

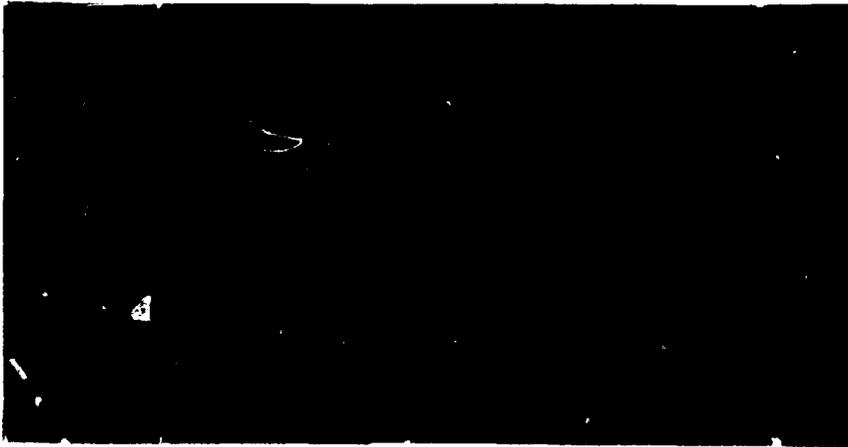
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**INTERNATIONAL CO-OPERATION IN THE FIELD
OF OPERATIONAL SAFETY**

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1. Introduction

Operational safety in nuclear power plants is without doubt a field where international co-operation is in constant progress. Accounting for over 80 per cent of the 400 reactors in service throughout the world, the member countries of the OECD Nuclear Energy Agency (NEA) are constantly striving to improve the exchange and use of the wealth of information to be gained not just from power plant accidents and incidents but from the routine operation of these facilities.

The Committee on the Safety of Nuclear Installations (CSNI) helps the Steering Committee for Nuclear Energy to meet the NEA's objectives in the safety field, namely :

- to promote co-operation between the safety bodies of member countries
- to contribute to the safety and regulation of nuclear activities.

The role of the CSNI is most aptly described in the words of its current chairman :

"At the international level, the main task in the nuclear safety and protection fields is the search for consensus based on scientific and technical knowledge : this means exchange and understanding, not imposition and criticism... It is in our Committee on the Safety of Nuclear Installations that knowledge is effectively reviewed and incidents analysed in detail to meet the vital need for exchange of operating experience. The CSNI is a crucible where safety concepts are refined, then made available to the international community".

The CSNI relies on the technical back-up of several different working groups made up of experts appointed by the member countries. For the past three years I have had the honour of chairing Principal Working Group 1 (PWG 1), which deals with operating experience and human factor. It is in this capacity that I will attempt to outline the group's various activities and its findings illustrated by a few examples.

To put things in a proper perspective, it should be recalled that a working group composed of international experts often based at widely scattered geographical locations must overcome communication problems and make the most of discussions and exchanges of views held during its three-day annual meetings. This means that these meetings must be prepared efficiently down to the finest detail, and the work planned a long time ahead. The NEA Secretariat, especially the Nuclear Safety Division, provides the necessary backing and invaluable help, a fact I wish to draw attention to before entering into the heart of the subject. Three main aspects will be discussed :

- the group must have relevant basic data at its disposal in order to discuss problems related to power plant operating experience and the human factor. I shall describe the means that are used, in particular the Incident Reporting System for notifying nuclear incidents, which has been set up and operated by the NEA (NEA-IRS).
- the group must identify the safety topics which should be investigated, organize its own internal work and promote international specialist meetings while broadening the debate to include plant designers, licensees and various bodies whose activities involve reactor safety. I shall give a few examples of the working methods used.
- finally, as part of the exchanges currently conducted by NEA with other international organisations such as IAEA, contacts are arranged at regular intervals between the safety authorities of OECD and IAEA member countries. International meetings are also held frequently under the auspices of the two organisations. I shall give an account of the findings of the latest symposium held in May in Paris on the feedback of operational safety from nuclear power plants.

2. Working tools

2.1. Data banks

In order to exchange information acquired from the incidents and abnormal events occurring at reactors, a need was felt to create and develop a data bank. In 1980, the IRS system was set up by the NEA to collect and disseminate the lessons learnt from the analysis of selected safety-related incidents so that each country might apply them in an appropriate manner. The system is constantly being improved and has been the subject of detailed papers [1], [2], [3]. Suffice it to say that it now includes over 1 100 reports, of which some one hundred come from non-OECD members countries through the IAEA.

The data are sent by IRS coordinators nominated by the safety authorities of each of the 13 member countries involved in PWG 1 activities. The said coordinators, who are members of PWG 1, send reports on any incident judged significant, on the basis of criteria that were jointly agreed upon, giving details on the nature, causes, consequences and, above all, the safety significance of the incidents and the lessons learnt concerning the modifications to be introduced in the facilities, operational procedures, organisation, training etc. The NEA Secretariat is responsible for forwarding the reports to the member countries (after quality control) and storing them in a computer bank (at the Saclay Nuclear Centre along with the other NEA data banks). The coordinators have access to the bank either through a direct link or through diskettes usable on their own computers for research purposes or to select data on specific topics ; this retrieval is made possible thanks to a detailed coding included with every incident report. Each member country is responsible for using and disseminating within its territory the data transmitted by the IRS in a suitable form.

The IRS is PWG 1's main working tool. The feasibility of developing other means is currently being evaluated. For instance, after its 1987

meeting, the group suggested to the CSNI that basic technical data on the safety characteristics of the different reactors in operation in member countries should be collected to enable the safety authorities of each member country and the NEA Secretariat to speed up their assessment of the safety significance of events occurring elsewhere. This project is now being implemented. The basic data transmitted by each coordinator will be collected and stored in a suitable manner by the NEA.

2.2. Surveys

For many of the topics selected by the group for the purpose of exchanging information not dealing directly with specific incidents, but rather with more general aspects of reactor operation, surveys are conducted by one or more members of the group by means of questionnaires sent to the member countries. The material is then analysed and discussed for internal use by the group or for broader dissemination. Two examples focusing on human factor problems are worth mentioning :

- A few years ago, the group was concerned about the methods used in order to analyse incidents specifically involving human factors. A representative of the group sent out a questionnaire drawn up as a result of consultation with the group and prepared a synthesis of the replies so as to provide the group with an overall view on the methodological approaches used.
- In 1985, it was decided to exchange information relative to the use of computers in the control room, the need for computerisation, current technical developments and the safety problems and requirements connected with the use of computer aids for operators. A detailed survey was conducted in each country under the responsibility of members of the group addressing all bodies concerned, and in particular licensees. A sub-group drew up a synthesis of the conclusions. This work, deemed very useful by the group, was presented at an international conference in Tokyo in 1988 [4].

As a general rule, when the group proposes a specialist meeting at an international level, it conducts a detailed survey on the topic selected, which is then presented and discussed at the meeting.

3. Exchange and analysis activities

At its annual meetings, PWG 1 discusses, among other things, activities connected with the development of the IRS and holds detailed exchanges of information. It also examines generic studies on preselected themes concerning series of incidents and operational problems.

3.1. Development of the IRS

The development of the IRS is discussed on the basis of ongoing NEA activities and proposals put forward by the group concerning both form (presentation, data to be supplied and coding) and content, especially the quality of the reports. These proposals are based on the coordinators' own experience, since they are obviously closely involved in the planning

and achievement of "good" reports which are easy to understand and to use. The NEA Secretariat devotes its efforts to derive more benefit from the IRS ; it is currently exploring, on a trial basis, the use of an adapted software to link events or parts of events occurring during incidents, in order to identify "precursors" of unexpected serious accident scenarios. Following the Chernobyl accident, co-operation was considerably strengthened between the NEA and IAEA, which is developing its own IRS system. As well as exchanging incident reports, the two bodies have decided to harmonize the incident selection criteria, format and coding of documents. IAEA representatives are now invited to attend PWG 1 meetings so as to be fully informed of the Group's activities at an early date. The members of PWG 1 inform one another of IRS incidents which have resulted in certain actions being taken in their own countries.

3.2. Exchanges and discussions on specific incidents

Detailed discussions are held each year on one or two themes selected the previous year and proposed either by members of the group or by the NEA. Some of the topics dealt with in recent years, covering both system and equipment failures as well as human factor problems, are as follows :

- losses or near losses of redundant safety systems and their support systems
- failure or insufficiencies of isolation between the reactor cooling system and connected auxiliary systems
- failures of safety valves, relief valves and check valves
- human error in electrical and instrumentation systems
- systems interactions
- procedure quality and compliances.

This year, a review was conducted on incidents occurring during shutdown for refuelling and maintenance, as this is a situation where "man" and "machine" problems, due to multiple operator actions and special plant conditions, are very difficult to separate. The group concluded that related risks have to be studied more thoroughly, and that a lot of improvements need to be made, especially regarding the management of these conditions.

3.3. Generic studies

In 1986 on a proposal from the CSNI, the group conducted a more detailed generic study derived from the first of the topics listed above, namely loss of safety functions. This study, which was undertaken by a single member country only, was considered extremely useful and valuable for the entire nuclear community, and it was accordingly decided to pursue this direction by jointly selecting topics of general interest to be investigated by several countries grouped within "task forces", according to the workload involved.

The aim is to use the IRS data bank by selecting incidents related to the topic chosen and analysing them in terms of their root causes and consequences and by comparing the approaches used by the different authorities in order to overcome the difficulties brought to light from the incidents. Over the past year, the group pursued the aforementioned generic study by focusing on the residual heat removal system which had encountered problems in several countries. The group also undertook a study (shared between five countries) on 67 incidents selected from the IRS data bank and involving impairment or loss of the containment function provided by the reactor building and directly connected systems.

Within the same field of activities, a sub-group was set up two years ago in order to investigate 13 incidents selected from the IRS data bank and in the course of which the operator had misunderstood or misinterpreted plant status or the implications of his action, this theme having been suggested more specifically following the Three Mile Island and Chernobyl accidents.

Despite the difficulties encountered relative to the identification of relevant incidents and to the lack of data of IRS reports, useful conclusions in that domain were obtained and presented at an international symposium in Tokyo in early 1988 [5]. The study led to further specific work on improving the coding and content of the reports entered in the IRS with regard to the human factor [3]. Some of the technical conclusions in the report are worth mentioning :

- when the operator misunderstands events at the plant, he is induced in error (hence non performance of actions or decisions not complying with procedures)
- the consequences may be two-fold :
 - .the errors made can lead to situations similar to those arising from component failures covered by safety studies, but the frequency of such situations would then be much higher than foreseen (posing a problem for scenarios involving a succession of multiple failures which had not necessarily been fully analysed)
 - .the errors made can bring the plant into an unexpected configuration implying consequences that may not have been studied or are not covered by existing procedures
- The causes of the errors may, on first examination be attributed to :
 - .conflicting objectives (safety vs. economic or time constraints)
 - .hasty assessment of the situation under pressure from immediate objectives
 - .previous experience with situations considered to be similar
- defensive measures were mentioned, such as further automation, adequacy of procedures suitable separation of redundant trains including the staggering of testing and maintenance operations, and the prioritisation of information displays and alarms,
- errors are recovered within highly variable periods (a few minutes to a few hours).

It should be noted at this stage that the findings of the PWG 1 may be used by other principal working groups. For instance, PWG 5, which is responsible for risk assessment, is obviously concerned by all data related to human failures, and indeed one of its members has joined in the work performed by the sub-group mentioned above.

3.4. Specialist meetings

It is important for the representatives of safety authorities to initiate and promote international exchanges with licensees and plant designers as well as with the bodies involved in nuclear safety.

The group therefore has the task of selecting suitable current topics for such exchanges. After approval by the committee, the topics form the subject of meetings or symposia organized under the auspices of the NEA, possibly in co-operation with other bodies including licensee associations, in the member country which has extended the invitation. Members of the group then form a programme committee in order to define the objectives of the meeting, select proposed papers and organize the sessions.

The following are examples of such exchanges :

- a specialist meeting on steam generator problems in Stockholm in October 1984 |6|
- a specialist meeting in October 1985 in London on on-site emergency power sources
- a symposium in April 1986 in Tokyo on reducing scram frequency |7|
- two meetings on personnel training, the first in Charlotte, N.C. (USA) in 1981 and the second jointly organized with NRC at Orlando, Fla. (1987) |8|
- a meeting in Madrid in 1987 on improving technical specifications for nuclear power plants, jointly organized by OECD and UNIPÉDE.

It might be useful to describe two of these in greater detail, because of their implications for the group's activities :

.The purpose of the symposium held in Tokyo on scram frequency was to draw up a consistent picture of statistical scram frequencies and interpret the appreciable differences in the data obtained from country to country. To this end, a preliminary survey had been conducted by several members of PWG 1. The analysis of the data collected and all the papers submitted allowed a better understanding of the differences observed from one country to the next.

In general, the symposium showed that all countries had undertaken actions covering both plant design and operation in order to reduce scram frequency, which should be considered as a symptom and not a disease. Scram frequency is an indicator of plant safety. Participants agreed that it was necessary to cut down the number of unjustified scram signals even further ; recommendations were made for systematic collection and periodic analysis, at an international level, of scram data.

The collection of present and future data was organized by the NEA with the participation of the different delegates. The data collected will be analysed by the PWG 1 but a longer further observation period will be required in order to assess any changes in the situations in the different member countries.

In Madrid in September 1987, the improvement of technical specifications for nuclear power plants was the subject of extremely useful exchanges between safety authorities, plant designers and licensees, who all showed very keen interest in this topic. The operating rules contained in technical specifications form the boundary within which the plant should be operated. Compliance with sensible and well-founded technical specifications forms the best safeguard for operational safety. These rules act as a contract, in the full sense of the term, between the safety authority and the licensee. An overall view of the problems encountered in the preparation and implementation of technical operating specifications in NEA member countries was presented on the basis of a highly detailed questionnaire drawn up by a few members of PWG 1 and completed by licensees and plant designers in member countries. Many papers were presented on regulatory aspects and the role of safety authorities, methodological approaches (probabilistic approaches, use of operational feedback), computer techniques to meet the many requirements involved more easily etc... PWG 1 presented the following conclusions to CSNI :

- in the IRS system for collecting incident reports, all violations of technical specifications should be entered ;
- a request should be made to PWG 5 to promote potential tools for evaluating technical specifications ;
- lastly, it is very important to implement programmes for improving technical specifications in all countries with nuclear facilities so as to improve operational safety. A follow-up of the evolution of these programs will be made by PWG 1.

4. Co-operation with the IAEA

In addition to exchanging incident reports and improving the IRS system in close co-operation, the NEA and IAEA organize an annual meeting for the representatives of the safety authorities of member countries, who report on the latest incidents in their own countries during the previous year. They also jointly hold international meetings with broader participation.

In May 1988 for instance, an international symposium was held in Paris on the feedback of operational safety experience in nuclear power plants, with the following main findings.

The objective of the symposium was to assess the results of the considerable effort made in recent years by the nuclear industry to improve operational safety in power plants by reviewing the main stages in the feedback process, namely :

- the identification of safety problems through data collection and processing, and the methods used for evaluating such data

- the analysis of safety problems (generic problems, incidents, accidents) through their immediate and root causes and the conclusions to be drawn about any further action
- the implementation of remedial measures, in particular decision making processes, methods adopted for solving safety problems involving equipment, the man-machine interface and personnel, and backfitting practices in power plants in operation.

This meeting was attended by near 170 participants from 28 member states. Almost 60 papers were presented. A panel discussion was held on the participants' main points of concern :

- how to assess operational safety ?
- how to monitor facilities effectively in order to prevent incidents ?
- how to improve safety for both equipment and operators ?
- the role of safety authorities ?

The information presented and discussed during the five days of the symposium cannot be summarized here, but a few significant trends are worth mentioning :

- Licensees, which hold the main responsibility for plant safety, are aware of the importance of effective organization of feedback and reported on the methods used, which are highly variable. In particular, the pooling of means within a country or between several neighbouring countries should be noted.
- Operating experience acquired by the industry as a whole is accessible through incident collecting systems set up or developed by licensees (UNIPED 9) and WANO 10) or safety authorities (NEA and IAEA IRS data banks) ; many examples of effective use of this experience were given. I want to stress the main trends in the evolution of these systems, in the light of their respective objectives. Nuclear operators want to maximize the exchange and use of technical information relative both to the safety and reliability of the operation of plants. They have decided to implement a worldwide association of nuclear operators (WANO). The IRS systems of safety bodies aim at retaining safety lessons learnt from incident analyses ; for the NEA the whole set of data collected must be used to perform thoroughgoing analyses.
- Problems encountered in the course of operation not only concern incidents but routine operation and plant maintenance. Licensees reported on the means they are developing or using to facilitate the daily routine of operators and the monitoring of the state of health of plants
- International bodies are developing many activities for promoting international co-operation. The NEA presented the outcome of the activities described in this paper.

The IAEA is also conducting activities to assist licensees, such as OSART (operational safety review team) [11], the value of which was emphasized.

- Safety authorities are striving to make constructive suggestions about the solutions and research needed in order to improve safety, in spite of the somewhat thankless nature of their interventions in some cases.

On the whole, this symposium was characterized by a marked degree of openness as well as by a strong desire to communicate, every participant having now acquired the conviction that much is to be learned from the others and that sources of concern and difficulty might be shared without reserve.

Some of the following themes in the introductory speech by the chairman of CSNI (one of the two chairmen of the symposium) were also amply illustrated :

- nuclear safety is not a system fixed once and for all : it is constantly evolving with the lessons learnt through experience
- the need for safe operation of nuclear plants is imperative to restore confidence within public and government opinions. Permanent analysis of operating experience, feedback to other planned and operating power plants, and taking into account the role of man in operational procedures are henceforth the main sources for improved safety in the future.

I want also to report important messages expressed by the vice-president for operations at Ontario-Hydro in Canada (the other chairman) during the conclusion ; he stressed the importance of human factor and of the quality of the dialogue between safety bodies and licensees. Both have much to gain from experience feedback, the lessons learnt from the latter are often independant of the reactor type.

5. Conclusion

I have attempted to describe all the advantages which may be gained from international co-operation in the operational safety field. The NEA approach is to gather a group of experts whose activities ensure continuity and feature long-term planning.

In the realm of operational safety, it is essential for specialists in plant operation and the human factor to be closely associated.

The useful discussions and both spirited and candid exchanges of opinions within this group have enabled experts with different viewpoints to work closely without segregating issues relating to man from those relating to the machine.

Much more work remains to be done but the methods are well established and effectively implemented thanks to the participants' full commitment to the chosen objectives.

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