

INTERNATIONAL CONFERENCE ON AVAILABILITY IMPROVEMENTS IN NUCLEAR POWER PLANTS

Nowadays, there are still black clouds hanging over the nuclear industry in spite of the great effort made to improve the availability of nuclear power plants around the world during the recent years. As all of us know, there are several parameters which influence the whole process of public acceptance of nuclear energy:

- Governmental decisions depending on electricity demand growth, available domestic resources and an appropriate combination of economically competitive sources of energy.
- Public information to avoid false alarms, misinterpretations and distress due to ignorance of nuclear matters.
- News media professionalism to generate the right messages based on experts "know how" and to elude the thirst for sensationalism usually based on inaccurate and purposely deceptive reports.
- Owners of NPPs to strive for excellence in plant operation so as to provide safe, reliable and cost-competitive energy free from significant incidents and accidents and with a good communication system between the people in the nuclear industry and with the public as well.
- Nuclear regulators to establish adequate rules and standards and inspect correct adherence thereto so that the safe operation of NPPs can be guaranteed.

However and unfortunately, what usually happens is that governments are overwhelmingly by affected the public's strong dislike of nuclear power and most of the politicians, on the other hand, do not take into account that nuclear energy is a proven and acceptably safe technology with minimal environmental impact during normal operation. The final result is that political support of nuclear power is completely eroded.

Furthermore, the public is uninformed or misinformed when a significant incident or accident occurs at any nuclear power plant in the world. It creates an atmosphere of confusion, fear and even panic in certain cases without taking into consideration that in reality, low radiation

levels, several times natural background, do not cause any deleterious effect on public health.

Moreover, the news media do not often contact the technical people who know exactly what has happened and who can provide the appropriated information because they have the sources and "know-how" to give a clear and correct explanation of the event, the current situation, its control and a future forecast.

Besides, even if the journalists do so, something depending on their own feelings and perception of nuclear power and/or the position of the news media they work for, the presentation of news and articles is made in such a way that it deeply alters the read and true facts, leading to a complete misconception.

With regard to Nuclear Regulators' behaviour, we observe that it differs from country to country. Meanwhile some Safety Councils are concerned about establishing a thorough and productive dialogue with nuclear operators in order to discuss safety matters, set up research programs, impose rational requirements and seek a direct and commensurable improvement of safety issues; some others are tremendously strict in applying requirements which most of the time results in an important overburden to plants operation without taking into consideration the overall impact on the safe operability of NPPs. Cost-benefit analysis should be applied to design changes and some fields should be left to the nuclear industry for self-regulation.

On the other hand, the owners of NPPs need to improve in the area of training and communications. One of the aims in achieving operational excellence is to effectively carry out a sound and complete training program not only for the operating crews, who already receive it, but also for the remaining technical personnel from management down to the last technician who works at or for the plant. Human errors are the common cause of most nuclear incidents and accidents; therefore, to avoid them as much as possible, good training is required and absolutely essential.

As regards the no less important field of

communications, we have to recognize that there was a tremendous lack of it within the nuclear industry and with the public as well in the 1970's. This lack of communication has improved in the eighties and there is still room for improvement in this area. Along these lines the Spanish Nuclear Society extended a special invitation to the representatives of electrical utility owners operating NPPs and to the nuclear industry people in general to cooperate and participate in an International Conference so as to share experiences and expertise in the fields of utmost interest for obtaining a safer and more reliable operation, a better regulatory atmosphere, greater public trust and a more economical commercial operation of NPPs.

All over the world, the nuclear industry has made important progress in improving the availability of NPPs during the past decade. It is clear that a good image and public trust of nuclear energy will mainly depend, among other things as previously described, on one own efforts to approach operational excellence and establish better communications for information exchange. If we achieve these goals, the improvement in availability of NPPs will be a consequence thereof as well as of a greater participation of nuclear power in covering the increasing world electricity demand.

As everyone acknowledges today, there is an increasing and imperative need for solidarity in the multiple fields of technique and humanities and the nuclear field is not outside of these. We need to help each other, and the exchange of operating experiences and new technological progress is of paramount interest in the international nuclear community. As stated by our president of the Spanish Nuclear Society, the resulting social relationship alone justifies this Conference.

We believe that we have accomplished the key objective of the Meeting, fundamentally aimed at sharing experiences and knowledge, identifying the factors which restrict availability and presenting solutions devised to solve actual problems encountered.

This type of information exchange in



- 1- Reception offered by the Mayor of Madrid.
- 2- Opening Ceremony.
- 3- Closing Ceremony.
- 4- Exhibition.

operational techniques, technological improvements, training quality and effectiveness, and human and material resources, together with management's involvement in daily tracking and solution of priority problems, constitute the basic principal of superior loading capability.

First of all, special attention was paid to underlining the necessary measures to be taken in order to pursue excellence in the operation of NNPs. The absolute necessity to focus our goals on substantial improvement in the quality of operation, which is often understood differently from one country to another, was set forth. Striving for excellence means to seek an optimum of safety and economy: a challenge for a plant management to operate profitably without endangering safety. It also means an increase in reliability and efficiency of site and support personnel. Several performance mechanisms were set up, from the well-known performance indicators to new programs in training and retraining personnel. Human factors were considered, as well as operator aids, scram frequency reduction, technical specification optimization and exchange of operating experiences relevant to safety and thermal efficiency.

All these programs lead to an increase in the availability and productivity level, and reduce the operating cost to a point dependent on Utility policy and regulatory regime. We thus seek an economy target complying at all times with the safety goals and standards required by the Regulatory Body.

Traditionally, the nuclear industry has concentrated on design modifications as a key way to improve availability. However, we can now say that the performance of operating personnel is much more important for normal operation, free from unscheduled outages, as well as for

controlling any kind of incident and transient and/or accident event. TMI and Chernobyl reflected the importance of human behaviour and man-machine interaction in such situations. Therefore, as the first lesson that this taught us, the subject of human reliability has been and is under thorough investigation, improvements have been made and there will be more forthcoming.

Indeed, the best designed plant can be poorly operated and the poorest plant with a well trained and attentive staff can achieve a high level of quality. We have observed how institutions dedicated to training site personnel have merited the acknowledgement of the nuclear community and their effort ought to continue and be extended in the future, with the help of simulators and microsimulators that faithfully reproduce in real time the status of the Plant as Nuclear Plant Analyzers with new T-H models to be taken into account. The incorporation in the near future of Artificial Intelligence will provide additional support to the operators as diagnosis elements. We have seen some good papers about AI and the application of some programs already in use.

On the other hand, it is evident that any significant incident which occurs at any NPP in the world can end up affecting all the other Plants in one way or another. Therefore, the number one priority is to maximize safety and reliability levels in all plants, according to cost-benefit criteria, by establishing better communications, more information exchange and emulation of good operational practices.

The new institution WANO will significantly contribute to achieving this goal, as well as the work developed by the IAEA OSART inspection teams. The effort made is of great magnitude. However,

the Utilities' attitude should be positive and completely cooperative at all levels of their organizations, so as to put the machine in good working order.

In the area of performance indicators, it is clear that an international agreement is needed on the terminology to be used in definitions so that we may compare things which are truly comparable. We should never try to use them for ranking NPPs nor for distorting managers' judgments or decisions by using the indicators inappropriately, but rather as a powerful and very interesting tool for self-assessment of quality operation. The number of indicators is not as important as a meaningful perspective, with fundamental results based on overall plant performance rather than on intermediate processes. Lastly, they will serve for easy identification of weak points to be quickly located and remedied so as to accomplish goals but still maintain realistic objectives.

It is worth mentioning the special programs aimed at system simplification from the design, operational and surveillance point of view. Meanwhile, applicable regulations and requirements tended to increase system complexity. Past experience and experiments have demonstrated the advisability of reanalyzing the situation to optimize, simplify and achieve a more flexible control and to handle the plant response without diminishing the established safety margins. This should be a common contribution of the nuclear industry and Regulatory Bodies. A good example is the Technical Specification improvement program undertaken in a good many countries to optimize the documents, reduce their contents, clarify the tests, and relax surveillance and out-of-service requirements. Other examples of simplification are the advanced NPP designs, and the scram frequency re-

duction programs carried out by Owners Groups and NPPs.

With regard to the operating experience feedback, the analysis and applicability to each plant of events occurring at other plants are needed. Similar incidents happen and happen again, and thus it is necessary to assign the appropriate resources to study and evaluate the surfeit of information generated in this area. The safety and economic benefits that we can obtain by avoiding such problems, which could take place in our Plants, and by solving them in a quick and efficient way, should widely compensate the cost of devoting resources nationally and internationally to keep each other informed. This area is predestined to grow and become more important year after year, and thereafter it will contribute to attaining the industry goals. The challenge is thus to make national and international cooperation a reality, as stated earlier, collecting not only the positive but also the negative aspects, and obviously we should provide clear and complete information to avoid discrepancies between experts and, lastly, disseminate the immense experience acquired by plant personnel.

On the other hand, there are various mechanisms to directly improve the availability of NPPs. In this area, should emphasize above all the optimization of refueling outages. Every Utility is working on this important issue, which on average consumes approximately 75 % of total plant availability time, from its careful early planning and long-term scheduling by a dedicated group of technical experts, through the entire process up to the final self-critical analysis to make progress in future outages. Usually, the longer refueling outages resulted from installation of plant modifications and extensive repairs. Therefore, a good control of design modifications with well-defined priorities, and a greater availability of special and well-designed tools to facilitate preventive and corrective maintenance, are necessary to perform a fast and effective job. Other areas of interest are those related to providing solutions to problems encountered in BOP systems and components (steam generators, moisture separators, reheaters, condensers, feedwater systems, etc.). Some solutions are better for control of water chemistry, others for thermal treatment of components or design modifications, and others are under research and experimental validation. In relation to water chemistry, strict control is needed. The strong interaction with materials of the RCPB and fuel cladding were depicted, as well as its impact on exposure minimization programs. Under this subject of ALARA, we have also looked at programs implemented regarding material selection for piping, components and filtration systems, new models developed to simulate the transport

and accumulation of corrosion and activation products for a wide variety of operating conditions, and applicable control measure and training to reduce exposure total time. From now on, the new technology called Robotics will be increasingly used in those jobs to be performed under special conditions, harsh environments and/or high radiation fields; examples of its use have been presented for steam generator repairs.

With regard to the no less important subject of maintenance, many improvements were depicted referring to the problems faced and the improvements implemented in most NPPs. Again, Robotics has been used to solve some of the maintenance problems, to reduce dose exposure and to achieve a higher level of productivity and quality, together with the application of reliability-related maintenance programs to identify priorities, frequencies and activities that reflect actual operating experiences and trends. There are excellent handbooks published on maintenance guidelines, and both the industry and Regulatory Bodies are paying much more attention to this increasingly important field.

An understanding of the underlying degradation mechanisms of components and a data-bank analysis to extract trends are absolutely necessary for selection of critical components, failure modes, surveillance requirements, diagnosis techniques and recommended actions for predictive and preventive maintenance and life extension programs. We have received confirmation of pilot study results demonstrating that the life service of most equipment can be substantially increased without allowing aging degradation to affect safety margins.

The NUMARC-NUPLEX working group is developing the technology and methodology to support NPP life extension licenses in the USA, and other countries are taking similar steps as well.

Furthermore, with regard to the mechanisms for improving availability, we should mention, all the help received by the Utilities from the Engineering and Service Companies who give support in specific technologies to operating units in order to solve specific problems with well-defined work packages, normally short schedules, data acquisition and processing systems, inspection and testing equipment, etc., combining field and desk work under a dynamic management. Nowadays, the transformation of AEs into Service Companies is essential. One of the services provided corresponds to Configuration Management Control. More than a control of documents, it is a set of organizational methods and computerized systems providing real access to the information that reflects the actual status of the Plant.

We think that we can expect a renewal of nuclear orders in the next decade and

we have different types of designs to choose from, from highfull-power advanced designs to medium-and low-power simplified designs, and PWRs, BWRs, HTGRs and CANDU type reactors. All of them offer new designs to reduce the construction period and operating costs, through simplification and modularization techniques, improved maintenance, simple operation, reduced dose exposures and radioactive waste, and incorporation of new passive features, in the case of the so-called simplified designs, to allow the operators more time to think before action is required in accident conditions. Thus, there is a broad spectrum of possibilities from which to choose a new type of plant design, depending on the Utilities' specific, needs and constraints and, of course, in accordance with the corresponding energy policy.

As regards the evolutionary nuclear fuel changes, we have verified with satisfaction the tendency of Manufacturers to work in close cooperation with Utilities to adapt design to the requirements of each Plant. The different designs are continuously evolving toward better neutronic economy, weakening fuel-cladding interaction, reaching higher burnups and optimizing fuel management. The improved competitive situation among suppliers has a positive effect on the offered product and developed research.

We would also say a few words about solid waste reduction programs. It was stated that waste management should be part of a national integrated system and that it is necessary to expedite changes so as to lower the waste volume generated in the Plants. New systems for separation and ultrafiltration have been presented, as well as compaction and incineration results.

To conclude this summary we again emphasize, as in the beginning, the operational excellence that corresponds to the responsible owner. The term "excellence" is not just a nice concept, tossed up by INPO after TMI, to talk about in magnificent conferences, but rather a day-to-day workable target to be achieved by the joint effort of everyone working in this field, from management down to the last technician who, with good training and motivation, must do his job at the highest level of quality.

We have substantially improved training and communications, and we must continue to do so in the future to achieve better management and efficiency. This type of International Conference and Symposium organized by the Nuclear Societies and other Organizations such as NEA (OCDE) and IAEA, are absolutely essential for international cooperation. As everyone knows, trust in Nuclear Energy grows slowly, step by step, through convincing results, dialogue, information, mutual cooperation and communication.