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Specialist Meeting on

SEVERE ACCIDENT MANAGEMENT PROGRAMME DEVELOPMENT

Organised by

OECD NUCLEAR ENERGY AGENCY

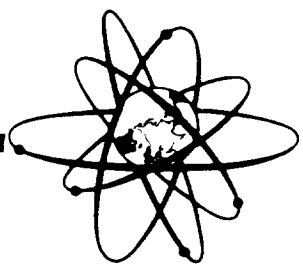
in collaboration with

ENEA/DISP

SUMMARY AND CONCLUSIONS

Rome (Italy)

23-25 September 1991



COMMITTEE ON THE SAFETY OF NUCLEAR INSTALLATIONS
OECD NUCLEAR ENERGY AGENCY
29, boulevard Suchet, 75016 Paris, France

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FOREWORD

An OECD (NEA) CSNI Specialist Meeting on Severe Accident Management Programme Development was organised from 23rd to 25th September 1991 in Rome in collaboration with ENEA/DISP.

Effective Accident Management planning can produce both a reduction in the frequency of severe accidents at nuclear power plants as well as the ability to mitigate a severe accident. The purpose of an accident management programme is to provide to the responsible plant staff the capability to cope with the complete range of credible severe accidents. This requires that appropriate instrumentation and equipment are available within the plant to enable plant staff to diagnose the faults and to implement appropriate strategies. The programme must also provide the necessary guidance, procedures, and training to assure that appropriate corrective actions will be implemented. One of the key issues to be discussed will be the transition from control room operations and the associated emergency operating procedures to a technical support team approach (and the associated severe accident management strategies).

Following a proposal made by the Senior Group of Experts on Severe Accident Management (SESAM), the Committee on the Safety of Nuclear Installatioons has decided to sponsor a Specialist Meeting on Severe Accident Management Programme Development.

The general objectives of the Specialist Meeting were to exchange experience, views, and information among the participants and to discuss the status of severe accident management programmes. The meeting brought together utilities, accident management programme developers, personnel training programme developers, regulators, and researchers.

In general, the tone of the Specialist Meeting - designed to promote progress, as contrasted with conferences or symposia where the state-of-the-art is presented - was to be rather practical, and focus on accident management programme development, applications, results, difficulties and improvements.

As shown by the conclusions of the meeting, there is no doubt that this objective was widely attained.

ENEA/DISP gave generous hospitality to the Specialist Meeting. We also would like to express our gratitude to the members of the Programme Commitee, Mr. G. Petrangeli (General Chairman of the Meeting), Dr. B.W. Sheron (Technical Chairman), Mr. P. Bystedt and Mr. L. Reynes. Their efforts and advice have strongly contributed to the success of the Specialist Meeting, as well as those of the other members of SESAM: Dr. M.V. Bonaca, Dr. N.E. Buttery, Mr. Y. Cornille, Dr. P. Govaerts, Mr. A. Omoto, Mr. J. Rohde, Dr. L.A. Simpson, Dr. K. Soda and Dr. H. Tuomisto. Dr. J.R. Lehner assisted the Senior Group in the preparation of the attached Summary and Conclusions.

J. Royen
NEA Secretariat

SUMMARY AND CONCLUSIONS

The CSNI Specialist Meeting on Severe Accident Management Programme Development was held in Rome, Italy on September 23-25, 1991. It was hosted by the Italian Regulatory Organisation (ENEA/DISP). About seventy experts, representing thirteen countries and the OECD, attended the meeting. Over a period of two and one half days a total of twenty-seven papers were presented in four sessions, which covered specific aspects of accident management programme development. Plenary Sessions at the beginning and end of the meeting were also held. The proceedings will be published by ENEA/DISP under separate cover.

This was the first meeting sponsored by CSNI on the subject of Severe Accident Management (SAM), and it purposely focused on the programmatic aspects of accident management rather than on some of the more complex technical issues associated with accident management strategies. Many of these complex, technical accident management issues are currently being addressed by CSNI's Principal Working Groups 2 and 4. The meeting showed that most OECD Member countries have actively started working on severe accident management programmes. However the degree of implementation among the Member countries varies significantly. Some countries have stated that they have implemented practical accident management programmes that address the major elements of accident management, while others have stated that their accident management programmes are still in the development stage or in various stages of implementation.

The major observations and conclusions from the meeting are as follows:

1) Severe Accident Management is the ultimate part of the defense in depth concept within the plant. It is function and success oriented, not event oriented, as the aim is to prevent or minimize consequences of severe accidents. There is no guarantee it will always be successful but experts agree that it can reduce the risks significantly. It has to be exercised and the importance of emergency drills has been underlined.

2) The basic structure and major elements of accident management programmes appear to be similar among OECD Member countries. However, the extent and type of strategy implementation are different. Implementations range from the usual actions to prevent core damage or maintain containment integrity to innovative provisions to further increase the likelihood of lower vessel cooling via external flooding.

3) Dealing with significant phenomenological uncertainties in establishing accident management programmes continues to be an important issue, especially in confirming the appropriateness of specific accident management strategies.

4) The technical debate that transpired during the meeting reached no clear consensus on the extent to which operator aids can and should be used. There appeared to be general agreement that simplified aids, such as graphs, precalculated parametric relationships, or simple analysis tools

are useful. At the other extreme, the benefits of having sophisticated analysis tools (e.g. RELAP) on-line and running significantly faster than real time in order to predict possible outcomes of proposed accident management strategies are not yet clear, and further investigation is necessary.

5) Although the majority of the papers discussed the positive effects of SAM a number of papers were presented that indicated that certain "instinctive" accident management actions (i.e., adding water, depressurizing) may have detrimental aspects (e.g., depressurizing can enhance the likelihood of steam explosions or adding water to a degraded core can increase steam generation and thereby may increase metal water reactions and fission product release). A design goal for future reactors should be to eliminate detrimental effects of accident management actions if possible. For current reactors, the detrimental effects must be weighed against the benefits. The resulting operator guidance should be clear and unambiguous and not burden the control room operators with doubts about the appropriateness or efficacy of their actions.

6) Only a few presentations included information on training for accident management, although this is considered to be a major element of a successful accident management programme. While this does not necessarily mean that this aspect of accident management is being neglected in OECD Member countries, further consideration regarding how, and to what extent, CSNI should address this issue is certainly indicated. The Senior Group of Experts on Severe Accident Management plans to provide specific recommendations to CSNI on this area in the future.

7) The organisational structure used by nuclear plant owners varies widely from country to country and can differ among utilities in the same country. What is important is that organisational lines of authority during a severe accident should have been previously established and clearly defined. It is recognized that these organisational factors may influence the elements of individual accident management programmes.

8) Based on the information presented at the meeting it was concluded by the Senior Group that at least two additional specialist meetings dealing with SAM are warranted. A specialist meeting on operator aids to deal with SAM should be scheduled within about 2 years time. A second specialist meeting on SAM programme development should also be scheduled to be held in about 2 years. The purpose would be to identify the progress made in OECD Member countries regarding the implementation of SAM programmes since this meeting. The exact timing of this second meeting should be established after an assessment that significant progress has been made to warrant such a meeting. These specialist meetings can be sponsored by the SESAM if it is still in existence or by CSNI Principal Working Groups.

The following is a summary of the papers presented at the Specialist Meeting:

The First Session: "Approaches to Severe Accident Management", included eleven presentations by representatives from seven countries. Due to the homogeneity of this session it is summarized here by topics rather than by individual papers. All presentations verified that SAM, although not

necessarily defined completely similar, is recognized to be very important for safety, both for preventive and mitigative reasons. Although research and development programmes will continue to provide additional information to reduce uncertainties, today a substantial knowledge base on severe accident issues exists such that implementation can be undertaken at specific power plants. Since the TMI-2 accident, the implementation of improved procedures for the plant operating personnel is well established. Nevertheless, procedures for dealing with severe accidents involving substantial core damage have not yet been generally implemented. Projects for further development in areas such as analytical capabilities, operator tools, and the addition of mitigative features, are underway in many countries, however with differences in scope and schedules. The approaches regarding plant technical modifications differ.

All participants agreed that it is the responsibility of the licensee to develop and implement a SAM programme for the benefit of safety at the plant. Government authorities are responsible for planning appropriate emergency measures in the surroundings external to the plant site. A constructive co-operation between these two entities is essential in order to obtain optimal outcomes. Due to many differences among countries, and possibly among licensees in the same country, guidance, coordination, and co-operation between the parties involved most likely will need to be organised in different ways. The key element is that the maximum possible benefit is gained from co-operation and that each licensee gets the needed guidance and support in the development of a SAM programme.

The importance of structured training, not only of operators, but also of the various support personnel groups, including management, was recognized in the discussions. SAM guidance should be familiar to the plant staff and, to the extent applicable, the information should be structured along the lines that are used for normal operations. The utilization and implementation of training programmes and of simulation tools varies from country to country.

Many research programmes are underway in different countries. These will generate knowledge that must be taken into account, one way or another, in SAM. Thus SAM must be developed and updated, taking the latest experimental and analytical results, as well as operational experiences, into account.

Session Two was entitled "Technical Issues Associated with Severe Accident Management Programmes for Existing and Future Reactors". It began with the Italian perspectives for SAM in the next generation of nuclear power plants which take into account the effect of plant simplification and the slower evolution of accidents for the plants under consideration. A Swedish study of the long-term aspects of Accident Management for existing plants pointed out the importance of short-term measures on the longer term radiological effects of a severe accident. A Canadian study looked at the effects the composition of the vessel atmosphere during core melt has on fission product releases. It noted that oxidation as well as temperature during core melt accidents has an effect on fission product release. The impact of phenomenological uncertainties on SAM was highlighted in a British presentation. Possibilities to retain or delay noble gas releases by utilizing off-gas filters in BWRs, studied in Italy, were also presented. The discussion following the presentations concentrated on the value of actual plant-specific studies, in combination with known technical issues, to largely minimize the influence of phenomenological uncertainties in a specific SAM approach.

Session Three concentrated on "Severe Accident Management Information Needs and Operator Aids". For the first topic, information needs, a methodology developed under USNRC sponsorship was presented. This methodology determines, for existing plants, the information needed for accident management for a wide range of severe accidents, and the availability of this instrumentation in accident situations. A second paper, presented by a German (GRS) representative, described an identical approach directed toward German plants. The two papers included an application of the methodology to a PWR with a large dry containment.

It was suggested that this kind of study should be implemented as part of a utility's Severe Accident Management Programme. Comprehensive methodologies of these types should certainly be adequate to identify key instrumentation in a plant that may be critical in monitoring and managing a severe accident. However, the analytical work necessary to implement these methodologies would probably be of little use to the staff managing the accident, unless the results are presented in a practical format. In addition, this kind of examination would be of great interest for future reactors when the information needs for severe accidents are considered. Several papers were presented on the second topic of operator aids. Such aids in place at or under development for nuclear reactors sites are actually designed primarily for personnel in the plant's Technical Support Center.

The main objectives of these aids are the following:

1 Providing plant specific data
2 Validating plant measurements
3 Evaluating measurements for additional information to diagnose the accident
4 Estimating plant parameters not measured
5 Extrapolating to determine the future outcome of the accident
6 Estimating strategy effectiveness.

Proposed aids vary widely in sophistication. The simplest format can be a graph of data or calculated information; the most complex format is a personal computer or a workstation using sophisticated codes.

The discussion which followed the presentations showed two different positions. On the one hand, a large number of people support very simple tools, using a limited amount of information to achieve objectives 2 through 4 above. On the other hand, a number of people think it is possible and useful to employ an integrated code package on a workstation, executing substantially faster than real time, to achieve objectives 5 and 6, at least up to the beginning of core melt.

It is difficult to conclude today what should ultimately be done in this field. An important point, emphasized by the speakers, is that all the tools, sophisticated or not, have to be appropriately fitted to the people of the accident management team in charge of using them. Therefore, the types of tools ultimately available in a nuclear plant will depend heavily on the organisation and types of people the utility has chosen to support emergency operations. As a consequence, it is necessary to maintain a high level of expertise among the people in charge of accident management by establishing a comprehensive training programme.

In conclusion, the development of operator aids to assist accident management personnel, particularly in the Technical Support Center, is proceeding in several directions. The types of aids will vary from plant to plant. It will be interesting to make a survey of the situation, and to discuss the experience gained, in a future meeting on operator aids recommended to be held 2 years from now (conclusion 8 above).

The Fourth and final Session addressed "Severe Accident Management Organisation, Guidelines and Decision Making". French SAM methodologies were presented by EDF and IPSN. The EDF methodology consists of diagnostic stages and prognostic stages. The state of the fission product barriers and the releases of fission products are diagnosed and these diagnoses are then used to estimate environmental consequences as a final product. The IPSN methodology presented at the meeting focused on the work done by the Plant Assessment Unit which synthesizes the plant state from the available information and estimates the source term.

A Swedish paper on verification of SAM strategies outlined the basic demands for an emergency organisation: to handle the accident at the affected unit, and to help to provide information to the authorities and the pubic. The accident management documents for each level of personnel were also presented.

The final presentation discussed a USNRC sponsored model consisting of an eight element process describing accident response. The model is influenced by the organisational factors which include communication, decision making, management attention, organisational culture, standardization, and external relations. There is no doubt that those organisational factors are also important elements for the implementation of a SAM Programme.

In this session, the usefulness and limitations of fast running computer programs as a tool to describe accident progression were again discussed.