

DISCUSSION PAPER: WHAT NUCLEAR SAFETY LESSONS HAVE BEEN LEARNED SINCE THE FUKUSHIMA DISASTER?

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Ensuring the right to the peaceful uses of nuclear energy is one of the core pillars of the Treaty on the Non-Proliferation of Nuclear Weapons (NPT). However, major accidents at nuclear energy plants have caused some of the public to question their safety and security. The 2011 Fukushima Daiichi Nuclear Power Plant accident was one of the most catastrophic accidents in the history of the peaceful uses of nuclear energy. This paper highlights some key cross-cutting and technical lessons from the Fukushima disaster.

While the Fukushima accident is often compared to the Chernobyl disaster, it provides us with more lessons than Chernobyl, not only in terms of the severity of the accident, but also in terms of its complex nature. Unlike Chernobyl, the Fukushima incident involved simultaneous accidents caused by the combined effects of natural disasters – specifically, earthquakes and tsunamis – and the interaction of multiple reactor units at a nuclear power plant.

Numerous nuclear safety-related conferences have been held in the wake of the Fukushima nuclear accident and many reports have been issued, including the most recent Chairperson's Report and a "Call for Action" issued during an International Atomic Energy Agency (IAEA) conference in November 2021. In addition, numerous accident investigation reports have been issued in Japan and abroad. These include three Independent Investigation Commissions by the National Diet, the Government of Japan, and the private sector. There are also reports by U.S. think tanks, the IAEA and OECD's Nuclear Energy Agency (NEA). Moreover, the Japan Nuclear Safety Institute (JANSI) has published a report that has drawn common lessons from several of those major reports.²

Cross-Cutting Lessons

Drawing on the various reports of the Fukushima accident, three cross-cutting lessons can be drawn.

Openness and Transparency

The first cross-cutting lesson is the importance of openness and transparency during and after a nuclear energy crisis. Starting with openness and transparency is critical for communication and trust-building with the international community and the domestic public in the immediate aftermath of an accident. Openness and

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² Japan Nuclear Safety Institute, *Lessons Learned from Accident Investigation Reports on the Fukushima Daiichi Accident and JANSI's Supporting Activities* (December 2013).

transparency are also essential for strengthening nuclear safety and nuclear power systems after an accident and sharing these measures with the rest of the world. Japan has accepted 15 IAEA expert missions, including the IAEA's Fact Finding mission in May 2011, immediately after the accident, and the IAEA has issued many reports on the Fukushima accident. Japan itself has shared its lessons learned at various nuclear safety-related conferences. Openness and transparency should be made a standard in nuclear safety, as they are key to strengthening international nuclear safety.

International Cooperation

A second cross-cutting lesson is the importance of international cooperation. International cooperation is necessary in a variety of areas related to nuclear energy production, including safe operation, emergency response, strengthening and universalizing the international nuclear safety regulatory framework, incorporating lessons learned into national programs, and capacity building to create more resilient systems.

Nuclear Safety Culture

A third cross-cutting lesson is the importance of strengthening nuclear safety cultures. To strengthen nuclear safety, a constant attitude of questioning and critical reflection on existing regulatory assumptions must become an integral part of the nuclear community, aiming for higher goals, rather than being satisfied with the current state of regulation. "Thinking the unthinkable" is important. Wishful thinking or denying possible failure can lead to potentially catastrophic unpreparedness. This applies not only to national regulations, but also to international legal and non-legal regulatory frameworks for nuclear safety.

Nuclear Safety Lessons

Drawing on the various reports of the accident, six technical nuclear safety lessons can also be drawn.

Independent Scientific Advice/Review Organization

A first lesson is the necessity of an independent scientific advice/review organization. One of the major causes of the Fukushima nuclear accident was the "inverted relationship" between the regulator and the regulated, whereby the regulator became the "captive" of the utility companies, and as a result, the monitoring and supervision function of nuclear safety collapsed. The National Diet of Japan Fukushima Nuclear Accident Independent Investigation Commission called this the "regulatory capture."³ Thus, a strong regulator with a high degree of independence is needed. High independence means (1) independence from nuclear power promotion organizations within the government, (2) independence from operators, and (3)

³ The National Diet of Japan, Fukushima Nuclear Accident Independent Investigation Commission, *The official report of the Fukushima Nuclear Accident Independent Investigation Commission*, p.11. The report defines "regulatory capture" as regulatory authorities becoming the "captives" of nuclear operators and devoted to maximizing the interest of the nuclear operators that are supposedly placed under them. <https://warp.ndl.go.jp/info:ndljp/pid/3856371/naaic.go.jp/en/report/>

independence from politics.

Low-Frequency, High-Impact Events

A second lesson is that more consideration must be given to low-frequency but high-impact events, such as tsunamis and massive earthquakes. Since the Fukushima nuclear accident demonstrated the need to respond to the combined effects of nuclear accidents and natural disasters, it is necessary to recognize the risks of combined disasters and take proactive rather than reactive responses to various events. In the event of an accident or disaster that causes extensive damage over a wide area, it is necessary to have a new disaster prevention philosophy that requires appropriate safety and disaster prevention measures to be taken regardless of the probability of occurrence.

Flexible Accident Management Response

A third lesson is that an accident management strategy should be developed that allows for flexible response, taking into account unforeseen events such as terrorism, severe natural disasters, prolonged loss of power, simultaneous severe accidents in multiple units, and prolonged accident response. Response procedures that consider the occurrence of "black swan" events should be developed and their effectiveness verified. By contrast, the Fukushima accident gave the impression that the response was confused by unexpected events.

Severe Accident Education and Training

A fourth lesson is that, based on the recognition that severe accidents exceeding assumptions – including terrorist attacks – can occur, practical severe accident education and training should be conducted to ensure that personnel responding to accidents have the necessary knowledge and skills to respond effectively. It is imperative to reorganize the response to crises and emergencies, and to improve effectiveness through practical training to mitigate the worst effects and prevent the spread of damage.

Radiation Dose Control and Management

A fifth lesson is the importance of radiation dose control and radiation management. Critical monitoring facilities at Fukushima, such as monitoring posts, stopped functioning due to, among other factors, the loss of power supply. The government's radiation diffusion forecasting tool (SPEEDI) was not useful because continuous monitoring of radioactivity discharged outside the site was not possible. Therefore, it is necessary to prepare for various events such as earthquakes and tsunamis and their combined disasters in the design and operation of emergency dispersion forecasting tools and monitoring facilities.

The Importance of Public Trust

A sixth lesson is that the Fukushima nuclear accident made clear that public trust is essential for any public policy implementation. It also raised awareness about both the difficulty and importance of risk communication. In particular, the Fukushima accident showed just how difficult it is to make the public, media, and other non-

specialists understand the international system of radiation safety. Radiation risk assessment used in radiation protection was misunderstood by the media and the public, causing confusion and undermining public trust in experts. This occurred in part because the importance of risk communication was not emphasized, and teams dedicated to risk communication were not established in advance. At the site of the Fukushima accident, personnel who were supposed to be dealing with the accident were busy handling the media response. It is necessary to establish in advance a system specializing in media response, including technical experts, to ensure the prompt and reliable disclosure of evolving events and to place the highest priority on the disclosure of critical safety information for nearby residents.

Conclusion

The Fukushima accident is a constant reminder that there is no end to ensuring nuclear safety, and international cooperation is necessary for constant improvement to the safe operation of nuclear energy reactors. After past serious accidents, the international nuclear community tended to become complacent as time passed. Such complacency can lead to a new serious accident. It has been over 10 years since the Fukushima nuclear accident, and we must not repeat the same complacent attitude. In the coming years, we must repeatedly remind ourselves of the lessons learned from the accident. That should include revisiting the lessons of the Fukushima accident during anniversary milestones, such as every decade.

Before the Fukushima accident, nuclear power was being vigorously promoted around the world in a so-called “nuclear renaissance,” but the momentum was largely lost due to the accident. Although the increasingly serious problem of climate change is reversing the trend recently, it has yet to recover the momentum of that time. In order to maintain the stability of the NPT regime, which is inherently unstable, it is necessary to safely promote the peaceful uses of nuclear energy, one of the three pillars of the NPT. Ensuring a high level of nuclear safety will reduce the risk of serious accidents and contribute to the promotion of the peaceful uses of nuclear energy. This, in turn, will contribute to maintaining and strengthening the NPT regime