Severe Accident Research Network of Excellence – NUGENIA Technical Area N°2
Newsletter N°10 (August 2017)

The main events since the last Newsletter N°9 (published in early 2016) concern the European Commission H2020 Call on the Work-programme 2016-2017 with publication of results in early 2017 and the ERMSAR-2017 conference in April 2017 that was a great success. But many activities continue in TA2/SARNET such as technical workshops, launching of new in-kind projects and soon the 6th short course on severe accident phenomenology in Slovenia.

General news on SARNET

Some information is briefly given in this Newsletter on the FP7 or H2020 R&D projects that are closely linked to TA2/SARNET: either finished in the last months, or starting recently, or ongoing: respectively PASSAM and CESAM, SAFEST, ALISA, and IVMR. The status of two in-kind projects launched in TA2/SARNET frame is also described: CoreSOAR and IPRESCA.

As in previous years, successful workshops were held on progress of R&D on the in- and ex-vessel corium behaviour. And the 6th one-week course on severe accident phenomenology will be hosted by JSI in Slovenia in October 2017.

Discussions have recently progressed on the potential cooperation between NUGENIA and the European Radiation Protection (RP) Research Platforms (MELODI, EURADOS, NERIS and ALLIANCE). Both associations will enhance the dialogue about the respective Strategic Research Agendas or research roadmaps. A first step is the invitation of NUGENIA to the Radiation Protection Week in October 2017 and the organization of a side meeting during this event to examine together how extending in practice the collaboration process.

An important action is planned in the next 8 months: the update of the severe accident part of the NUGENIA "condensed" (60-pages long) R&D roadmap that was published in 2013. For that objective, the SARP (Severe Accident Research Priorities) group will resume from September its activities that stopped in 2013 at the end of the SARNET2/FP7 project. The process will be now coordinated by JRC.

All events (workshops…) are announced on the NUGENIA public website (www.nugenia.org) and on the SARNET public website (www.sar-net.eu).

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H2020 Call and new R&D proposals

Three proposals on severe accidents have been submitted in Sept.2016 to the Work-programme 2017-2018 of the H2020 Call but they were rejected, mainly due to a strong concurrence in the Topics on Gen.II-III NPP safety:

- USTA ("Uncertainties in Source Term Assessments"), proposed by CIEMAT, on estimation of uncertainties affecting source term predictions,
- SAMHYCO ("Severe Accident Management HYdrogen and Carbon monOxyde. Improvement of hydrogen and carbon monoxide explosion risk assessment models and safety management procedures"), proposed by IRSN, on the severe accident long term management of risk of gas explosion,
- E2VR ("European Ex Vessel Retention project"), proposed by CEA, on corium retention in the reactor cavity.

The 2nd one is being proposed to run as "in-kind" project in the TA2: still coordinated by IRSN and named SAMHYCO-NET, it is under elaboration with a core group of interested partners (probably around 20 initial SAMHYCO partners). The kick-off meeting is planned at end of Sept.2017.

Both other ones may be submitted again at the H2020 next call on the Work-Programme 2018 (and last call in H2020 before the FP9 new period). This call is planned to be published in autumn 2017, for submission of proposals in September 2018 and a start of new projects in spring 2019.

Another TA2 "in-kind" project has been launched in June 2017: see below the section on IPRESCA.

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Progress of the IVMR H2020 project on in-vessel-melt-retention

The first tasks of the IVMR project have already allowed drawing preliminary conclusions. The most obvious one is that most current SA codes are suitable for deterministic and probabilistic evaluations of In-Vessel Retention (IVR) but they must be carefully used with appropriate options and some models must be updated. Another important conclusion is that, when using severe accident system codes and dealing with transient situations, the most significant criterion for the success of IVR is the minimum residual thickness of vessel wall rather than the classical comparison of internal heat flux with the external CHF which is only relevant for steady-state evaluations.

Small-scale experiments performed with prototypic corium by NITI (Russia) have shown that it is actually possible to observe the transport of molten steel through the top oxide crust, leading to an inversion of stratification.

Evidence of steel transfer across the oxide crust and thinning of top metal layer (from NITI)

Large scale experiments with simulants (SIMECO-2 at KTH and LIVE at KIT) are under preparation to investigate the heat transfers in various situations of stratified molten pools under transient conditions.

The perspectives of use of CFD codes to provide reliable evaluations of situations that are not covered by experimental data are promising. The first studies show very satisfying results on the in-vessel pool simulant benchmarks.

Detailed mechanical codes are being used to evaluate the resistance of the vessel after significant ablation. A preliminary EDF study showed that a 16 mm thick wall (corresponding to 2 MW/m^2 heat flux) would not fail, even at pressure up to 30 bars.

Finally, from the first reactor calculations results, an analysis of scenarios and design parameters revealed there is a critical time window during which, if the vessel lower plenum remains filled with water, the IVR strategy can be successful even for high power reactors. Among the influent parameters, the “minimum mass” of molten steel in the corium pool in the vessel lower plenum was identified as the most sensitive parameter.

Several requests of participation from Korea, China, Russia, Ukraine and Belgium have been received and were already appreciated positively by the project partners.

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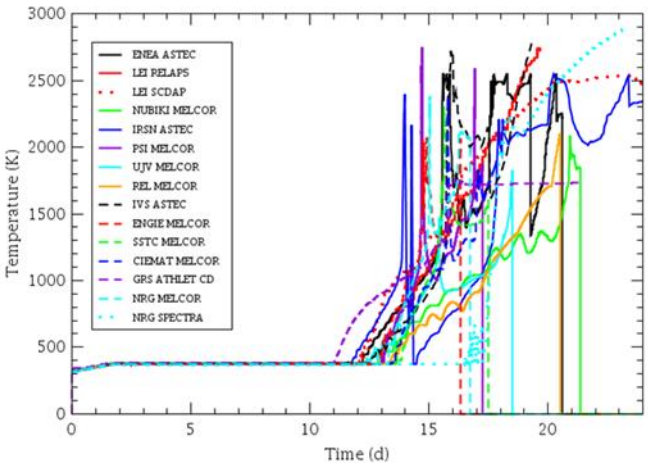
Learnings from the AIR-SFP project in NUGENIA+ frame

Spent fuel pools (SFPs) are large structures equipped with storage racks designed to temporarily store irradiated nuclear fuel removed from the reactor. SFP severe accidents have long been considered as highly improbable since the accident progression is slow (in comparison with reactor core accidents) and let time to corrective operator actions. However, the accident at the Fukushima Dai-ichi Nuclear Power Plants has highlighted the vulnerability of nuclear fuels that are stored in SFPs in case of prolonged loss of cooling accidents and consequently renewed international interest in the safety of SFPs. In this context, the AIR-SFP project, funded by the Euratom 7th FP in the frame of the NUGENIA+ project, was launched in May 2015 with 15 participants.

The first objective of the project was to assess more precisely the applicability of SA codes to the calculation of transients in SFPs through a benchmark. This exercise was carried out on SFP geometry similar to the unit 4 of the Fukushima Dai-ichi Nuclear Power Plant for two scenarios

(boildown and small LOCA). For the degradation phase, the following codes were used: MELCOR (CIEMAT, ENGIE, NRG, NUBIKI, PSI, REL, SSTC NRS, UJV), ASTEC (ENEA, IRSN, IVS, JSI, LEI), ATHLET-CD (GRS), RELAP/SCDAPSIM (LEI) and SPECTRA (NRG). The criticality phenomena have been investigated in parallel by ENEA, KIT, GRS, NRG and LEI to determine under which accidental thermal-hydraulic conditions the criticality limit could be reached. The computation of the degradation phase has put in evidence that the onset of heat-up of the hot fuel assemblies (FAs) is in rather good agreement for the boildown scenario but not for the LOCA scenario (which shows a high sensitivity to pipe breach modelling) . For both scenarios, the heating rate of hot FAs differs by a factor of 3 and there is an even larger scattering for cold FAs.



Evolution of the peak cladding temperature of the recently unloaded core for the loss of cooling scenario

The total amount of hydrogen produced differs significantly by a factor of 5 for the boildown scenario and by a factor of 10 for the LOCA scenario. It was demonstrated that the first source of discrepancy is the modelling of the configuration of the storage racks (and not the code used) leading the participants to recommend the writing of guidelines for SFP studies. The second source of discrepancy is the difference in physical models between SA codes: thermal-hydraulic models, heat transfer modeling (especially between the racks), modeling of cladding oxidation under air/steam mixtures that drives the heat up. Another source of discrepancy is the choice of user options in the code input decks, often linked to absence of clear guidelines for such SFP applications.

For the criticality risk assessment, comparable results have been obtained by the participants in non-accidental conditions and an increase of the k_{eff} from about 0.785 to about 0.819 was computed in accidental conditions (increased neutron coupling between FAs due to the decrease of water absorption). It was finally shown that the safety limit (0.95) may be exceeded if reactivity increase due to Gadolinium depletion is added to specific accidental conditions (high decay power).

The AIR-SFP project has enabled to evaluate the SA codes readiness to address these "beyond-scope" scenarios. SA codes can be used for SFPs application only with a careful examination of modelling assumptions, a deep understanding of simulated processes and considering the high uncertainty of simulation results. Further R&D activities are thus recommended in order to improve SA code response.

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Status of the SAFEST and ALISA FP7 projects on experimental platforms

The **SAFEST** (Severe Accident Facilities for European Safety Targets) project started in FP7 frame in mid-2014 for 4 years. One of its main objectives is to integrate major European research facilities into a pan-European laboratory for severe accident and corium research and to provide these facilities for access to interested user groups from the EU member countries for better understanding of possible severe accident scenarios and corium behaviour. After publishing the rules of access to the SAFEST facilities in October 2014, two calls for proposals were announced attracting the interested users to specify the experimental requirements and conditions. Following each call, the user selection panel with the help of independent international experts evaluated the proposals and selected a short-list of user groups. Together with facility operators the user groups prepare, perform, analyse and document the experiments. Total of 16 experiments have been selected to be performed in SAFEST test facilities, eight experiments have been successfully performed up to now, other tests are scheduled for late 2017 and early 2018.

The draft of the European corium experimental research roadmap was completed in 2016 with the help of many contributors from the various SAFEST partners. The roadmap is based on the research

priorities determined by the SARNET SARP group as well as those from the NUGENIA TA2 on severe accidents. It also takes into account issues identified in the analysis of the European stress tests and from the interpretation of the Fukushima-Daiichi accident. The roadmap takes advantage of the current and developing European corium infrastructures and, if necessary, recommends its adaptation.

More information about the project is published on the project website at http://www.safest.eu.

The objective of **the ALISA** (Access to Large Infrastructures for Severe Accidents) project, started in FP7 frame in mid-2014 for 4 years is to provide a transnational access to research facilities in Europe and in China to allow the optimal use of the resources in the complex field of severe accident analysis. European research groups can propose and perform the tests in the facilities in China, and Chinese researchers can get access to the experimental facilities at KIT and CEA. Funded by the EC and the ALISA project partners, no facility costs arise for the guest institutions.

After two calls for proposals and subsequent evaluation by the user selection panel (with the help of independent international experts), six experiments in European facilities and six experiments in Chinese facilities have been selected. Four experiments in Europe (HYKA, LIVE, KROTOS and VITI) and three experiments in China (HYMIT, COPRA and IVR2D) have been successfully performed up to now. Other tests are scheduled for 2018.

The 3rd ALISA Review Meeting will take place at the Karlsruhe Institute of Technology (Germany) from October 10 to 12, 2017.

More information about the project is published on the project website at http://alisa.xjtu.edu.cn.

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The PASSAM FP7 project on source term mitigation

The PASSAM (Passive and Active Systems on Severe Accident source term Mitigation) project was launched in the frame of the 7th framework programme of the European Commission. Coordinated by IRSN, this four year project (2013 – 2016) involved nine partners from six countries: IRSN, EDF and University of Lorraine (France); CIEMAT and CSIC (Spain); PSI (Switzerland); RSE (Italy); VTT (Finland) and AREVA GmbH (Germany).

It was mainly of an R&D experimental nature and aimed at investigating phenomena that might enhance source term mitigation in case of a severe accident in a Nuclear Power Plant (NPP). Both already existing systems (i.e., water scrubbing and sand bed filters plus metallic pre-filters) and innovative ones (i.e., high pressure sprays, electrostatic precipitators, acoustic agglomerators and, advanced zeolites and combined wet-dry filtration systems), were experimentally studied in conditions as close as possible from those anticipated for severe accidents.

About existing systems, extensive studies on pool scrubbing led to a better understanding of hydrodynamics in the jet injection regime (although complementary experiments should be done) and in SGTR situation with the secondary side still flooded. The effect of sea water and water with surfactant was also studied and the effect on the decontamination factor for aerosol was evidenced. In addition, potential delayed release of iodine trapped in a scrubber solution was observed and analyzed. Finally a study on trapping of organic iodine by scrubbing concluded to a non-sufficient retention, in spite of many different solutions studied. Sand filters and metallic pre-filters (French system) were also studied as solid filtration systems. It was confirmed that organic iodides are not trapped by these systems while molecular gaseous iodine may be trapped on the metallic prefilter. It was also evidenced that CsI aerosols trapped on the sand filter may lead to a delayed release due to the non-stability of CsI under temperature and irradiation.

About innovative systems, acoustic agglomerators, high pressure sprays and wet electrostatic precipitators (coupled to an ozoner in order to transform gaseous iodine into particles of iodine oxides) showed potential interesting performances. Nevertheless, their applicability as FCVS or as pre-conditioners upstream a FCVS is not straight forward. A large experimental data set was obtained on zeolites, in particular on their high capacity for trapping gaseous iodine, including organic iodides. The stability of iodine trapped by zeolites was confirmed under temperature and irradiation. Finally, a combined wet (pool scrubber

operated at the pressure of the containment) and dry (zeolite operated at atmospheric pressure) was developed and studied in "representative" conditions: the retention efficiency for organic iodine was above 98%.

Globally, in-depth analysis of the experimental results allowed a deeper understanding of the phenomena involved in the performance of the mitigation systems studied, and simple models or correlations which should be easy to implement in accident analysis codes, like ASTEC could be proposed for several PASSAM experimental studies.

The main technical outcomes of the project were presented in a final workshop held on February 28th and March 1st, 2017 in Paris (France) and documented with more details in the final synthesis report of the project.

PASSAM Final Workshop - Paris - February 28th and March 1st, 2017

Note that all the public documents of the project are available on ***a dedicated PASSAM web site at https://gforge.irsn.fr/gf/project/passam/***.

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The CESAM FP7 project on ASTEC integral code

The CESAM (Code for European Severe Accident Management) FP7 project was coordinated by GRS (Germany) with a strong IRSN involvement (www.cesam-fp7.eu). It involved 19 partners from Europe and India, including the European JRC. It aimed at the improvement of the European reference code ASTEC for use in Severe Accident Management (SAM) analysis. It ended in March 2017 with a final workshop hosted by KIT in Karlsruhe that gathered about 50 code users.

One first outcome is the new V2.1 series of versions that are able to model adequately BWR and PHWR. This series contains a new coupling of thermal-hydraulics module CESAR in the reactor cooling system with the core degradation module ICARE, enhanced physical models and core components and enhanced robust numerics. In addition the ASTEC capabilities for support to emergency situations have been enhanced by a coupling to environmental consequence tools and estimation of the current plant status.

The validation work showed the general capabilities of ASTEC to simulate most of the relevant severe accident phenomena at the state-of-the-art, particularly in-vessel corium retention, ex-vessel corium coolability, hydrogen behaviour in the containment, as well as consideration of source term mitigating phenomena like applicability of filtering and pool scrubbing. Although some areas still need further modelling improvements, such limitations also apply for all current severe accident code (such as, beyond ASTEC, MELCOR and MAAP).

Another outcome of the project is a library of reference input decks for different NPP-types under operation in Europe (PWR including Konvoi, VVER-440 and 1000, BWR) and for several SA-sequences. These generic "reference" input decks capitalize the users' whole experience and developers' recommendations and should allow any user to adapt them to their own NPPs in the future. These input decks were successfully applied in plant applications with a special focus on simulation of severe accident management measures.

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ERMSAR-2017 conference

The 8th Conference on Severe Accident Research (ERMSAR-2017) was hosted by NCBJ (National Center for Nuclear Research) in Warsaw (Poland) on 16-18 May 2017. It gathered 179 participants from 27 countries and 84 organizations, at the high level of the previous ERMSAR-2015 one. This conference displayed the intense research activities, originated in the SARNET projects and now linked to the NUGENIA association. The conference can be considered as a success through the number of participants and the scientific quality of papers.

The main objectives were to present the latest progress of international knowledge on severe accidents and to give an opportunity for researchers to discuss future R&D priorities in this field. A large part of the presented papers was however a kind of sequel of the Fukushima accident, either direct (as Japanese papers) or indirect, as all the mitigation-related papers. An important feature of this conference was again its open characteristic. This "*open*" feature, consolidating ERMSAR as a major international conference on severe accidents, leaves space to presentations by specialists not directly involved in the NUGENIA/SARNET network. The conference was also the opportunity to hear about the SA R&D general programmes in Korea by KAERI.

The main sessions of the conference were addressing:

- **General issues,** with the NCBJ general presentation, an overview of NUGENIA/SARNET and of EURATOM Research activities related to severe accidents within H2020
- **Introductory plenary talk** - with the presentation of OECD-WGAMA work and of the FASTNET FP7 project on emergency tools
- Session 1 **"Ex-vessel corium interactions and coolability"** with 10 papers
- Session 2 **"Source term issues"** with 9 papers
- Session 3 **"Containment behaviour incl. H2 explosion risk"** with 7 papers
- Session 4 **"In-vessel corium and debris behavior"** with 15 papers
- Session 5 **"Severe accident scenarios"** with 15 papers.

Some general aspects can be underlined

- Many papers have addressed mitigation aspects (IVR, pool scrubbing, corium coolability in MCCI, recombiners…)
- Increasing use of CFD codes in addition to integral codes as already noticed at ERMSAR-2015
- Large focus on IVR, esp. on modelling of corium behaviour in vessel lower head, directly linked to IVMR project in H2020
- Source term: accent on pool scrubbing issues
- Many lectures on progress of modelling in simulation codes (ASTEC, MAAP, MELCOR…) but also big efforts in Asia to build new integral codes (Korea, Japan and soon China)
- SFP accidents: only 2 lectures but 1 collective one (AIR-SFP)
- Uncertainties very often mentioned: major concern, important to be further addressed.

As final impression, it was good to see ERMSAR still fully active 12 years after the 1st ERMSAR in 2005 in Aix-en-Provence, with a large number of participants (about 170), including 25% out of Europe (a majority from Asia), 65 papers and 14 posters. A large number of young researchers (about 30 %) were also present but also a number of participants that can be considered as "credited senior experts" (above 30 years' experience). It makes ERMSAR an excellent forum to share experience among researchers and engineers generations.

Picture of the ERMSAR-2017 attendants in Warsaw

All the ERMSAR 2017 papers and presentations have been uploaded on the SARNET public web site and a selection of the papers will be released in a special issue of the "Annals of Nuclear Energy" journal, probably in the 1st quarter of 2018.

At the end of the conference a satisfaction questionnaire was filled in by about 35% of the

participants and the general feedback was very positive with an excellent organization by the NCBJ host on all aspects. The main highlight is the request about PSA2 as a specific session for the next Conference.

The next ERMSAR conference will be hosted by UJV in Prague in spring 2019.

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TA2/SARNET review meetings on corium issues

The yearly TA2/SARNET review meetings on in- and ex-vessel corium behaviour were held in Spain at end of February 2017.

The 4th annual TA2.1 review meeting on in-vessel corium behaviour was held on March 2-3, 2017 in Puerto de La Cruz, Tenerife (Spain) with 37 participants from 11 European countries and from South Korea. The main objective of the meeting was presenting the current R&D progress and discussion of the future plans and joint activities. Another important objective was discussion and preparation of the proposals for joint projects that can be submitted to the next Euratom call for proposals. During the meeting, various aspects of in-vessel melt behaviour were discussed, such as (i) reflooding and coolability of a degraded core, (ii) remelting of debris, melt pool formation and coolability, (iii) reactor applications, and (iv) analysis of spent fuel pool accidents. The presentations addressed both experimental studies and analytical activities, including code development and application.

Currently, a large number of experiments on various aspects of the in-vessel debris and corium behaviour (e.g. debris bed re-melting, transient behaviour of stratified melts with layer inversion, etc.) are being prepared and performed in the SAFEST, ALISA and IVMR European projects so that more results are expected at the next NUGENIA TA2.1 review meeting which is planned in spring 2018.

The TA2.2 devoted to ex-vessel session in Spain was a great success during 2 days (8-9 March 2017). 22 oral presentations have been given in 4 sessions: ex-vessel Fuel Coolant Interaction, Molten Corium Concrete Interaction, Corium Thermodynamics and Thermochemistry, Fukushima status. A special invited paper has been presented by Paul David Bottomley (JRC-Karlsruhe) before his retirement "Thermochemical Severe Accident understanding from Corium from TMI-2 to Fukushima". Obviously, it has been a great success and the 50 persons who were present have congratulated David for his nice presentation and also for the very good job he did during his all professional career in the field of Severe Accident. The session devoted to ex-vessel FCI was specially of high interest and it has been decided to propose for the ERMSAR-2017 conference 2 invited papers describing "old" experimental tests from the 90's on corium spreading under water, but not well known (by AREVA/Erlangen and KIT). For the ex-vessel FCI, one future priority has been identified concerning metallic alloy and water interaction. Concerning MCCI, a new facility is now operational at UJV Rez in the unit of Cold Crucible Laboratory: 30 kg of corium can be molten. For Fukushima topic, it has to be noted that a large MCCI VULCANO test with prototypical corium has been performed for JAEA at beginning of 2017 by CEA (Cadarache) reproducing the "Best -Estimate" Knowledge for Fukushima Daïchi 1F1. The special session devoted to a common analysis of Fukushima Daïchi 1F2 accident to establish the possible location of the corium outside of the vessel was of high interest but did not allow to reach a general consensus with the partial knowledge on the status of the reactor.

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The CoreSOAR in-kind project on core degradation state of the art

In 1991 the OECD Nuclear Energy Agency Committee on Safety of Nuclear Installations (NEA/CSNI) published the first State-of-the-Art Report (SOAR) on In-Vessel Core Degradation (report NEA/CSNI/R(91)12, 1991) in water-cooled reactors, updated in 1995 under the European Union (EU) 3rd Framework programme (report EUR16695EN, 1996). These reports covered phenomena, experiments, material data, main modelling codes and their assessments, identification of modelling needs, and

conclusions with needs for further research. This is relevant to such safety issues as in-vessel melt retention of the core, recovery of the core by water reflood, hydrogen generation and fission product release.

In the following 20 years, there has been much progress in understanding, with major experimental programmes finished, such as the integral Phébus FP tests, and others with many tests completed, e.g. QUENCH, on reflooding degraded rod bundles, and LIVE, on melt pool behaviour, and more generally in EU Framework projects such as COLOSS and ENTHALPY. A similar situation exists regarding integral modelling codes such as MELCOR (USA) and ASTEC (Europe) that encapsulate current knowledge in a quantitative way. After the two EU-funded projects in the SARNET network of excellence, now continuing in the TA2 of NUGENIA association, it is timely to take stock of the knowledge gained.

The CoreSOAR project combines the experience of 11 European partners to update these SOARs over the two years to June 2018. At this, stage, half-way through the project, data collection for relevant small-scale and integral experiments has largely been completed and good progress has been made with drafting the relevant chapters; the main modelling codes are now being reviewed along with their validation. Progress is regularly monitored at project meetings; the last one was in May 2017, with the next planned for October. Following the reviews of codes and experimental data, research needs in the in-vessel core degradation area will be evaluated and main conclusions will be drawn. The main report will serve as a reference for ongoing research programmes in NUGENIA, in other EU research projects, e.g. in Horizon2020 such as that on in-vessel melt retention (IVMR), and in OECD/NEA/CSNI, such as the Fukushima benchmark (BSAF).

During the course of the activity, papers and presentations have been made and are planned on the project status. Firstly, a presentation and paper were given at the Nuclear Energy in New Europe (NENE) conference, Portorož (Slovenia) in September 2016, summarising separate-effects experiments on materials interactions performed by IRSN, France and Karlsruhe Institute of Technology (KIT), Germany. A presentation was made at the QUENCH Workshop at KIT in October 2016 on the important contribution Russian experiments under the auspices of OECD/NEA and the International Science and Technology Centre (ISTC) have made to the understanding of late phase core degradation. A more general presentation was given at ERMSAR-2017, Warsaw (Poland) in May 2017, giving the overall status of the project. Further conference papers are foreseen over the rest of the project duration, for example one on the status of severe accident analysis codes has been accepted for NENE2017 at Bled (Slovenia) in September.

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IPRESCA: An In-Kind Project on Pool Scrubbing

The kick-off meeting of the IPRESCA project was held on June 21st in Frankfurt (Germany). IPRESCA (Integration of Pool scrubbing Research to Enhance Source term CAlculations) is an in-kind project framed in the sub-technical area TA2.4 (Source Term) of NUGENIA which purpose is to integrate the international research activities on pool scrubbing. Both experimental and analytical investigations are foreseen: the former aiming at broadening the current database and the latter targeting to enhancing the existing predictability. Back-to-back a technical workshop on pool scrubbing was held in which a total of 16 presentations were made summarizing most of the worldwide current activities on the field.

The kick-off meeting was structured in four parts: an introduction on the IPRESCA "environment" in the TA2.4; a review of the major pillars of the IPRESCA project; short presentations of potential contributions from partners; and, finally, a wrap-up session in which foreseen experimental, analytical and reactor applications contributions foreseen according to what had been presented were summarized. Most importantly, near-term actions (June 2017 – June 2018) were identified: a critical assessment on the background; specifications of "reference tests"; selection of valuable tests for validation of different aspects, like hydrodynamics, aerosol scrubbing/re-entrainment, and/or gaseous iodine removal or re-volatilization. An action plan was agreed to be distributed to all partners by the end of July 2017.

A special emphasis was placed on setting up and signing a Memorandum of Understanding which

would serve as the main basis for the IPRESCA consortium.

Two specific documents are proposed as deliverables before end of 2017: one summarizing in-kind contributions (experimental and/or analytical) proposed by partners, and the other defining IPRESCA work scope with details on work activities for each work package and participating organisations. Some planned activities, e.g. preparation of a skeleton for critical assessment report and PIRT, are proposed to be launched before end of 2017. Finally, it is worth noting that even though IPRESCA is an in-kind project, the expected outcomes might result in the technical bases to apply for external funding (e.g., EC project) by the IPRESCA project consortium in a mid-term horizon.

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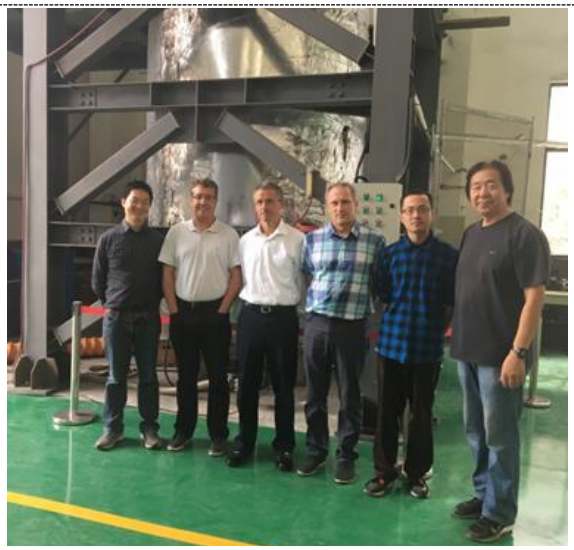
Hydrogen combustion experiment in HYMIT facility (China)

An experiment on hydrogen combustion was successfully performed in the HYMIT experimental facility at Shanghai Jiao Tong University (PR China) on October 17, 2016. The experiment was performed within the Chinese-European project ALISA. The specification of the experiment was proposed by the Jozef Stefan Institute (JSI – Slovenia) and the Nuclear Research and Consultancy Group (NRG – The Netherlands). The proposers were joined later by the Karlsruhe Institute of Technology (KIT – Germany).

The HYMIT cylindrical vessel has a volume of 12 m^3, with height 4 m and maximum diameter 2 m. The initial conditions were such as to obtain hydrogen deflagration. The experimental results will be a valuable addition to the experimental database for further investigations of hydrogen deflagration in middle and large size vessels, with the purpose to apply new insights to hydrogen combustion in containments of actual nuclear power plants. The organisation of a benchmark exercise, based on the performed experiment, is also planned.



Picture of the HYMIT facility and of European and Chinese involved researchers

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Recent main publications

- "Trends in severe accident research in Europe: SARNET network from Euratom to NUGENIA", J.-P. Van Dorsselaere, F. Bréchignac, F. De Rosa, L.E. Herranz, I. Kljenak, A. Miassoedov, S. Paci, P. Piluso, TOPSAFE-2017, Vienna, February 10-13, 2017
- L.E. Herranz, C. López, K. Chevalier, C. Chavardes, M. Sonnenkalb, F. Mascari, J.C. de la Rosa, M. Torkani, S. Paci, "Uncertainties of Source Term Assessments (USTA): An Indispensable Project", 6th NUGENIA Forum 2017, 28 - 30 March 2017, Amsterdam (NL)
- P. Piluso, S. Paci, J.P. Van Dorsselaere, A. Miassoedov, I. Kljenak, C. Journeau, L. E. Herranz Puebla, "The Severe Accident Phenomenology Short Course (SAP): 12 years of excellence for dissemination of Severe Accident knowledge at international level", 6th NUGENIA Forum 2017, 28 - 30 March 2017, Amsterdam (NL).

Some recent and forthcoming events

***May 16-18, 2017**: ERMSAR-2017 conference of TA2/SARNET, hosted by NCBJ in Warsaw (Poland)*

***June 21, 2017**: IPRESCA kick-off meeting and international workshop on pool scrubbing, organized by Becker Technologies in Frankfurt (Germany)*

***June 20-23, 2017**: IVMR/H2020 workshop on analytical activities (WP2) and 2nd annual meeting, hosted by JRC-Petten in Alkmaar (Netherlands)*

***July 17-21, 2017**: IAEA Workshop on Advances in Understanding the Progression of Severe Accidents in BWRs, in Vienna (Austria)*

***September 2017**: publication of the Euratom Work Programme 2018*

***September 3-8, 2017**: 17th NURETH (International Topical Meeting on Nuclear Reactor Thermal Hydraulics), Xi'an, Shaanxi (China)*

***September 11-14, 2017**: Nuclear Energy for New Europe (NENE) conference, Bled (Slovenia)*

***September 11-15, 2017**: CSARP meeting organized by USNRC in Bethesda (USA)*

***October 9-12, 2017**: IAEA TM on the status and evaluation of severe accident simulation codes for water cooled reactors, in Vienna (Austria)*

***October 10-12, 2017**: ALISA 3rd Review Meeting, Karlsruhe (Germany)*

***October 16-17, 2017**: 2nd Workshop of the FASTNET H2020 hosted by IRSN in Paris (France)*

***October 17-19, 2017**: 23rd QUENCH Workshop hosted by KIT at Karlsruhe*

***October 23-27, 2017**: 6th short course on severe accident phenomenology, hosted by JSI in Ljubljana (Slovenia)*

***November 6-7, 2017**: EUROSAFE Forum, hosted by IRSN in Paris (France)*