Potential Strategies to Address the 3S Challenge for Japanese Nuclear Power

Peter Lyons*

As a *gaikokujin*, it is a daunting challenge to be invited to provide opinions on nuclear power in Japan. Nevertheless, I hope my suggestions may be useful.

Japan is a highly developed, very densely populated, advanced industrial society with minimal energy resources. These factors lead to significant challenges in providing safe, clean, reliable, and economic energy. Compounding these challenges are the shadows of the Fukushima accident, which created the necessity for Japan to import large quantities of fossil fuel while the nuclear plants are closed. Both Japan's economy and carbon emissions have been negatively impacted by import of those fuels.

While the initial reaction of the Japanese people toward nuclear power after Fukushima was understandable, their continued negative views toward nuclear power are harder for me to understand. The causes of the Fukushima accident are well studied, very well understood, the accident was completely preventable, and the safety of any plant cleared for restart meets the new Regulator's strengthened requirements.

Studies have clearly shown that the Japanese nuclear industry and the previous regulator were not prepared for the tsunami, which caused and dramatically compounded the Fukushima accident. Those studies have noted the absence of a strong regulator and of a strong nuclear safety culture. Those two absences led to failure to build an adequate sea wall, failure to anticipate that water-tight doors should be installed at the plant, failure to take compensatory measures (such as venting containment) promptly, failure to supply backup equipment for each plant, etc.

But now, to my surprise, despite a new, strong, independent regulatory system, the Nuclear Regulator Authority (NRA), and extensive safety improvements to Japanese nuclear plants, some of the public have continuing fears of nuclear power, which are delaying restart of some plants. Restart of many plants is vital if Japan is to regain a positive balance of payments and its former leadership in reducing carbon emissions. Of course, nuclear power is not the whole answer to Japan's clean energy future. Wind and solar energy are also important sources of clean, economic energy. But only nuclear power can supply clean electricity whenever needed. In my view, a strong

* Retired U.S. Assistant Secretary for Nuclear Energy, Department of Energy; Retired Commissioner, U.S. Nuclear Regulatory Commission / Distinguished Fellow, The Institute of Energy Economics, Japan

nuclear power sector in Japan is vital to the future strength of the nation.

These fears are, I presume, leading to some of the legal challenges in Japan against restart. To my surprise, some of the restarts have actually been blocked by Japanese courts on technical grounds. In the U. S., it would be very unusual for court action to intervene in a U. S. Nuclear Regulatory Commission (NRC) decision on technical grounds, while, in contrast, intercession on a procedural issue might occur. By interceding on a technical issue, it appears to this *gaikokujin* that the technical expertise and authority of the nuclear regulator, the NRA, is being significantly undermined and perhaps even usurped. I find it amazing that any Japanese court has the technical expertise to credibly challenge a technical decision by the NRA, and this court action seems to set up a confused system wherein Japan has hundreds of regulators, the NRA and every court. The U.S. legal system is far easier for me to comprehend and explain!

As nuclear power is evaluated in Japan, attention must be paid to the "3S" challenges of "Safety, Security and Safeguards." This paper will focus on safety but all three are essential for nuclear power to be accepted.

In the United States, when I was a Commissioner at the U.S. NRC, I regarded two factors as mutually essential and supportive in assuring the safety of U.S. nuclear plants. First was a strong, independent regulator, with no direct ties to the nuclear industry and with no promotional interest in nuclear power – the U.S. Congress assured that when they created the NRC is 1974. And second was a strong organization binding the nuclear industry together to share best practices and to assure that each company has an extremely strong safety culture. In the U.S., the Institute for Nuclear Power Operations (INPO) was formed after our only major accident, Three Mile Island, in 1979. INPO serves all U.S. nuclear power plants using peer and economic pressure to demand that its members achieve the highest standards of safety. INPO and the NRC coordinate many aspects of their work, while respecting their distinct separate missions, to assure safety in the United States.

Japan has created its new, independent NRA that is diligently working to assure safety of plants before restart. In addition, the JApan Nuclear Safety Institute or JANSI, analogous to the U.S. INPO, is now operating. As JANSI achieves the same strength in Japan as INPO in the U.S., and is working cooperatively with the NRA, the people of Japan should be well assured that safety is the highest priority.

Turning to the other two S's, both our nations value security and safeguards, but our approaches are different. For example, in the U.S., heavily armed guards are present at every nuclear site and constant drills assure that they are ready to repel terrorists. U.S. plant security is coordinated and regularly tested (in very realistic exercises) in coordination with local, state, and federal agencies including the military and police. But while recognizing that the cultures in the two nations are very different, I am struck by the absence of heavily armed guards at Japanese

commercial nuclear sites. Both military and police have roles in the security of Japanese plants, but at least in the U.S., we favor an armed guard force at each facility. Our reason is that a dedicated force of armed guards has in-depth knowledge of their plant and their defensive operations are well coordinated with plant operations. This level of coordination would be challenging to accomplish with either police or military as the initial responders.

Japan and the U.S. are leaders in safeguards policy and share the goal of avoiding any leakage of nuclear materials into the wrong hands. Proliferation issues with the reactors used in both countries are very well understood and both nations dedicate significant resources to the nuclear non-proliferation regime. The two nations do, however, take very different points of view towards safe management of used nuclear fuel. In the U.S., the used fuel is stored in cooling ponds for some years before transfer to large dry casks to await final disposition in an underground repository. The U.S. does not reprocess used fuel to access plutonium, although the U.S. did use reprocessing in the past primarily for military purposes and now continues research on reprocessing technologies for civilian use.

Japan plans to reprocess their used fuel, has demonstrated pilot reprocessing technologies, and is building a large reprocessing facility. The extracted plutonium would then be used in fuel for Japan's nuclear plants. However, since the extracted plutonium could also be used in nuclear weapons, it must be safeguarded with great care. Due to cessation of nuclear operations in Japan for years and delay in operation of the new plant, Japan has stockpiled large quantities of plutonium. In my view, such stockpiles should be viewed with concern and actions expedited to "burn" that plutonium in Japanese reactors – as long as Japan elects to follow the path of reprocessing.

Even though current reactors are very safe, three actions might help enhance the acceptability of nuclear power in Japan. First, passive safety is now incorporated in the most modern, safest reactors. Passive safety refers to the ability of a nuclear plant to cope (for 3 days in the case of the Toshiba/Westinghouse AP1000) in an emergency without prompt action by the operators. Limited elements of passive safety have been introduced in many current plants, but all commercial reactors in the U.S. and Japan primarily use active safety, which requires prompt (within one hour) action by the operators. In the U.S., four AP1000 plants are under construction. Perhaps discussion of passive safety in Japan would be useful, and actions to introduce passively safe plants in Japan might be welcomed as another advance in future safety for Japan.

Second, the U.S. is supporting development of a new generation of small reactors with extremely robust passive safety. Specifically, the U.S. government is sharing development costs with the NuScale company, whose design requires zero operator action at any time. That design is small enough that no pumps are required, so there are none to fail, and all the water needed in any accident is stored in the plant. The plants are small enough to be sited underground and can use air

cooling. Underground siting improves security and air cooling would enable plants to be located inland – far removed from any tsunami concerns. Further exploration of these technologies in Japan might also help to assure the public that the government is actively seeking far higher safety standards.

And finally, it's important for the public to understand that no energy source is risk-free; therefore, there should be careful national discussion on the risks and benefits of each source One of many ways of examining risks is to study the total life-cycle fatalities (even including mining and transportation that occur in the life cycle) from any power source. These complex studies typically present results in fatalities per TW-hr of electrical energy produced (for reference, Japan uses about 1000 Tw-hr annually). The fatalities per TW-hr for coal range from about 10 (for the U.S.) to 170 (for China) for coal. In contrast, the value for nuclear power is 0.09 worldwide and below 0.0001 in the U.S.

Using these figures, and remembering that Japan produced 24% of its energy from coal before Fukushima and 30% in 2013, these studies (using the low U.S. rates) suggest that the total annual fatalities from Japan's current coal use are around 3000 (with some of those in the country where the coal was mined). Furthermore, since Fukushima, Japan's carbon emissions have increased to new highs. Evaluations like this lead me to question whether the Japanese public is really comfortable with plans for a 56% reliance on fossil fuels in 2030 with about 40 new coal plants planned. These observations do not correlate with Japan's former leadership on global climate change issues and with its emphasis on public health, to say nothing of the economic impact of continued massive fossil fuel imports.

I believe that Japan needs a strong nuclear power industry and the current steps in Japan involving the NRA and JANSI should reassure the Japanese public of the safety of these plants when they are approved for restart. But I also note that advanced reactors, beyond those currently in operation, offer enhanced safety and that the Japanese public would benefit from progress on their deployment. And I suggest that it would be beneficial if the Japanese public were better informed about both the benefits and risks of all sources of energy.

Writer's Profile

Peter Lyons

He led the Office of Nuclear Energy in the U.S. Department of Energy while serving as the primary policy advisor to the Secretary of Energy on issues involving U.S. and international civilian nuclear energy research, development and demonstration activities. He was a Commissioner of the Nuclear Regulatory Commission and served as Science Advisor on the staff of U.S. Senator Pete Domenici and the Senate Committee on Energy and Natural Resources, where he focused on military and civilian uses of nuclear technology. He now acts as a consultant to several corporate and laboratory boards, as well as assisting several international groups.