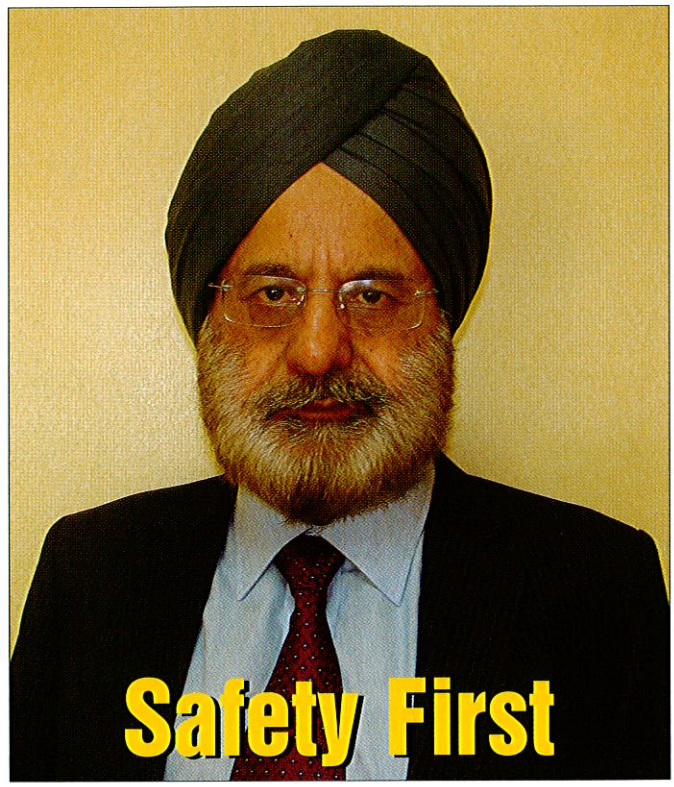

Safety First

Satinder Singh Bajaj, chairman, Atomic Energy Regulatory Board, has worked for several years in the area of nuclear safety and regulation. Following detailed reviews of the country's nuclear power plants post-Fukushima, he is satisfied with their safety status...

Rebutting hypothetical arguments with reason is difficult. If anti-nuclear power groups spread information about the dangers of nuclear power plants that is entirely speculative and not based on evidence, then it is almost impossible for scientists like Satinder Singh Bajaj, chairman, Atomic Energy Regulatory Board (AERB), to counter them successfully.

Another difficulty is that nuclear power is too complicated for most ordinary people to understand, so when scientists speak in their own language – beyond a certain point, a layperson's vocabulary becomes inadequate – the public struggles to grasp the technical details.

As someone who has spent his entire life working in the area of safety regulation of nuclear and radiation facilities, reactor safety analysis, system thermal-hydraulic, plant transient studies, probabilistic safety assessment, and system safety studies, Bajaj's voice on safety, in light of recent anti-nuclear agitations, is a weighty one.

Bajaj says that, apart from the innate complexity of the subject, a further complication is that agitations such as the one around the new Kudankulam plant in Tamil Nadu – which will start producing electricity soon – tend to be hijacked.

"It started off as a local agitation but was later exploited by other outside groups and interests to whip up anti-nuclear sentiment. The fact that Fukushima happened helped them," says Bajaj, in his office at AERB in Mumbai.

But he acknowledges that the nuclear establishment did not succeed in conveying reassuring messages about nuclear power in India, largely because of a lack of communication skills and also because it woke up rather late to the need to communicate information to correct misconceptions.

"We know the effect of radiation at a high level. It's not possible to see what the effect is at a very low level of exposure because when it is so low, it gets masked by other factors. We work on the assumption that even a tiny amount could cause cancer. This is a deliberately conservative approach, which as a philosophy for radiation protection is very good, but it scares people," he says.

Despite being slow to communicate with the public over Kudankulam, the board responded swiftly to the issues raised by the Fukushima disaster. Expert groups and committees were formed to examine all the issues and decide what needed to be done.

The Board conducted a detailed review of all the existing plants in the country and those under construction to understand how the country's reactors stood on safety following Fukushima. They are all well designed to withstand earthquakes and floods but this time, the Board had to imagine a Fukushima-like situation where all normal cooling provisions collapsed due to a loss of electrical supply.

"There are several levels of safety that we look at, depending on different contingencies. We found that, on all four levels, we were in very good shape but we had to address what everyone globally in the industry also had to address, namely, a 'prolonged station blackout' as happened at Fukushima. For that, we made recommendations for additional features to be added to withstand such remote possibilities," he says.

Some of these additional safety features have already been installed; others will be completed in the next two to three years. Oddly enough, some of these extra features involve installing such routine commonplace things as portable diesel generators, along with an arrangement for hooking them up to the electrical systems at the plant.

Bajaj grew up in Shimla where his engineer father was posted in the public works department, an area he still loves, particularly Mashobra. Later, the family moved to Srinagar. After graduating as a mechanical engineer, Bajaj won a place at the BARC Training School in 1968. He was thrilled because nuclear power was fairly new to India, even though the country had set up the first research reactor in Asia in the 1950s.

Bajaj joined Nuclear Power Corporation of India Limited (NPCIL) where he remained till 2007, working in the area of nuclear reactor safety. Among many

things, he was closely involved in developing and validating computer codes for safety analysis, including the challenging task of the indigenous development of system thermal-hydraulic-neutronic computer codes for LOCA and the transient analysis of pressurised heavy water reactors (PHWRs). This in-house developed code system is currently being extensively used for PHWR safety analysis.

Bajaj also worked in comprehensive LOCA and transient analysis of Indian PHWRs, including analysis for evolving performance requirements of safety systems and assessing their adequacy, and optimising reactor control system parameters/logics.

One of the highlights of his career at NPCIL in the 1990s was developing Probabilistic Safety Assessment and Reliability Analysis – a form of safety analysis for nuclear plants where all the various factors that have a bearing on safety, such as human error, design faults, equipment malfunctions, and random failures, are all integrated. These interrelationships and the events they can lead to are all combined into a model. "It was really satisfying to have this responsibility. The model gives you a new perspective on what might go wrong," he says.

In 2003, Bajaj won the Indian Nuclear Society Award for Outstanding Achievements in Nuclear Reactor Technology/ Reactor Safety, just one of many awards he has won in his career as a distinguished scientist.

He left NPCIL as senior executive director, safety in 2007. In 2010, he joined AERB where he has been overseeing the safety regulations of nuclear and radiation facilities in the country. His initiation happened almost immediately afterwards when a radiological incident in the scrap market at Mayapuri in Delhi in which one person died aroused a lot of media attention.

"It was challenging on several fronts. One, because we didn't know where the radioactive cobalt material, which was discovered, had come from. Second, we didn't know how much more of the material might be lurking elsewhere. Third, we had to reassure the public that we were in control of this situation and that there wasn't any further danger," he says.

It took intensive efforts before Bajaj could announce conclusively that the material had emanated from some research equipment at Delhi University. "We were able to locate the original supplier, who had given it to the university in the 1960s, and got details of it. We counted each and every piece. Being able to tell the public that it was all safe, about a full month later, was a landmark," he says.

Following the incident, AERB revamped its systems to ensure that all radioactive material came under its regulatory control, including material used in radiotherapy equipment for cancer treatment.

Post-Fukushima, the Board took up an intensive review of India's nuclear plants and procedures, and shared the findings with international bodies to get the country's nuclear safety status peer reviewed and validated. "What our review revealed was that our safety status was ahead that of many other countries whose reviews had still not been fully completed to enter the implementation phase. Our findings were endorsed internationally and that was a source of great satisfaction to me and everyone at the Board", he says.

The Board also reviewed radiotherapy equipment in government and private hospitals. The equipment was checked and carefully inventoried. "We know how many machines there are and where they are. The problem is X-ray machines because there are tens of thousands of them from since before regulation was introduced, and so not all are on our list. One of our challenges is to get them all registered," he says.

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In terms of expansion, he says it is undoubtedly easier for India to add more units at existing sites than to build new ones, given the controversies relating to land acquisition. But NPCIL has also identified new sites such as one in Haryana.

The Board has also expanded over the past couple of years, increasing its workforce by almost 50 per cent to be able to cope with the needs of more and more complex regulation and the fact that the nuclear power programme is proceeding apace, requiring more reactors and other radiation applications in medicine and industry to be monitored.

The basic technology of nuclear plants is not, says Bajaj, going to change drastically. There will be "incremental" improvements but nothing revolutionary is expected. The next "big thing" will be Generation 4 reactors, which will be, as parlance goes, "inherently safe". These are on the drawing board and at the research stage globally. "It will be another 20 years before the first Generation 4 reactor comes up. We are not sure which country will be the first off the mark. At one point, we thought it would be South Africa as it was developing one version but not much has been heard about this recently. Many other countries, including India, are working on these technologies," he says.

Bajaj and his wife, a former French teacher, live at Malabar Hill in Mumbai. At this stage in his career, he tries not to take work home to the extent possible. Reading tends to be limited to work-related material. Retirement, he says, will be devoted to doing all the things he didn't have time to do earlier, such as travelling, listening to music and reading widely. ■