OECD/NEA joint projects in the nuclear safety area

C. Vitanza *

In many OECD member countries, nuclear power plays an important role in the overall production of electricity. As in the past, operational requirements, plant utilisation and fuel designs are expected to continue evolving, even for current generation reactors, posing new challenges and new questions. Operational experience and plant ageing will also raise new questions. Research will be needed to support a high level of safety, in a context in which economic pressures on plant operators are increasing. Research will also be needed to support developments for new reactor systems, including both evolutionary designs and more advanced reactor concepts such as those under consideration by the Generation IV International Forum (GIF).

Over the past several years, a number of experimental facilities have been shut down and others are in danger of being closed in the future. Consequently, concerns have been raised as to the ability of individual NEA member countries to maintain critical competence and to focus on important safety areas unless practical countermeasures are put in place. International co-operation can help provide a solution and makes economic sense.

The responsibility of the NEA Committee on the Safety of Nuclear Installations (CSNI) entails, amongst others things, the conduct of research in support of the resolution of outstanding safety issues, the maintenance of a valid technical infrastructure and expertise, and the promotion of co-operation on safety research in OECD member countries. The establishment and operation of OECD/NEA joint projects constitutes one means for carrying out these CSNI tasks.

This article provides an overview of the joint projects being carried out under NEA auspices with a view to preserving technical infrastructure and competence in critical safety research areas. In particular, it describes the joint projects which were set up to address safety-relevant issues by means of experimental programmes carried out at specialised facilities. The databases created in support of operating experience evaluations are also described.

Overall scope

There are currently 14 OECD/NEA joint projects being carried out in the nuclear safety area, which can broadly be divided in the following categories:

- *Fuel projects*, which deal with matters related to assessments of fuel behaviour, fuel limits and fuel margins in a variety of operational or anticipated accident conditions. These investigations normally require large and expensive experimental infrastructure, and in some cases unique capabilities, such as test reactors and specialised hot cells. It is common that regulators and industry participate jointly in these projects, while preserving their respective roles, partly because cost-sharing among several parties is a practical way to carry out the programmes, but more importantly because industry co-operation is essential for obtaining the fuel or material specimens required for the experiments.

** Mr. Carlo Vitanza (e-mail: carlo.vitanza@oecd.org) works in the NEA Nuclear Safety Division.*

Table 1. Current OECD/NEA joint safety projects*

Project name	Subject	Host country
HALDEN	Fuel and materials, I&C, human factors	Norway
CABRI	Fuel in RIA transients	France
SCIP	Fuel integrity	Sweden
ROSA	Thermal-hydraulic (T-H) transients	Japan
PKL	PWR T-H, boron-dilution	Germany
SETH	Containment (T-H, CFD)	Switzerland
PSB-VVER	VVER 1000 T-H transients	Russia
MASCA-2	Severe accidents (in-vessel)	Russia
MCCI	Severe accidents (ex-vessel)	USA
PRISME	Fire propagation	France
COMPSIS	Database, computerised system events	
FIRE	Database, fire events	
ICDE	Database, common-cause failures	
OPDE	Database, piping failures	

* Further details on all of these projects can be found at www.nea.fr/html/jointproj/.

- *Thermal-hydraulic projects*, mainly dealing with postulated accidents like the loss-of-coolant accident (LOCA) and other thermal-hydraulic transients that are identified as the dominant safety concern for water reactors. As full-scale experimentation is not feasible in most situations, significant computational capability is needed to simulate such transients properly, as required for the safety case of these reactors. The CSNI has always devoted great attention to the issue of thermal-hydraulic code validation as well as to the experimental database needed for such validation.
- *Accident assessment projects*, currently including two experimental projects on severe accident scenarios following core damage and melting, and one experimental project dedicated to simulations of a variety of fire propagation scenarios relevant for nuclear power plants. Prevention and control of fire propagation are considered to be major contributors for reducing accident risk in nuclear installations, while prevention or mitigation of severe accidents are the largest contributors for reducing the potential risk to the public arising from plant operation.
- *Database projects*, which have the main function of gathering important data and information on operating experience regarding equipment malfunction or failure. These databases are intended to form the basis for lessons learnt and for measures dealing with replacements or preventive maintenance. International co-operation is essential in order to incorporate experience that is as broad as possible on events that are by nature relatively rare.

Project set-up and organisation

The process for setting up an OECD/NEA joint project normally begins on the initiative of a member country or in follow-up to a specific CSNI recommendation. The CSNI determines the steps to follow during the establishment phase, but once started, the responsibility for the project execution resides with those parties that have decided to join it. The projects are thus run in a relatively autonomous fashion, where the participants who have taken responsibility for funding the project define the details of the programme.

As no funding is set aside beforehand, the project financing has to be sought on a case-by-case basis. The ability of the proposed programme to attract a large number of participants is therefore critical in order to arrive at a satisfactory cost-sharing arrangement. For the experimental projects, it is customary that a major part of the project cost, typically 50%, is covered by the host country (the country in which the experiments are to be carried out).

A so-called operating agent has responsibility for carrying out the programme according to the instructions given by the steering body, which is made up of project participants. In addition to providing technical guidance, the steering body also delineates the project's main administrative rules, for example, concerning deliverables, ways of reporting and limitations on data dissemination.

The NEA role is to facilitate the project's establishment and execution, in accordance with CSNI instructions. It ensures that the programme is run according to sound principles of transparency and efficiency, that the work scope adequately balances the expectations of the various participants, and that consensus solutions are suitably reflected in the programme. The experience gained with the Halden Reactor Project, which has been run successfully for almost five decades, constitutes the basis and term of reference for most other OECD/NEA joint projects.

The experience with the operation of NEA joint safety projects is generally very good. The project agreements contain provisions for dealing with situations where there is a lack of consensus, but fortunately these provisions have never been used. In general, there is a shared understanding among participants that consensus must be sought for an orderly conduct of the project and for obtaining results that will, in the end, be valuable to everyone.

It is common practice that analytical activities dealing with data prediction and interpretation, model development and computer code validation are performed by some or all project participants in parallel with those of the project. These analyses constitute a very valuable complement and an additional benefit of the NEA safety projects. They contribute to maintaining or improving expertise and analytical tools in OECD member countries, to enhancing technical exchange among specialists, and to promoting consensus building on approaches to resolving safety issues. As for the future, possible challenges might include being able to respond to multiple demands for new projects while maintaining quality and efficiency, as well as a sufficiently large degree of participation and cost-sharing. Increased industry participation in the projects might help this development, and would be desirable for several reasons, as outlined in the report of the Group on Regulator-Industry Co-operation (GRIC) in research.[1]

The SESAR initiative

For the past several years, the CSNI has commissioned studies by senior experts in safety research (SESAR-FAP[2] and SESAR SFEAR[3]) that address technical priorities for facilities and programmes in the area of nuclear safety. The outcome of these studies is contained in reports focusing on research needs and priorities in the areas of: thermal hydraulics; fuel and reactor physics; severe accidents; human factors; plant control and monitoring; integrity of components and structures; and seismic behaviour of structures.

These studies have concluded that in some areas specific follow-up is currently not needed, either because sufficient infrastructure and programmes already exist or because the priority is low. The areas of thermal hydraulics and severe accidents, however, have been identified as requiring attention and follow-on initiatives. The CSNI has thus focused its efforts on both of them, keeping in mind that certain other areas such as fire safety or seismic behaviour may also need attention.

Table 2 summarises the recommendations made by the SESAR group in 2000, together with the actions taken by the CSNI in response to such recommendations (second column). The influence of these initiatives on the follow-on SESAR assessment is summarised in the last column of the table.

Experience has shown that all NEA joint safety projects entail substantial analytical activity, which accompanies the execution of the experimental programme. This activity is centred on code assessments and validation, and where suitable, on model development. Code benchmarking or analytical exercises consisting of both pre-test and post-test calculations are organised among project participants, always bearing in mind the data utilisation for the reactor case. This extensive analytical effort has proven to be a very efficient

Table 2. Status of implementation of SESAR-CSNI recommendations

SESAR recommendation	Resulting CSNI action	Impact on SESAR follow-on (year 2006)
1. Maintain the PANDA, PKL and SPES facilities in the thermal-hydraulics area (the above facilities were in near-term danger of closure).	Initiated the SETH programme utilising the PANDA and PKL facilities (no host country support for SPES).	– PANDA maintained through 2005. Currently in near-term danger and addressed in the SESAR follow-on study (SFEAR). – PKL active and not in near-term danger.
2. Monitor and maintain key thermal-hydraulics (T-H) facilities in the long term. T-H facilities should be maintained in North America, Europe and Asia.	Facility status monitored. Initiated programme utilising the ROSA facility when it was in danger of being shut down.	ROSA is active and not in near-term danger. Other thermal-hydraulics facilities continue to be monitored.
3. Maintain the RASPLAV and MACE facilities in the severe accident area (these facilities were in near-term danger of closure).	– Initiated the MASCA programme as a follow-on to RASPLAV to maintain the facilities. – Initiated the MCCI programme utilising the MACE facility.	– MASCA is currently active. – MCCI is active and therefore the MACE facility is not in near-term danger.
4. Develop a centre of excellence for fuel-coolant interaction (FCI) in consideration of the potential loss of the FARO and KROTOS facilities.	Initiated the SERENA programme (group of experts to discuss the status of FCI and future experimental needs). FARO has been shut down. KROTOS has been kept on standby.	The SERENA programme has recommended that an experimental programme be conducted at KROTOS, which may impact the preservation of the facility. A CSNI expert group is to review the SERENA recommendation.
5. Develop a centre of excellence (COE) for iodine chemistry and fission product behaviour.	The proposal for a centre of excellence is currently under evaluation.	At present, no additional CSNI action is needed.

manner to maintain or develop relevant technical expertise. For database projects, workshops are organised when appropriate in order to assess the main outcomes of the data collected and the main lessons learnt from the events contained in the databases.

For further information concerning OECD/NEA joint projects in the nuclear safety area, see: www.nea.fr/html/jointproj/. ■

References

1. NEA (2003), *Regulatory and Industry Co-operation on Nuclear Safety Research – Challenges and Opportunities*, OECD, Paris.
2. NEA (2001), *Nuclear Safety Research in OECD Countries – Summary Report of Major Facilities and Programmes at Risk*, OECD, Paris.
3. NEA (in preparation), *Support Facilities for Existing and Advanced Reactors (SFEAR)* (provisional title), OECD/NEA, Paris.