
OECD Nuclear Energy Agency role in promoting and maintaining nuclear safety research

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Abstract:

The paper describes the activities of the safety committees of the OECD Nuclear Energy Agency. The Committee on the Safety of Nuclear Installations (CSNI), promotes the exchange of safety relevant information and develops common understanding and approaches on current safety issues. One of the unique features of NEA is to organise safety research activities, and in particular to promote Joint OECD/NEA Research Projects. During its forty years of work, NEA safety committees have contributed to address safety challenges and to look for common approaches to regulatory practices and criteria.

1 BACKGROUND

The nuclear community has for some time been facing changing conditions in the industry as well as in governmental organisations. These changes have had, and will continue to have, profound impacts on the access to R&D funding and on the way research is organised and financed in most NEA Member countries.

Government funding has been decreasing in most Member countries, affecting the grants made available for experimental work in facilities and R&D centres, as well as the budgets of safety research programmes that are traditionally carried out by nuclear safety organisations.

On the industry side, utilities are faced with intense competition, and in order to compete efficiently they are looking for means to improve operational economics and flexibility, and to reduce costs whenever feasible. The focus of utility-sponsored research is thus narrowing towards programmes devised to demonstrate more efficient means of running the plants, i.e. programmes that can provide a tangible economic return as quickly as possible.

This paper provides an overview of the activities being carried out under the aegis of the NEA with a view to preventing irreversible losses of infrastructure and technical competence in critical safety research. It is apparent, however, that the reduction of both industry and government funds has put great pressure on all nuclear research centres, which as a result have been experiencing reductions in personnel and scope of work throughout the last decade. While significant differences exist from one country to the next, the overall trend has been in the direction of smaller and fewer safety-related programmes, a decrease in nuclear R&D expertise, and the closure or threat of closure of many facilities.

There are indications suggesting that this trend is likely to continue in the immediate future and possibly extend to countries that have so far been relatively immune to this process. Consequently, concerns have been raised as to the ability of individual NEA Member countries to maintain critical competence and focus on important safety areas, unless practical countermeasures are put in place. International co-operation is helping to provide a solution and makes economic sense.

2 NEA SAFETY RESEARCH ACTIVITIES

The Nuclear Energy Agency has a regular budget that covers the Programme of Work agreed by all Members, currently 28 OECD countries, arranged according to a number of priorities. The first priority established by Members concerns nuclear safety and regulatory activities. With this aim the NEA develops a large number of focused activities through the committees on the safety of nuclear installations (CSNI) and on regulatory activities (CNRA). In addition to the regular budget there is also the possibility for some member countries to join on specific activities that are of interest to a more restricted membership. These activities are called OECD/NEA Joint Projects, and are funded by the countries participating in the activity. The NEA provides support to these countries by performing the technical secretariat function and by promoting the environment for these projects to happen and develop to reach their objectives.

Focusing on nuclear safety, to ensure the adequacy of projects, relevant NEA technical committees discuss and identify research needs and priorities. These committees recommend actions for immediate and longer term research and for key facilities to be preserved. The aim is to have a network of unique facilities and programs in different technical fields and in different countries to serve the OECD nuclear community.

If these basic premises are met then the key questions for each specific project are the following:

- Is there a significant safety question that deserves additional research?

- Is there an adequate facility to address the safety question and perform the research?

- Will the project provide an output that would contribute to solve the safety concern?

- Has the project a reasonable budget and schedule to attract the interest of a significant number of countries?

The NEA helps the country or countries that put a proposal on the table to find the responses to these questions, and if the answer is satisfactory, then there is a good chance of finishing with a successful project. The fact that the funds are provided by the interested countries is a guarantee that there will be a real commitment to pursue the project and obtain meaningful results.

3 THE SESAR FAP INITIATIVE

For the past several years, the CSNI has commissioned studies by senior experts in safety research (SESAR), the last of which addressed technical priorities for facilities and programmes (FAP). The outcome of this study was presented in a report 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.

It emerges that in some areas specific follow-up is not needed at this time, either because sufficient infrastructure and programmes already exist or because the priority is low. The areas of thermal hydraulics and severe accidents, however, were identified as requiring immediate attention. The CSNI thus focused its efforts on both of them, keeping in mind that certain other areas such as seismic behaviour may also need attention in the future.

The next steps concentrated on the implementation of a convincing experimental programme for specific facilities. The intention is to provide a method and the means for preserving a meaningful technical infrastructure on nuclear safety research.

As a first step in this direction, the facilities identified in the SESAR-FAP report, operating in the thermal-hydraulic area, were requested to define a three-year programme of work

consistent with the priorities indicated in the report. The facilities in question are PANDA in Switzerland, PKL in Germany, and SPES in Italy.

Similar to what has been done in the thermal-hydraulic area, two research centres put forward proposals for NEA research programmes in the severe accidents area. The two centres are the Kurtchatov Institute in Russia and the Argonne National Laboratory in the USA. Both proposals deal with phenomena occurring during a severe accident progression. The objective of the programme proposed by the Kurtchatov Institute (MASCA project) is to investigate in-vessel phenomena. The Argonne proposal focused on ex-vessel phenomena and, in particular, on the molten core/concrete interaction, both in the case of a dry containment cavity and of the presence of an overlying water layer. Molten core coolability will also be investigated.

4 OECD/NEA JOINT RESEARCH PROJECTS

The NEA is experiencing a blooming of joint OECD-NEA projects in different technical areas, mostly nuclear safety. In fact, now the situation is demanding to take care about managing growth, such that it occurs in a very gradual manner, without detriment to quality and in harmony with member countries interests. The NEA has currently in operation 16 Joint Projects, as I said most of them on nuclear safety (11) but also covering waste management, radiation protection and nuclear development.

In addition to the projects already mentioned in the areas of thermo-hydraulics and severe accidents, two projects deserve specific mention. The **Halden Reactor Project** is the largest NEA project and constitutes a very important international technical network in the areas of nuclear fuel reliability, integrity of reactor internals, plant control/monitoring and human factors. The project has been operating by way of three-year renewable mandates over the past 40 years. The programme of work in the fuel and materials area includes fuel assessments in the high/very high burn-up range (both at normal operating conditions) and in transients, as well as embrittlement and cracking behaviour of reactor internals materials. These investigations are carried out experimentally at representative reactor conditions and with the utilisation of advanced instrumentation. The proposed programme on plant control and monitoring is intended to assess systems having the potential for improving plant performance and operational safety. The activities on human factors aim to extend the knowledge of human performance in a control room environment and to demonstrate how this knowledge can be incorporated in control room engineering solutions. The Halden Project is executed at the Halden establishment in Norway and is supported by approximately 100 organisations in 20 countries.

The **CABRI Water Loop Project** is investigating the ability of high burn-up fuel to withstand the sharp power peaks that can occur in power reactors due to rapid reactivity insertion in the core (RIA accidents). It involves substantial facility modifications and upgrades and consists of 12 experiments to be performed with fuel retrieved from power reactors and refabricated to suitable length. The project will run for eight years. While the main lines of the programme of work and schedule have been defined, details of the scope and of the experimental conditions are being discussed by participants as needed. The experimental work is carried out at the Institut de radioprotection et de sûreté nucléaire (IRSN) in Cadarache, France, where the CABRI reactor is located. Programme execution can, however, involve laboratories in participating organisations (for instance, in relation to fuel characterisation or post-irradiation examinations).

5 THE PKL PROJECT: AN EXAMPLE OF A NEW OECD PROJECT

The PKL project for the NEA is a synonym of sound and efficient co-operation and of result-oriented research.

The CSNI SESAR study was devised to identify facilities that were important for safety research, but that were at risk of being closed due to decrease in funding. The PKL was one of these facilities, and the CSNI study recommended to activate an international project focussed on its capabilities.

From previous studies in the international community, including some specific CSNI activities, the real impact of boron dilution on the safety of nuclear plant operation was an open question. The understanding of the thermal hydraulic behavior during the investigated accident scenarios, including not only the system behavior but also the local behavior (e. g. SG tubes), was considered not sufficiently profound to assess the accident management strategies.

For PWRs, boron dilution scenarios may prevent an adequate control of reactivity and cause local power excursion that may overcome fuel limit criteria. So the application of expected results to nuclear plant operation and the regulation of accident management was clear.

In addition, the PKL research project could help to address the experimental verification/optimization of cooldown procedures or operator initiated countermeasures.

Finally as in most safety projects, the data produced are of significant value for the validation of codes, extensively used for safety analyses. The project includes holding several meetings that will discuss in depth pre- and post-test analyses of PKL tests as well as plant analyses.

Regarding the facility, PKL is the only large-scale integral test facility with 4 primary loops, which are symmetrically arranged around the reactor pressure vessel. Modelling of a 3-loop plant is possible by simply isolating one loop. This allows a realistic simulation of accident transients under symmetric and non-symmetric conditions and the investigation of individual effects of multiple failures.

Regarding participation, public institutions and industry, with due respect for their independence and respective role, have found ways to co-operate on experiments – and both to draw benefits from them. They might interpret the results differently, but share the common goal to generate the data that are needed for the safety assessments.

Public institutes and industry co-operate also to keep good facilities and teams at work. This represents an important part of the NEA strategy, which is to maintain critical competence and infrastructure, as well as to contribute to knowledge management. Cost-sharing is again important in this context. In this perspective, whether a facility is public or private is an immaterial difference. The PKL is the first private facility ever used in a joint OECD-NEA project. A sign that the times are changing, and also a sign of flexibility from various parties.

Regarding expected results, the NEA is convinced that the information obtained will contribute to a better understanding of boron dilution events, to the improvement of analytical tools and, what is more important, to the validation of accident management strategies.

6 CONCLUSIONS

In summary, the NEA is promoting nuclear safety research activities with the aim of improving knowledge to support the high level of safety reached at existing NPPs. An important product of these activities is maintaining critical competence on nuclear safety. In this context, OECD/NEA joint research projects are considered a good example of international co-operation, and the NEA thanks its Members for their trust as a reliable reference for setting-up international research activities.