

Safety in nuclear power plant operation

by H.A. Wright*

Even if no more nuclear power plants come into operation, many will still be operating well into the next century. This statement was made by Mr Morris Rosen, Director of the Agency's Division of Nuclear Safety, in his opening address to a seminar on the safety of nuclear power plant operation held in Vienna in November 1983. Plants ten years old or younger, of which there are about 200, can reasonably be expected to be counted among those still operating after the year 2000.

A seminar on operational safety was therefore timely; one can foresee the need for many more. Such seminars bring together experts from both industrially advanced and developing countries to exchange information on their experience and needs. In particular, they can highlight difficulties, and the solutions that have been found to many problems. Since the IAEA has nearly completed its Nuclear Safety Standards (NUSS) programme, it was only natural that the programme planned for the seminar should be based on the NUSS code of practice on nuclear power plant operation, and associated safety guides. The final programme included three sessions on management, and one on quality assurance. Few or no papers dealing with some areas important to safety, such as maintenance, operational limits and conditions, core management, fuel handling, and on-site waste management, were received.

It is difficult to say whether a seminar is successful or not, but about 80 participants attended, 31 papers were presented in the nine sessions, the generous amount of time allocated for discussion usually proved insufficient, and some of the participants expressed enthusiasm after the seminar had ended — all signs of some measure of success.

Managing a utility for safe operation

Several speakers said it must not be forgotten that it is the responsibility of the utility not only to produce electricity at "commercial" prices, but to operate its plants in a safe manner. Aspects of management in certain areas related to safety are usually given greater emphasis after the introduction of nuclear plant than before, and this can create quite radical changes in the structure of an organization. It must, for example, be organized in such a way that safety-related matters receive proper attention at decision-making levels, in order to ensure that effective action is taken even though it may appear to conflict with costs and schedules. Consequently, organization of features such as comprehensive

systems for review and audit, safety review committees, and arrangements to utilize relevant operating experience as effectively as possible were described.

Greater emphasis is being put on recruiting the best available personnel, and on training them to achieve and maintain their competence. In some countries, certain operating personnel have to be licensed. A controversial subject at the seminar was how to provide the shift operator, who controls the plant, with rapid and reliable technical support when plant indicators show that an abnormal condition has arisen. Put very simply, there are two schools of thought. One school considers that shift operators themselves should be highly qualified. One can then rely on them to see to it that the condition of the plant is correctly diagnosed and that an optimal procedure is adopted to restore it to normal working. The other school considers that the shift operator need be sufficiently competent only to cope with the plant under normal conditions, while more highly qualified persons who specialize in the study of the abnormal behaviour of the plant are on hand to deal with any abnormality soon after it manifests itself.

Maintaining plant in a safe condition

Maintenance, like many other safety-related activities, requires careful consideration during the design stage, and the involvement of maintenance personnel during construction and commissioning. Another aspect stressed in this session, which often does not get the attention it deserves, is the need for good communication between maintenance and operating personnel — not only clarity in the spoken language, but written evidence of plant conditions at hand-over of responsibility. Clear and unambiguous labelling, tagging, work restrictions, and work areas are the sort of things requiring effective administration.

Preparedness to cope with radiation hazards

Preparations for coping with an accident at a nuclear power plant which results in the release of radioactive materials into the environment were described by three authors from different countries. In the French presentation the practice of holding "tabletop" exercises, in which the relevant persons are gathered together and each states the action he would take in a given scenario, was mentioned. This practice has some obvious advantages and should appeal to utilities as a useful supplement to their total programme of exercises. A paper from the Commission of the European Communities (CEC) discussed steps toward harmonizing emergency preparedness

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among CEC member States. One step is a common methodology for deriving source terms (that is, the analysis of the radioactive materials leaving a plant during an accident, and how they enter the atmosphere). It was claimed that some harmonization would be advantageous for emergency planning in the case of nuclear plants close to borders.

The session on radiological protection showed perhaps that effective use of experience could reduce markedly the total dose to site personnel.

Constraints on plant operation

There are some things that an operator cannot do, either because a given practice is known to be hazardous or because it has not been shown to be safe. Such constraints are called operational limits and conditions. In practice, there are a number of these, and some can be technically complicated. The operator has a problem in ensuring that he complies with them, and in deciding what is to be done. Other constraints arise from the need to operate the reactor in such a way that the fuel is utilized as effectively as possible, which is the principal activity in core management. The operating limits for the fuel need to be approached as closely as possible for good fuel utilization, but the more closely they are approached, the smaller the safety margins become. Since the operating limits of the fuel cannot be measured directly, the core conditions have to be assessed. Both operational limits and conditions and core management were the subjects addressed by an invited speaker. A related paper described the arrangements made in one country for reconstituting fuel assemblies in PWRs to extract energy from the fuel at a high rate only when the corrosion of the Zircaloy cladding is small, and so improve fuel utilization.

Should the manufacturer operate the plant before handover?

This question was discussed during the session on commissioning. In the end the answer seemed to depend on what was meant by "operating" the plant. Generally speaking, manufacturers supplying the plant do not themselves manipulate the plant controls but the utility's

operating staff do so under their instructions. This staff thereby obtains "hands-on" experience. Practices differ mainly in the degree of responsibility taken by the manufacturer and that taken by the plant management during this hand-over period. It is attractive for a developing country to let the manufacturer have full responsibility until a period of full power operation has been achieved, but some participants pointed out that the motivation of the manufacturer completing his contract was different from that of the operators. The latter wish to take extra care during commissioning to avoid problems in the future.

Commissioning featured in the panel discussion on management. Considerable stress was placed on the need for involvement of operating and maintenance personnel in commissioning. Some advised that such involvement should occur during construction, or even at the design stage. The need for early involvement has also been stressed in the NUSS documents, so it may be hoped that responsible persons in countries about to embark on nuclear power programmes will be influenced. This panel also discussed the type of operating procedures that should be developed and the freedom to be given to operators to depart from them, at least under abnormal conditions. These questions may seem simple, but procedures are part of the man/machine interface, for which questions concerning operator qualification, training, and competence are also clearly involved, although these were not re-opened during discussion.

Who is using NUSS operations documents?

This was the basic question discussed by a second panel. Quite a number of countries are using NUSS documents in different ways, including their adoption as national requirements. They are being used in countries starting nuclear power programmes, and in countries which have many years of experience. Translation into the languages of the user countries is essential however if the NUSS documents are to receive widespread use, and that presents quite a problem. The general plea for more details to be supplied and for examples to be given can only be met in any practical way by the development of explanatory supporting documents. This is something for the future.

