specifically devoted to answer plant shut-down state simulation requirements.

Next ASTEC formal issue for the CESAM WP30 will be the V2.1rev1 revision (Deliverable **D30.34**) that is scheduled for a release by IRSN at the end of October 2016. This future ASTEC V2.1 first revision will include most of the IRSN on-going modelling tasks which are, for few of them, addressing some of the remaining key-issues in the field of SA simulations such as the reflooding of damaged cores or the iodine behaviour in containment through notably a specific evaluation of the sump pH value or a new pool scrubbing model.

As to the code extension for diagnosis, the interfacing of ASTEC V2.1 with standard dispersion tools to predict environmental consequences was successfully achieved at IRSN end of April 2016.

This interface package (Deliverable **D30.32**) is now to be used at short term by both IRSN and GRS aiming at demonstrating its reliable operation through the realization of two practical exercises, i.e. applying respectively this ASTEC new interface to the French reference dispersion code pX (IRSN task) and to the German reference dispersion code RODOS (GRS task).

Besides, the deliverable **D30.33** “Methodology accounting for the uncertain information provided by plant instrumentation” was also completed by IRSN in April 2016 on the basis of the main lessons that have been drawn from the PhD thesis that was successfully achieved at IRSN in that field. The goal of this PhD was indeed to investigate whether the diagnosis capabilities of ASTEC in case of accident could be improved, using both the development of uncertainty theories and the extended current knowledge of severe accident phenomenology (methodology based on Bayesian networks for evaluating the probability of the different possible accident scenarios from the uncertain information provided by the plant instrumentation).

News from ASTEC Validation Work

As already reported in the last Newsletter Nr.3 the validation of ASTEC V2.0 series in CESAM has finished with creation of the deliverable **D20.24** “Synthesis of validation of ASTEC V2.0rev3 version” (Buck et al., 2015). Now that the ASTEC V2.1 series is available in CESAM and to all ASTEC partners beyond CESAM, validation will more and more focus on this new series of ASTEC development resulting in a final validation report **D20.25** “Synthesis of validation of ASTEC V2.1rev0 and rev1 versions” at the end of the CESAM project, i.e. in spring 2017. During the 7th ASTEC user’s club in Alkmaar first validation results applying this new V2.1 series have been presented by different partners. As the main progress is in the new modelling and coupling of the ICARE/CESAR part, examples for these modules are given below.

The first example is the LOFT LP-FP-2 experiment that has been calcualted by ENEA using the ASTEC V2.1 beta version and, later on, the first official release V2.1rev0p3. The LOFT facility is illustrated in Figure 1 and is composed of an intact loop and a broken loop. The LP-FP-2 experiment is a LOCA experiment that is terminated by reflooding of the severely damaged Central Fuel Module (CFM). While the usage of the beta version included the reflood phase, the updated V2.1rev0p3 version does not use DEBRIS model and thus had to be stopped before reflood.

The analyses performed with both versions give an identical calculation of thermodynamic properties during the pressure decrease phase as well as during the degradation phase, including pressure behaviour, water level in core as well as increase of cladding temperature. The calculated results are in very good agreement to experimental measurements up to the reflooding phase. As an example the calculated hydrogen production is shown in comparison to experimental data. In Figure 2 the beta version is applied with an underestimation after reflooding start. In Figure 3 the results of the latest ASTEC version are shown. Both calculations deliver very good results until start of reflooding phase. It has to be stated that calculation of the FP release fractions, as estimated before reflood in LP-FP-2 experiment, is significantly improved with the latest V2.1 version of the code with respect to V2.0 results.

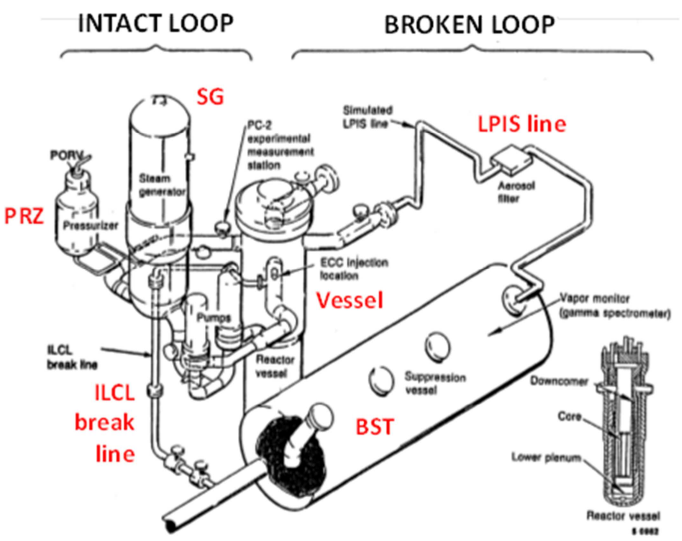


Figure 1: The LOFT Test Faciliy

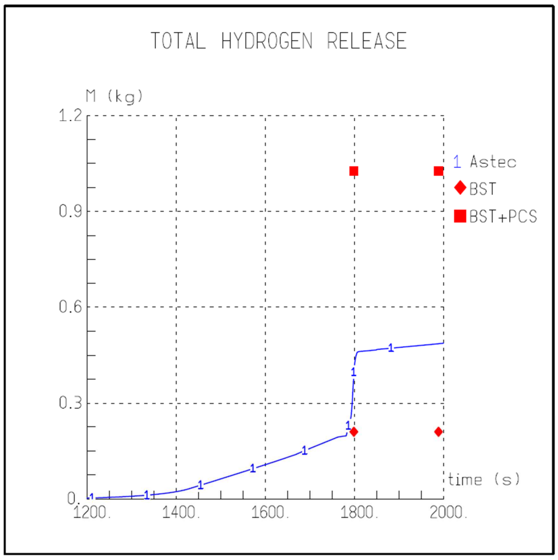


Figure 2: Hydrogen production ASTEC V2.1 beta

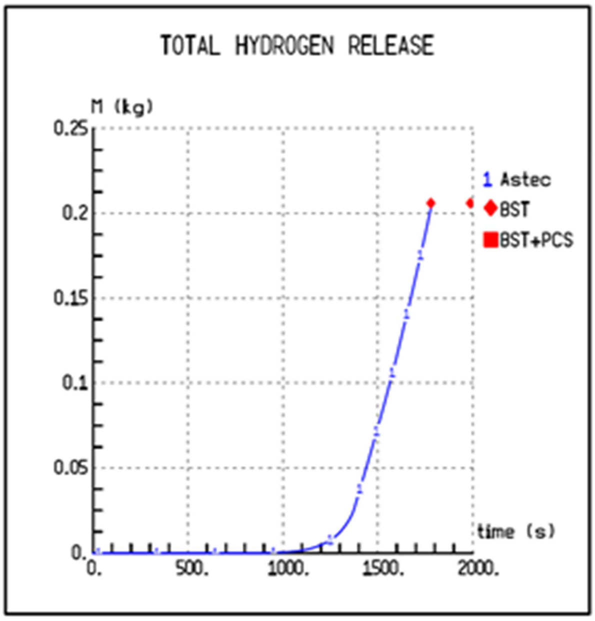


Figure 3: Hydrogen production ASTEC V2.1rev0p3

ASTEC News from Model Validation

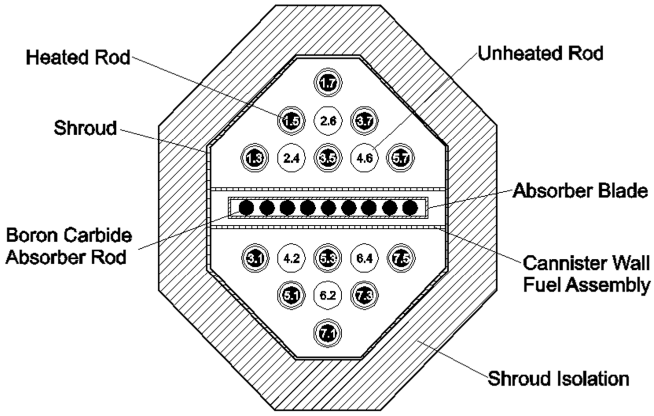


Figure 4: BWR like geometry in CORA-17 experiment

Another example of ASTEC V2.1 validation is the post-calculation of the CORA-17 experiment by RUB. This experiment is conducted explicitly for BWR geometry, taking into acount a simplified bundle box including absorber blade, canister walls of fuel assembly, shroud and heated and unheated fuel rods. The geometry of the experimental test assembly is given in Figure 4. The hexagonal structure contains 11 B_4C absorber rods, a stainless steel absorber blade, Zry-4 shroud and 18 UO_2 rods, from which 12 are electrical heated. The hexagonal structure had to be transferred to cylindrical geometry in the simulation since it is mandatory within the ICARE module. Due to the ICARE specific modelling the canister is radially meshed, which does not allow canister oxidation within the CORE bundle model of ICARE. All component and streaming path cross sections have been kept at the original value. The experiment consisted of 3 phases starting with a gas pre-heat phase, following a degradation phase and finally the quenching or cooldown phase. These phases can be well recognized in Figures 5 and 6 that show the temperature evolution in cladding and blade at different heights over time. During the pre-heat phase temperatures stay constant. The degradation phase is visible on the basis of rising temperatures. Finally during the quenching phase the temperatures decrease rapidly. Both Figures compare ASTEC results with solid lines to experimental data marked by dashed lines. During the degradation phase from 3000 s to 5000 s, temperatures rise from about 500 – 600 K up to 2400 K. The temperature distribution at different locations in the cladding is not correctly simulated with ASTEC. At some locations the experimental values are overestimated while at others they are underestimated. Within the blade the temperature is underestimated in all locations. That leads to a wrong prediction of material relocation as it is visible within the sudden drop of measured temperatures.

Further the temperature drop during the quenching phase is overestimated by ASTEC. The experimental temperature decrease is much slower than the calculated values.

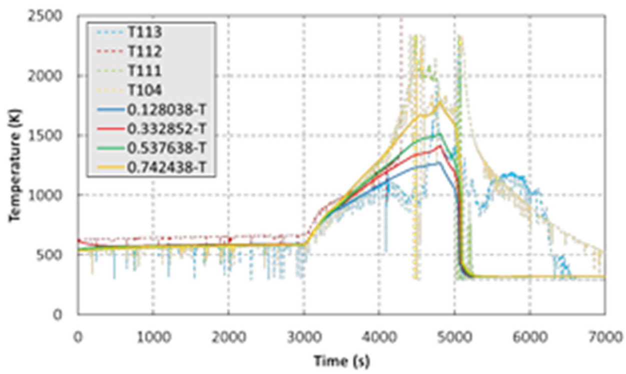


Figure 5: CORA-17 Cladding temperatures

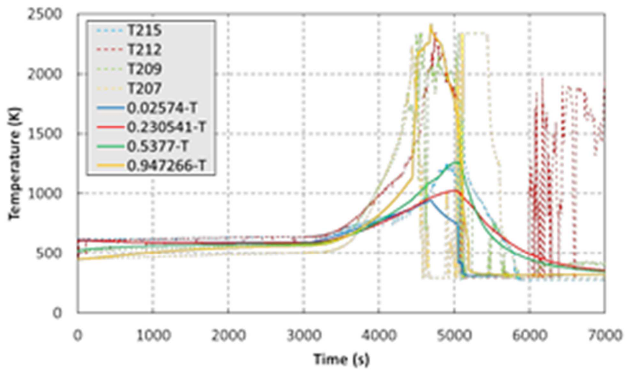


Figure 6: CORA-17 absorber blade temperatures

The performed analysis is a preliminary attempt to use the ASTEC capabilites to simulate BWR specific geometry and thus deliver valuable experiences of applying these new capabilites to well-known experiments in the frame of BWR core degradation. Summarizing, ASTEC V2.1 is in good accordance to experimental data during the pre-heat and beginning degradation phase, but discrepancies exist during the later degradation phase and quenching phase. Within the ICARE model the missing heat generated from CANISTER oxidation leads to a lack of energy release and finally to less material relocation. At the beginning of the quenching phase, wrong geometrical boundary conditions also deliver wrong estimation of temperature decreases.

Currently, it has to be stated that all ASTEC users will take some time to learn the specifics of the V2.1 version. But availabilty of these new models will allow a successful validation of ASTEC V2.1 until the end of CESAM lifetime, i.e. March 2017.

News from ASTEC Plant Applications

Next to the significant improvement of the ASTEC code towards simulating SAM, the CESAM project includes as a key part plant applications. Generic models for types of NPP widely used in Europe will be made available to code users, and accident scenarios with operator action will be simulated to demonstrate ASTEC V2.1 capabilities in analysing the impact of SAM actions.

The past year of the CESAM project has been characterised by ASTEC V2.1.0 becoming available and being successively released in several patch versions, giving partners the chance to make the required changes to input decks and to work with ASTEC V2.1. IRSN has supported users through its GForge portal in solving problems and communicating solutions to the community.

For the remaining months of the project it is important that the focus shifts towards the Deliverables in the plant application work package. This will be the completion of well documented and validated generic reactor models and the application of these models in demonstrating the effectiveness of SAM measures using the gained capabilities of ASTEC V2.1.

PWR 900 MWe "Reference Dataset"

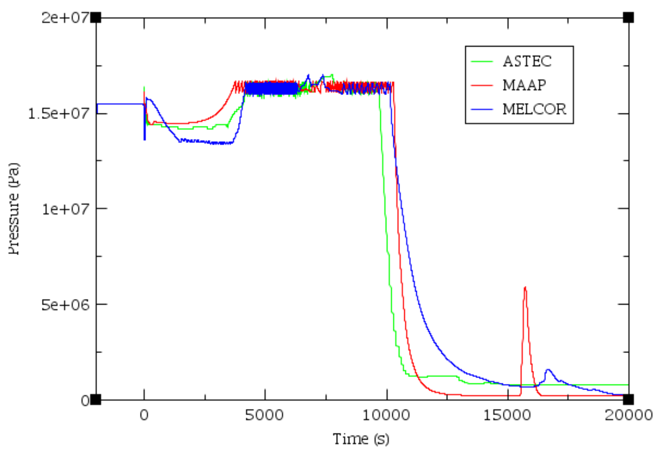


Figure 7: Primary pressure during unmitigated SBO with stuck-open valve

In the work on this generic model, ENEA and JRC have combined efforts to compare results of ASTEC V2.1.0, MELCOR 2.1 and MAAP 5.0.2 for an unmitigated SBO, with the safety relief valve assumed to stuck open when the core exit temperature reaches 650°C. Within CESAM, the PWR900-LIKE model provided with the ASTEC distribution has been modelled as closely as possible in both MAAP and MELCOR, and steady-state was shown to match well. Preliminary results shown at the CESAM Alkmaar workshop display agreement in general features of the accident transient, but also significant differences for the timing of specific events, and for e.g. H2 production.

It was pointed out that some of the differences obtained with ASTEC could be solved by adjusting the default pressure drops in the vessel and the primary circuit. The work is ongoing and improves the understanding of differences in models and codes.

While it is not part of the CESAM activity itself, IRSN used the combination of the 3rd CESAM workshop with the ASTEC users group meeting to show applications of the PWR900 input deck to shutdown states. Calculations of steady-state for several scenarios with different initial conditions have been carried out with ASTEC V2.1 and match within a few percent the results achieved with ASTEC V2.0. Work is ongoing on transient calculations.

KONVOI 1300 MWe "Reference Dataset"

Work on this German-style PWR type is shared between GRS, who have provided the ASTEC V2.0 input deck, and the partners from KIT and the universities of Bochum and Stuttgart. The latter have in the past year worked on completing and making run the KONVOI ASTEC V2.1 model and have developed the severe accident scenarios that they will contribute to CESAM, still under ASTEC V2.0 or already using V2.1.

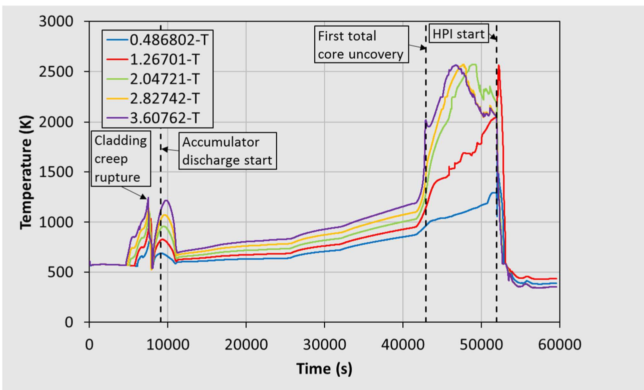


Figure 8: KONVOI 1300 core temperatures' evolution during an SBLOCA

Steady-state achieved with the ASTEC V2.1 input deck is good. First transient calculations have been carried out for a SBLOCA, and results checked for plausibility. Temperature evolutions from such a calculation are displayed in Figure 8. The scenario features a late reflooding (of the dried-out core) for which the ASTEC model is still under development.

Also, for a LBLOCA, variations on the duration of water injection availability and the impact on the accident evolution have been analysed. This was done with ASTEV V2.0, with a view of applying V2.1 in the next step.

News from ASTEC Plant Applications

VVER-440/213 "Reference Dataset"

The work on developing a detailed VVER-440 input deck for ASTEC V2.1 is on-going. At the moment, this effort is in the phase of de-bugging errors that are experienced. As in all other models developed, IRSN is supporting the effort by solving issues reported to its GForge support platform.

VVER-1000 "Reference Dataset"

The translation of the existing ASTEC V2.0 input deck, based on a reactor in Bulgaria, to V2.1 has been worked on by INRNE and BARC since the end of 2015. Stand-alone models for primary and secondary loops (CESAR) and the core (ICARE) were developed and have in the meantime been coupled to containment CPA. The SOPHAEROS models have also been activated.

At the end of February 2016, work was on-going on improving the match of the model's steady-state results with the reference plant.

GE BWR4 – MARK I "Reference Dataset"

By late 2015, the Mark I containment model was upgraded to ASTEC V2.1 by CIEMAT; similarly, the reactor core ICARE/CESAR model was translated to V2.1 by GRS, and was functional in stand-alone mode; see also Figure 9.

JRC have integrated the partner contributions (also the cavity by LEI) with the systems, sensors and regulations, leaving mainly the modelling of the fission products to be added.

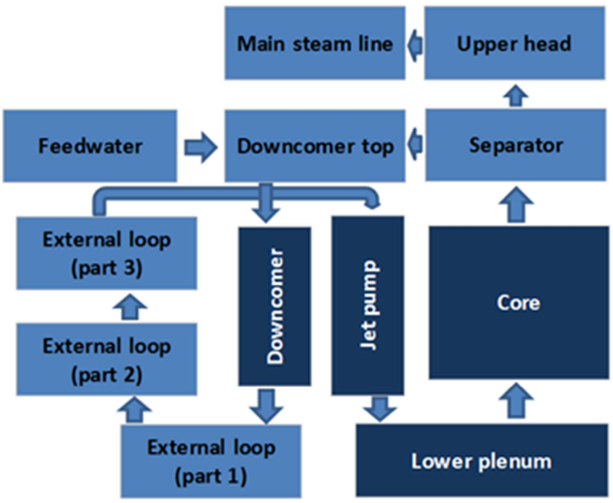


Figure 9: BWR4 Mark I: CESAR volumes and their connections to ICARE channels

The input generated has been updated, and it includes: (i) the RCIC system that injects water to the feedwater volume. RPV water level and pressure trigger this system; (ii) the LPCI system and, (iii) the jet model for the recirculation loops with a regulation taking into account the contributions of the RPV, and the wetwell and drywell venting. Further systems implementation works are going on, and some additional contributions are expected.

The effort is now focused on stationary and transient calculations to complete the validation of the model.

PHWR CANDU "Reference Dataset"

Given the very different geometry of CANDU reactors as compared to the typical PWR reactor, the development of this reference dataset implies the code development of specific models in ASTEC as well as the use of the more flexible geometry options that were introduced by ASTEC V2.1. BARC works on these developments in close cooperation with IRSN.

The PHWR-specific module created computes physical quantities like pressure tube deformation, temperatures in contact locations of pressure ans calandria tubes, and the boiling heat transfer around calandria tubes.

With the models made available, an input deck has been created and calculations carried out for a LOCA with SBO, comparing cases with moderator boil-off, re-start of moderator injection and calndria vault wter injection.

Spent Fuel Pool "Reference Datasets"

Several users groups have created ASTEC V2.1 input decks for the SFP mostly relating to the reference plant they are also concerned with.

For a BWR Mark 1 SFP, LEI have shown the analysis of a loss of coolant event – leakage through a Ø10cm break at the bottom of a pool filled with 3055 fuel assemblies – at the recent CESAM Alkmaar workshop. The model predicts the slump of corium after 68 hours. LEI plans to refine this modelling, to include Zr oxidation in air, and to also simulate a loss of cooling "boil off" scenario. Results are to be compared with results from RELAP/SCDAPSIM code.

ASTEC adaptation to Sodium-cooled Fast Reactors

The main progress of activities on ASTEC-Na in the frame of the JASMIN FP7 project on sodium-cooled fast reactors since summer 2015 is shortly summarized below. The project extension by 6 months has been accepted by EC: the project will thus finish at the end of May 2016.

On core neutronics, the refinement of the zero-point kinetics model was implemented in v2.0 and the next step is the extension to Na boiling. The second phase of the benchmark on the Working Horse core of the CP-ESFR the FP7 project will extend after Na boiling.

On fuel behaviour, calculations of the CABRI AGS0, E9 and LT2 tests were performed again with the latest version ASTEC-Na v2.0. The calculations of the A4 and E7 tests have started, as well as the calculation of the SCARABEE Be+3 test in bundle configuration.

The formulations of 316 SS flow stress and strain limit model are being adapted to code developers' specifications (strain rate parametrization). The clad plastic models will soon be adapted to SCANAIR programming environment and extended to other clad materials.

Sensitivity studies are being done on RIA models, which should lead to identify the needs of modelling improvements.

On Na thermal-hydraulics, the analysis of the existing model with respect to boiling onset and two-phase flow behaviour on ISPRA Tubular test led to identify a few modelling improvements, such as interfacial/parietal friction. New correlations are being implemented and a validation task is planned on KNS-37 Na boiling experiment. In the meantime, the thermal-hydraulic module has been compared to several experiments in the JASMIN test matrix, like some from the CABRI reactor or even from the PHENIX reactor, and a good consistency has been found particularly during the single-phase flow of the tests.

On source term, the main work consisted in an upgrade of the particle generation model and in the start of the assessment of the aerosol ageing model on analytical tests. Both models have been validated as far as possible against data collected from the open literature, coming mostly from the ABCOVE and FAUNA experimental programmes. Even though ASTEC consistency with experimental trends looks promising, there is still work to do concerning comparison against a more robust and representative database. Uncertainty analyses are being done on source term evaluation, which should lead to identify the needs of modelling improvements.

A new version of ASTEC-Na v2.0 was released in October 2015. It included diverse modelling improvements, mainly

- Updated laws for MOX fuel mechanical behaviour
- Additional state law for computing the fuel swelling through the intra and inter granular bubble pressure calculation
- Updated version of MDB with MOX thermal and physical properties vs [Pu], burn-up, stoichiometry and fuel porosity
- Implementation of a first in-pin fuel motion model in ICARE
- Implementation of two models in CPA for Na oxide particle nucleation and their subsequent physico-chemical transformation
- Refinement of the zero-point neutronics model

A new V2.1 version is planned to be released in June 2016, being the final version at JASMIN's end.

7th ASTEC User's Group / 3rd Periodic CESAM Workshop

Within the CESAM project, in total four workshops are conducted from 2014 to 2017. The first one was held in Ljubljana in March 2014 and the second one in Bologna in February 2015. This second workshop has also been conducted as the 6th ASTEC users' club meeting, including all ASTEC users also beyond CESAM.

The third periodic workshop now also has been conducted as 7th ASTEC user's club. It took place at the TAQA Theater De Vest in Alkmaar, The Netherlands, from 29/02/2016 to 03/03/2016. In total, 56 participants from 29 institutions (see below the picture of the attendance) presented and discussed their work on all technical CESAM WPs as well as on ASTEC topics beyond CESAM during two full and two half days of the workshop. 10 of the 56 participants were from institutions that are not members of CESAM project. In total 30 presentations have been given by 19 institutions.

The workshop has been separated in different sessions starting with "Code Development" on Monday afternoon, in which session the main developer IRSN gave an overview of the modelling capabilities of the new ASTEC V2.1 series. Further IRSN summarized the activities started on user feedback gained through questionnaires and the GForge bug tracking site. The Tuesday morning session on "Assessment and Validation" still comprised presentations on the old ASTEC series V2.0, but more and more the focus switcheds on results using the new version V2.1.

Covered were very different topics like re-flooding of degraded core, fission product behaviour in the containment or the consequences of hydrogen deflagrations. Some partners gave an "overview" of the ASTEC activities performed in their organisation on Tuesday afternoon. The focus of this Workshop was on "Plant applications" with sessions on Wednesday and Thursday morning. The topics covered applications to PWR, BWR and CANDU-like reactor types as well as applications to spent fuel pools, again with both current ASTEC series applied.

The workshop was very well organized by JRC-IET in Alkmaar and the technical presentations given during the different sessions were of high quality. Most of the presentations were followed by constructive discussions and gave further important insights on modelling capabilities of ASTEC, recommendations for usage of models and correlations, and identification of code deficiencies of the current versions. Especially, first applications of the new V2.1 version gave insight on what is to be expected from this new branch of ASTEC development. Participants were informed about the status of this new version that will be used for a wide range of tasks during the last year of the CESAM project.

The final CESAM workshop will take place in Karlsruhe from March 13th to 15th 2017.

3rd CESAM Workshop in Alkmaar

ASTEC Training Activities

Training thought the CESAM Mobility program

In the frame of the CESAM Project, the mobility program offered quite unique opportunities for PhD students or young researchers to participate to the mobility program dedicated to improve the skills on performing simulations and developing nuclear power plant models for ASTEC.
In 2015, two doctoral students, one of KIT and another one of RU Bochum, spent six months each in Cadarache working closely with the code developers on issues related to code validation and plant applications.
This helped to considerably improve the QUENCH and CORA models for the latest ASTEC version. In addition, the ASTEC model for the generic PWR Konvoi reactor, developed by GRS and extended by KIT and RUB for selected SA accident scenarios were reviewed and, in close cooperation with the code developers, considerably improved. Of special importance was to learn how to optimize the development of large input decks for plant analysis using the functionalities offered by ASTEC code. This contributed to reduce the errors and to speed-up the development of complex input decks.
This fruitful cooperation and knowledge-transfer from the code developers to the doctoral students led to the publication of common journal papers.

In the next months, another applicant from BARC for the mobility program will work on the development of models to simulate the transition from LCDA to SCDA in PHWR of India for ASTEC. Key phenomena like moderator boil-off, exposure of rows of channels, sequential disassembly of channels, debris bed (consists of channels) gradual formation etc. in calandria need to be considered in the model development. Finally it is envisaged to develop a single input deck for severe accident and SAMG evaluation for PHWR.

Setting up of an e-learning tool for ASTEC

An ASTEC e-learning module will be set up within the dissemination work package WP50 of the CESAM project. The tool is designed to support the use of ASTEC by providing an overview of its features; it is addressed to students and new users of the code.

For the module, the code development team at IRSN has contributed information to set up 12 modules, on issues ranging from general descriptions of Severe Accident, the CESAM project or the evolution of ASTEC to the role and features of ASTEC modules that the user needs to use when defining the input deck for a plant and a scenario of his/her choice. Users will be able to follow slides and spoken text for each module, and will be quizzed by multiple choice after each module.

A call for tender is being launched for finding a contractor that will program the e-learning tool. The software will be available at the end of the CESAM project.

New ASTEC Publications

SCIENTIFIC JOURNALS: year 2015

Haste T., Steinbrück M., Barrachin M., De Luze O., Grosse M., Stuckert J., "A comparison of core degradation phenomena in the CORA, QUENCH, Phébus SFD and Phébus FP experiments", *Nuclear Engineering and Design,* 283 (2015), p.8-20

Van Dorsselaere J.P., Auvinen A., Beraha D., Chatelard P., Herranz L.E., Journeau C., Klein-Hessling W., Kljenak I., Miassoedov A., Paci S., Zeyen R., "Recent severe accidents research: Synthesis of the major outcomes from the SARNET network", *Nuclear Engineering and Design*, vol.291 (Sept.2015), p.19-34

Di Giuli M., Sumini M., De Rosa F., "Modelling of AP1000 and simulation of a 10-inches cold leg small break LOCA using the CESAR thermalhydraulic module of ASTEC", *Progress in Nuclear Energy,* 83 (2015), 387–397

Gencheva R., Stefanova A., Groudev P., "Plant application of ICARE/ASTECv2.0r3 computer code for investigation of in-vessel melt retention in VVER-1000 reactor design", *Annals of Nuclear Energy*, 81 (July 2015), pp 207-212

Hermsmeyer S., Pascal G., Gremme F., Lajtha G., Techy Z., Bujan A., Lind T., Reer B., Raimond E., Chatelard P., Foucher L., Sonnenkalb M., Nowack H., Barnak M., Matejovic P., Iglesias R., Herranz L.E., Stefanova A., Sangiorgi M., Vela Garcia M., Pla P., "Review of current SAM approaches in Europe and identification of related modelling requirements for ASTEC V2.1", *ATW - International Journal for Nuclear Power,* Vol 20 (July 2015)

Povilaitis M., Kacegavicius T., Urbonavicius E., "Simulation of the ICE P1 test for a validation of COCOSYS and ASTEC codes", *Fusion Engineering and Design,* 94 (2015)

Virot F., Barrachin M., Vola D., "Progress on source term evaluation of accidental events in the experimental fusion installation ITER", *Fusion Engineering and Design,* 98-99 (2015), p. 2219-2222

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- Chatelard P., Belon S., Bosland L., Carénini L., Coindreau O., Cousin F., Marchetto C., Nowack H., Piar L., Chailan L, "Main modelling features of ASTEC V2.1 major version", *Annals of Nuclear Energy,* Vol.93 (July 2016), pp. 83-93
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Relevant Conferences and Workshops

Conferences:

- International Conference in Nuclear Engineering (ICONE-24). June 26-30.2016 in Charlotte, USA.
- The European Forum (ECN-2016) to discuss Nuclear Science & Technology Issues, Opportunities & Challenges. October 9-13, Warszaw, Poland
- International Congress on Advances in Nuclear Power Plants (ICAPP-2017). April 24-28, Fukui and Kyoto, Japan.
- International Topical Meeting on Nuclear Thermal Hydraulics, Operation and Safety (NUTHOS-11). October, 9 to 13. 2016. Gyeongju, Korea.
- 22nd Quench Workshop on 18-20 October 2016 at Karlsruhe Institute of Technology, Campus North.
- EUROSAFE Forum 2016. November 7-8. 2016, Munich, Germany.

Related Projects and Project's Webpages:

- PASSAM: https://gforge.irsn.fr/gf/project/passam
- SARNET: www.sar-net.eu
- NUGENIA: www.nugenia.org
- FASTNET: FAST Nuclear Emergency Tools
- IVMR: In-Vessel Melt Retention Severe Accident Management Strategy for Existing and Future NPPs

Related OECD Activities

- WGAMA: Working Group on Analysis and Management of Accidents
- BSAF: OECD/NEA Benchmark Study of the Accident at the Fukushima Daiichi Nuclear Power Plant Project

Next CESAM workshop:

4th CESAM Workshop / Fukushima Meeting:

March 13th – 15th 2017
Karlsruhe KIT CN
Organized by KIT/INR

About us

This Newsletter is a common effort of the EC Project CESAM to inform potential ASTEC users, e.g. regulators, industry and universities or research institutions about the latest developments of ASTEC and the status of the validation and plant applications.