

## TOPSAFE 2008

### Conference Highlights

After almost 10 years of calm, the ENS Conference TOPSAFE 2008 devoted to the safety problems in nuclear has been held again. The great interest of the conference has been expressed by the fact that 130 participants from EU, Japan, USA, Canada and Russia were registered as well as a number of representatives from IAEA, OECD/NEA and EC/JRC were there. During three intensive conference days in the beginning of October 2008 in the beautiful town of the Adriatic coast Dubrovnik almost 100 technical papers were presented including 33 posters and seven invited lectures. The presentations and posters were divided into the eight categories: Harmonization of safety approaches, Operational safety, Scientific advances and trends, Safety of forthcoming reactors, Safety of Gen IV reactors, Safety of fuel cycle facilities, Human factor, Safety and ageing.

A very innovative approach was applied by the Program committee concerning the posters, consisting in their summarizing within three complementary presentations before the first poster session. We suggest to ENS to continue to apply this “best practice” for the next conferences.

#### **Context**

For present reactors, the safety issues are mainly focussed on how to improve their operability and to extend their lifetime, without compromise on the safety. Challenges also exist concerning the safety demonstration of future reactors, either generation III or IV, with the generalized use of sophisticated simulation tools. All this happens in the context of the nuclear renaissance, associated with a global hardening of the requirements of the safety authorities.

#### **Harmonization of safety approaches.**

There is a trend for harmonization of regulatory approaches within EU. There are major international initiatives underway about harmonization of nuclear safety standards and regulations, which was well reflected at the conference. Indeed such harmonization seems to be generally recognized as a prerequisite to allow the standardisation of forthcoming reactor designs necessary to facilitate the realisation of the nuclear renaissance. IAEA presented their plans for laying down new or updated Safety Standards for generic Nuclear Power Plant designs and also new Security Standards. At the same time the Regulatory bodies in the EU countries are working together in WENRA, Western Europe Nuclear Regulators Association, to benchmark their requirements against each other and reach a level where no substantial differences in regulatory requirements and their implementation remain. As a counterpart to WENRA, and to support this objective, the European nuclear power utilities have formed ENISS, the European Nuclear Installations Safety Standards initiative, which was also presented at the conference. For the regulation of new reactor designs, NEA has on its part started a Multinational Design Evaluation Programme (MDEP) in order to increase the cooperation between Regulators of different nationalities in this area. Requirements in this respect have also already been put down in the European Utility Requirement document (EUR). So, there are a lot of parallel activities to keep track of in the field of regulations.

#### **Operational safety**

Some controversy was raised in the discussion of Operational Safety and specifically operational experience feedback. As the EC-JRC (European Commission Joint Research Centre) presented its “Clearinghouse project” to support regulators in the assessment of operational events, it was strongly questioned by representatives from the Regulatory bodies why advantage could not be taken of WANO’s event reporting system and why this data base was kept confidential. From WANO and representatives of the utilities it was argued that it would threaten the necessary level of openness and alertness, and be counter-productive for safety, if the event reports would be publicly released. It was further argued that public event reports need to provide appropriate event analyses providing a good understanding of what has gone wrong and what needs to be done, which is not always the case when events are initially reported to WANO.

#### **Scientific advances and trends.**

Multiphysics and multiscale coupled-codes approach is being more and more applied for better understanding different neutron-thermohydraulic-mechanic phenomena and for more effective numerical simulation. Important trend has been observed to use CFD codes for safety analyses (fluid mixing, boron dilution, stratified flows, two-phase flows etc.). In the sessions on Safety Assessment and Analysis presentations gave much proof of the prevailing trend towards more advanced simulation tools, such as 3D coupled core-plant codes, in pursuit of best estimations. In support of the introduction of Best Estimate Plus Uncertainty (BEPU) methods, a few papers also dealt with methods for uncertainty treatment and determination of uncertainties. One major effort in this direction that was presented by NEA, is the LWR Uncertainty Analysis of Modelling (UAM) Benchmark, the objective of which is to determine the uncertainties and their propagation in all steps of a LWR coupled neutronics-thermal hydraulics calculation – an ambitious and long-term goal.

The evolution of the modelling takes place in a context of an increase of the pressure from Regulatory Bodies for best estimation of uncertainties.

Another area of safety assessment where huge research efforts are being put down is that of Severe Accidents. While some major safety issues are well investigated (e.g. reactivity-insertion-accidents, loss-of-coolant-accidents), there are still open issues for the existing plants mainly in the field of severe accidents like H<sub>2</sub> combustion, steam explosion, long-term corium stabilization, FP release etc. Most notable in this respect is the international collaboration planned to be performed under the framework of SARNET-2, the second phase of the Severe Accident Research Network, dedicated to resolving remaining open issues related to the stabilization and long-term of core meltdown for the enhancement of safety of both existing and forthcoming nuclear power plants.

### **Safety of forthcoming reactors**

The Forthcoming Reactors whose safety concepts were presented at the conference were AREVA's EPR (PWR) and SWR1000 (BWR), Westinghouse's AP1000 (PWR) and AECL's ACR-1000 (CANDU). Considering the large similarities of Westinghouse's and AREVA's generation III PWR's it is interesting to see how different their generation III+ PWR concepts have come out. The EPR is an evolutionary design relatively close to the design of existing plants, but with an improved defence-in-depth against accidents and for mitigation of the consequences of severe accidents. The development of the AP1000 on the other hand has been directed by EPRI's Utility Requirement Document (EUR), emphasizing simplification of design and passive safety systems. Just looking at the significant reduction of building volumes and components of the AP1000 one could guess that the capital cost would be considerably lower than that of the EPR, but this may on the other hand well be counterbalanced by the considerably higher electricity output of the EPR – 1600 MWe as compared to 1100 MWe for the AP1000. While AREVA was first out with the start of construction of the two EPR's in Olkiluoto and Flamanville and preparations for new-builds in China well underway, Westinghouse now seems to be gaining momentum with the start of the construction of the first of four AP1000 ordered from China in the beginning of 2009 and several orders underway in the US. So it's looking to be a close race between these two fundamentally different alternatives – and, not to forget, the long list of challenging new designs.

Concerning the implementation of new reactor concepts in Europe, one can state that, increasingly based on passive principles, they are good choice for mitigating the negativism in the public opinion in EU. Also a trend for mixing of passive and active designs (EPR, VVER etc.) is being observed.

Probabilistic safety assessment methods have not been fully addressed at this conference. Among the Design and Safety Issues that were discussed at the conference, the use of Probabilistic Safety Assessment during the design phase of new reactors, such as the Finnish EPR OL-3, deserves special mention as indicative of the state of the art for probabilistic safety assessment of evolutionary reactor designs.

In contrast to Gen III evolutionary reactors, for which safety issues seem well under control, fast spectrum reactors appear especially challenging. Many problems are still open- void coefficient, physico-chemistry of Sodium, reactivity etc. The community has little return of experiment on these issues, which will represent major research topics and possible deadlocks for the future development of these systems.

### **Safety of fuel cycle facilities**

Not too many presentations dealt primarily with Fuel Cycle Safety, which could also seem like an imbalance in the conference programme considering the high interest this particular field of nuclear safety is drawing from the public. However, there was for example an interesting contribution from AREVA on their development in the field of criticality safety analysis and also a short paper on AREVA's risk analyses to optimise transport security had been submitted.

**Human factor** has been also addressed in the conference although not so sufficiently as one would wish. While operating experience feedback was discussed in some detail, safety culture was identified as an issue that was not given sufficient attention at the conference. In this area a lot of interest was drawn to Electrabel's presentation on an innovative training program and facility for improving safety culture for nuclear power plant personnel - an initiative that has already been followed by a number of utilities in Europe. Also a poster from Bulgaria has demonstrated the use of simulators also for Human Reliability Assessment Techniques. During the closing panel HSC also suggested that simulators have to be further developed towards the severe accidents for validation of Severe Accident Management Guidelines.

### **Safety and ageing**

Issues that were not so well covered during the conference were those related to material safety and ageing, which could be expected to be a growing problem for the ageing reactor fleet. This problem area has drawn a lot of attention in Japan after a number of serious events linked to material degradation and a lot of research activities are on-going there.

### **Discussions during the closing panel and in the couloirs.**

Many interesting and, in some cases, alternative points of view on safety and investment policy in safety have been expressed within some presentations and the questions/comments after them, but due to the dense conference program schedule there was no

time to discuss them in depth and they remained besides for the closing panel mostly for the couloirs. Here below some of these points of views are summarized.

Many of incidents or accidents have their root cause in the weak of plant organization and management, and this is not fully recognized yet. Systematic approach and special methods have to be applied, to study different aspects of degradation of safety culture leading to such events. HSC recommends broadening the study of cultural and organizational factors leading to major events, as it is being started in Bristol University UK and at the level of EC/JRC Ispra.

Lack of mid- and long-term research programs can have disastrous consequences. The fact of absence funding (that often is the key element) will make teams to disappear and once they do, nobody can expect to reborn them again as needed. For instance, in the field of severe accidents – SARNET has its prolongation for the next 4 years, but what will happen after that? Partial answer has been given in one presentation that SARNET-2 would continue as a legal body afterwards. The same situation is with the International Scientific Technology Centre (ISTC) – while EU funding is being decreasing, the Russian government do not express strong interest in its activity.

One interesting and important comment made in the closing panel discussion, was that the industry is not making full use of the progress accomplished by research in modelling and experiments, due to unsatisfactory interconnections between the industry and research sectors.

This year other nuclear installations than power plants were not well represented. Utilities were also undermanned, as is often the case on this type of conferences. Some critical comments from the research community were also noted regarding their representation at the conference.

For TopSafe to fully to fulfil its ambition to cover all aspects of Nuclear Safety, the conference probably would have to grow so that the participant list better represents all members of the European nuclear society and a critical mass of experts from all relevant competence areas are present.

**In conclusion**, we can state that

It is a well-learned lesson after the TMI and Chernobyl incidents that in the nuclear community, *we are “all in the same boat”*. The only way to ensure the necessary level of nuclear safety at all parts is through cooperation and coordination between companies and institutions worldwide. TopSafe could serve an important purpose in facilitating and promoting such interaction. The conference was quite successful and most participants seemed to agree with the voices raised for an increase in the frequency of this event to once per four years.

All papers from TOPSAFE can be downloaded freely from  
<http://www.euronuclear.org/events/topsafe/transactions.htm>.

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