

Nuclear Safety

Impressive & Worrisome Trends

by Richard A. Meserve

The safety record for commercial nuclear power has, in the main, been impressive in recent years. Nonetheless, noteworthy events continue to occur around the globe, including events at reactors operating in countries with extensive operational experience and strong regulatory capabilities. None of the recent events has resulted in a substantial off-site release of radioactivity. But these events reinforce how wrong it would be to assume that the safety challenge has been “solved” and that attention can be focused on other matters.

Moreover, there are other worrisome trends:

Aging nuclear power plants

Aging plants present a continuing safety challenge because equipment can deteriorate with time and older plants may not have all the safety features and characteristics of more

modern designs. The interest in the extension of the lives of nuclear plants means that issues associated with aging are of increasing importance.

Decay in the nuclear infrastructure

The nuclear slowdown of the past two decades has resulted in a smaller cadre of highly qualified experts, fewer graduates in nuclear engineering, and less global financing for safety research than 20 years ago. Moreover, nuclear skills in the operators’ organizations and in regulatory authorities may, in some cases, be getting thin. This concern is heightened by the trend in some enterprises with operational responsibility for nuclear reactors to rely increasingly on managers with financial experience, at the expense of those with nuclear experience. A focused effort to rebuild the nuclear infrastructure should be a high priority, but progress has been slow.

keeping the lights on

The aging of the nuclear workforce is

Cause for Concern

“**The nuclear boom is over,**” says Prof. Vladislav Klener, a nuclear scientist in the Czech Republic. “Now we are facing a gap and we didn’t educate our successors.” It is a similar scenario faced by much of the world. The average age of the global nuclear workforce is around 50 years. In 15 years, half of the workforce will retire.

For the Czech Republic’s chief nuclear regulator, Dr. Dana Drabova, the situation is setting off alarm bells. “In five to ten years we will have a gap in employees who hold knowledge critical to nuclear power plant operations and radi-

ation safety,” Dr. Drabova says. “If the knowledge is only in the heads of people it is difficult to reconstruct. To keep the knowledge living you need an overlap of generations.”

How to assist countries like the Czech Republic survive the “information gap” is a focus of IAEA efforts internationally. Strategies range from

recording the data and developing IT systems to store it, to providing hands-on help to countries. At the Krsko nuclear plant in Slovenia, the IAEA, jointly with the World Association of Nuclear Operators (WANO), worked with the plant’s management to systematically capture undocumented information on safety and technical insights from retiring workers.

It is this tacit knowledge of experts — who know more than they might say or write down — that is often most difficult to capture, says IAEA specialist Andrei Kossilov in the Department of Nuclear Energy.

*Every third
light bulb in Czech
is powered by nuclear.*

*To keep the lights on,
keep the knowledge.*

Expanding interest in nuclear power

Some countries without experience in the operation of nuclear power plants have expressed interest in undertaking the construction and operation of such facilities. In order to ensure the safety of operations, any such country must make a substantial investment in the development of a commercial and regulatory infrastructure that serves to enable safe operation. If the plans of these countries are to be realized, the world nuclear community must seek to ensure that the systems that serve to ensure safety are put in place.

In light of these trends, scrutiny of the system for ensuring safety is warranted so as to remedy any deficiencies. The existing legal regime is founded on the fundamental obligation of operators to ensure safety, subject to rigorous oversight by a national regulatory entity exercising sovereign authority to protect the public health and safety. The national programs receive assistance from international and non-governmental organizations. There are also important international cooperative networks at the regional level and among national regulatory organizations and among users of similar technology. Moreover, there are international agreements relating to nuclear safety (e.g., the Convention on Nuclear Safety), as well as non-legally binding international guidance, such as the IAEA's safety standards. Nonetheless, there is a need to augment the national systems with a stronger overlay of international cooperation and engagement so as to ensure enhanced safety.

Several changes in the global safety regime should be implemented:

① Information sharing

A greater emphasis should be placed on establishing a universal, effective, and open network for sharing operating experience. In this connection, communication about "near-misses," design deficiencies, and even low-level operational events can be important because analysis of such occurrences can indicate ways of avoiding a serious accident. There are existing global systems by which regulators and operators report safety-related information. But it appears that not all relevant events and observations are reported. Moreover, there are inadequate mechanisms to sort and analyze the information, to distill and prioritize the lessons that should be learned, and to propagate those lessons widely in a user-friendly fashion. We now have more than 12,000 reactor-years of experience and the knowledge from that experience should be marshaled far more effectively than it has been to guide operators and regulators worldwide.

② Standards harmonization

In order to enhance the assurance of safety, there should be efforts to harmonize national safety regulations so that minimum requirements are met everywhere and greater compatibility is facilitated. In this connection, while rigid application of the IAEA safety standards may not be possible, particularly for existing facilities, the IAEA standards do provide a common approach to which nations should be

In the Czech Republic, nuclear plants and knowledge management are twin pillars. "Every third light bulb in Czech is powered by nuclear," notes Dr. Drabova. "If you want to keep the lights on ten years from now, then you need to keep the knowledge."

The challenge, says Mr. Kossilov, is to create an environment where tacit knowledge is routinely shared and disseminated, through multiple means. "No information management system can replace the need for face-to-face interactions," he says.

Training and well-equipped research centres are vital to bigger picture efforts to attract and retain the best and brightest students and ensure an overlap. Last year the IAEA supported over 2,000 participants in training courses and some 1,500 fellows and scientists through its technical cooperation programme.



In 15 years, half of the global workforce will retire. The IAEA is working with countries, like the Czech Republic, to see that information is transferred from one generation to the next.

Czech PhD student Daniel Seifert uses a cyclotron procured by the IAEA to learn his tools of the trade.

He is on the way to becoming a radio-pharmacist, which is a branch of nuclear medicine used to understand human disease and develop effective treatments. He dreams of research and discovery. "Everyone wants to be a millionaire," Daniel says with a smile. "But the chance to work in nuclear medicine offers a real chance to help people. That's why I do what I do."

Daniel is part of the changing nuclear guard. The IAEA is working with countries to ensure that students like him have the knowledge they need to keep the benefits of nuclear science alive.

— Kirstie Hansen, IAEA Staff Reporter

See photo essay, "The Changing of the Guard" at www.iaea.org/NewsCenter/Multimedia/PhotoEssays

encouraged to conform to the extent practical. At the same time, the continuing evolution in the IAEA safety standards should be encouraged in two different directions.

On the one hand, we should seek a global consensus on fundamental principles — how safe is safe enough — to guide the articulation of general safety goals, the expectations for new plants, and the requirements for safety improvements in older plants. On the other hand, the standards should be made sufficiently concrete as to provide unambiguous guidance as to the accepted and best practices in the multitude of areas in which regulatory guidance is needed. In this connection, however, the evolution of safety standards must somehow accommodate innovative new reactor designs. The existing standards were understandably written with current light water reactors in mind and many of the requirements may not be appropriate, at least in their current form, for some of the new reactors that are contemplated.

③ Focus on safety culture

There is the need to encourage certain essential characteristics that extend beyond standards, but that are the foundation for success in achieving safety. Prime among these is encouragement of an appropriate safety culture — by which I mean a cluster of organizational and individual elements. Elements at the organizational level include the recognition by management that safety is the highest priority, as well as a commitment by management to organizational effectiveness, successful communications, a capacity to learn and adapt, and a culture that encourages the identification of safety issues.

Elements at the individual level include personal accountability, a questioning attitude, and procedural adherence. These elements are difficult to define crisply and hence to regulate effectively. But they are a foundation of safe operations and the global safety regime should encourage them everywhere. Greater efforts must be undertaken to build these characteristics into regulatory and operator organizations around the world.

④ Strengthen Nuclear Safety Convention

The implementation of the Convention on Nuclear Safety should be strengthened. The review process could be more probing, perhaps by focusing on the most important safety issues, including weak links in the global nuclear safety regime, rather than by emphasizing the wide (and necessarily superficial) survey that is today's norm. Although the IAEA now reports to the meeting of the parties on conclusions drawn from its safety review missions and services, perhaps the IAEA's contribution could play a more central role. The IAEA's report might be given more focused attention by the parties, perhaps by requiring affected nations to respond to the Agency's observations. The IAEA might even be given inspection authority to verify that the obligations of the Convention are being met.

Perhaps most fundamentally, the perspective of the parties should change: rather than seeking to prove its own excellence in the review process, each country should instead welcome productive criticism and thereby collect useful ideas and lessons for safety enhancements. The questioning and open attitude that regulators expect of their licensees might also become the expected behavior of the parties in the review meetings.

⑤ Streamline review of plant design

Efforts should be undertaken to establish multinational design review. The nuclear industry has become more concentrated, with the result that a small group of vendors seek to construct their designs around the globe.

The time is ripe for cooperation among regulators so as to facilitate the construction of a given design in more than one country without substantial modifications. Multinational design review would facilitate the coordination of safety assessments, perhaps enabling more complete and thorough assessments than any one country could bring to bear. It would also promote international trade, by bringing cost savings to the parties involved in licensing the plants and in constructing them. And it would further the general goal of advancing greater international consistency, thereby avoiding questions that may reasonably arise if significant differences in design were to be required from country to country.

With the completion of these five tasks — greater sharing of relevant operating experience, enhanced reliance on common standards, worldwide encouragement of safety culture, enhancement of the Convention on Nuclear Safety, and establishment of multinational design review — the global safety regime could be significantly improved. These are not revolutionary changes; they build on both the current international cooperative efforts and the national systems that have served us well. But they will help to ensure that nuclear technology can continue to be harnessed for the benefit of all humankind.

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Dr. Meserve adds: My views have been guided by helpful input from colleagues on the International Nuclear Safety Group (INSAG), including in particular Jukka Laaksonen and Zieli Dutra, but the responsibility for these comments is mine alone. E-mail: rmeserve@ciw.edu