Top safety issues, NUSS reviewed

by Enzo Iansiti

After the accident at Three Mile Island, and as a consequence of numerous probabilistic risk assessments (PRA) and safety research programmes, severe accidents with degraded core have started to play a larger role in nuclear plant safety in some countries. The question is: Is it necessary to fundamentally change the design of nuclear power plants to prevent these events, or to mitigate their consequences if they occur?

The general consensus – reached at a recent IAEA symposium – was that such is not the case. No basic changes are needed, but adjustments are possible. As quoted, these include the possible use of vented containment, the suitability of increasing severe accident instrumentation, and incorporating devices in the design that could control hydrogen during accidents with severe core damage when the gas is produced in large quantities.

The topic of extreme accidents and plant design was one of several top safety issues addressed at the Symposium on the IAEA Safety Codes and Guides (NUSS) in the Light of Current Safety Issues, held from 29 October to 2 November 1984 in Vienna, Austria. The aim was to discuss the technical content and evolution of NUSS in view of the changing environment of nuclear safety techniques, due to results of safety research programmes and analyses of operating experience.

NUSS documents are composed of codes of practice and safety guides developed for the areas of governmental organization, siting, design, operation, and quality assurance – a total of 63 documents and more than 2000 pages in all. Started in 1974, the programme has nearly reached completion after substantial efforts from IAEA and Member States. During the past 11 years, IAEA's budget contribution to the programme has reached about US $10 million.

PRA in licensing

Should PRA be used as a basis for licensing? This was another issue discussed. The reply was that PRA can only be used as an additional tool to assist regulatory bodies in making licensing decisions. Moreover, PRA should not be used to evaluate "bottom-value probability figures" – meaning the absolute value of the risk of a given nuclear power plant, since the uncertainty of this absolute value is too high. PRA, however, can be used for risk control in different fields. The following examples were given:

- To improve operational safety (by identifying the accidents for which the operators should be trained in depth)
- To establish a maintenance programme (by identifying the critical systems)
- To analyse the impact of new research results (by establishing what would be the safety improvement if suitable design changes were adopted)
- To decide the need to change present design-basis accident-initiating events (because they may be not realistic such as, for example, the double-ended guillotine break).

Source term and its licensing impact

It is too soon to conclude and apply new research results on this subject in licensing. At the moment, it may already be said that the radiological impact for accidents characterized by late containment failure should be much smaller than presently hypothesized in licensing. If the containment held one day or more, the aerosols would settle down, many fission products would plate out, and the source term would become smaller. There could, however, be severer environmental impact if the containment had an early failure, or the primary circuits evolved toward high-pressure melt with ejection of particles of the melted core in the whole containment. Some questions were raised again on steam explosions, and it was clarified that the evaluation of the accident source term – which refers to the amount, timing, and type of radionuclides that might be released into the environment – is a complicated problem depending on many parameters and changing as a function of the plant and accident.

NUSS future: Stability or continuous updating?

Should any set of standards (not only NUSS) be changed every few years? Should the regulatory body oblige the owners to change their plants while being constructed and operated? This is not very convenient, but if the standards are kept unchanged they become obsolete with each change in technology.

The conclusion at the symposium was that the standards should be general enough without too many details so that the criteria they express may have a longer validity. NUSS represents a reasonable compromise, since it gives enough detail to identify the action to be taken for safety on the main problems of well-proven nuclear power plants yet it does not need frequent updating. It was also suggested that a systematic

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revision should be done only every six to ten years. Revision of some documents could be started sooner (maintenance revision), but this revision should be oriented not towards changing the technical contents of the documents which appear completely valid. It should be directed to improving the consistency among the documents, uniformity of wording, and distribution of contents among the main text, appendix and annex.

Reports on status and trends

Nuclear safety technology is developing rapidly and every year there are new safety research results that could contribute to improved safe design and operation. Should NUSS somehow transmit to the users the message on what should be done to improve safety? The possibility that IAEA could prepare reports on status and trends of these current safety issues was discussed and it was concluded that reports of these types should be developed by IAEA. One should not wait until international consensus is reached and then revise the codes and guides. This consensus would arrive too late. It is better to prepare status and trend reports with the opinions of different experts who could point out the possible solutions as soon as they are available.

Interfacing with other standards, regulations

Another problem area identified for NUSS was that of interfacing with national regulations and industrial standards. NUSS deals, in general, with different types of reactors. For each of these reactor types, there are detailed national technical regulations on the safety classification and design of safety systems which are developed in the supplier country. The problem is: How can the interface between NUSS and these standards be established? How can the input data necessary for applying these standards be evaluated according to the NUSS codes and guides? The same problem exists for establishing interface between the NUSS documents and industrial standards. These are used for the design of pressure containing parts, electrical equipment, civil structures, etc.

The reply was that this problem should be solved on an ad hoc basis for each supplying country and type of reactor, at least.

An interesting proposal was forwarded by a participant from Canada along the following lines. Some sort of technical co-operation project should be established at the request of the receiving country with the participation of IAEA, recipient, and supplier countries. The scope of the project should be the joint development of the national regulations of the recipient country based on NUSS. In this way, the problem of interface with national and industrial standards could be solved in particular cases.

NUSS widely used

In conclusion, it appeared from discussions that NUSS Codes and Guides are used widely, from China to Yugoslavia, as a basis for developing national regulations. It is clear that this IAEA programme, the result of an enormous international effort, is making an important contribution to nuclear safety. There is, however, still more work to be done, particularly in the form of direct assistance to Member States for implementing the documents, and for developing manuals and reports on status and trends, which should supplement the NUSS Codes and Guides.