

## **A Vital Energy Option at Risk??**

### **The Japan and U.S. Nuclear Energy Industries**

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Japan and the United States are the strongest of allies. Both countries rely on advanced technologies to assure a very high standard of living for our citizens. Both economies depend on reliable supplies of reasonably priced electricity, and both countries have expressed goals for reducing carbon emissions to minimize the impacts of global climate change. It should be no surprise that the Japanese and U.S. nuclear energy industries share many attributes. U.S. (and UK) companies were involved in construction of the earliest plants in Japan; in later years, Japanese companies led such construction. The ownership of Westinghouse by Toshiba and the partnership between General Electric and Hitachi are evidence today of the close partnership between the two nations in nuclear energy technologies. To a significant extent, nuclear energy issues in either country affect the other.

Significant differences between nuclear power in the two countries are evident in the aftermath of the Fukushima accident. Nuclear power accounts for about 20% of U.S. electricity generation, while Japan's contribution from nuclear power has fallen from near 30% before Fukushima to below 5%. In the U.S., nuclear plants contribute about 60% of the country's carbon-free electricity. The U.S. operates far more commercial nuclear reactors than Japan, with 99 in operation today versus 12 approved (of 44 still operable) for restart with only 5 in operation. Many U.S. reactors (87) have received license extensions for 60 years of operation versus only 3 in Japan. Both countries have very limited new plant construction, with 4 of the Westinghouse-Toshiba AP1000 units under construction in the U.S. and 3 new plants under construction in Japan.

In both countries, nuclear power is an asset at serious risk of loss. Nuclear power is under severe stress in both nations. Six U.S. plants have closed for various, mostly economic, reasons and many more are threatened with closure. Flat electricity demand, deregulation, low cost natural gas, and renewable energy tax incentives have changed the U.S. electricity market, and created a situation where many nuclear plants are no longer economic to operate. In Japan, natural gas is much more expensive than in the U.S. and nuclear power is frequently the lowest cost electricity option. But fear of nuclear power has led to lawsuits against restart of Japan's nuclear plants, despite the dramatic improvements made in the nuclear regulatory system of Japan since Fukushima. Yet, nuclear power is vital in both countries, it provides a diversity of generation

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sources, clean energy, highly reliable operation, and underpins many high technology industries and university programs in both countries.

The nuclear industries in both Japan and the U.S. are challenged by the severe financial issues at Toshiba, with a significant part of the difficulties traceable to delays in construction at 4 reactors in the U.S. The costs of these plants have escalated as delays have accumulated even though Japan, in the past, has demonstrated on time, under budget, construction of nuclear plants. The problems do not stem from the AP1000 design, but rather from lack of appropriate construction management and supply chains that have not been exercised in recent decades.

Issues in the U.S. are compounded by the failure of deregulated or “competitive” markets, and Japan would do well to study the errors made in the U.S. to avoid repeating them. In the many deregulated states of the U.S., there is no entity charged with planning for future power needs, only an emphasis on the lowest cost. (Despite this emphasis, some of the deregulated states in the U.S. have some of the highest electricity costs in the nation.) In addition, extensive renewable tax incentives distort the market and lead to times when electricity is sold at negative prices. At these times, renewable energy sources collect their tax incentives and remain profitable, while baseload sources that do not enjoy such benefits, including nuclear and some fossil plants, become uneconomical and are forced to close.

Japan must utilize nuclear power to a significant extent. Japan has almost zero energy resources and a very high population density, thus requiring power sources that consume minimal space. And if Japan is to regain its leadership position in reduction of carbon emissions, it must depart from its current dependence on fossil sources and return to greater emphasis on nuclear power. Since Fukushima, Japan’s carbon emissions from electricity generation have increased dramatically and Japan is certainly no longer a world leader in this area.

The public concerns in Japan with safety of nuclear power fail to recognize several realities. First, the nuclear safety regulatory system of Japan has improved dramatically since Fukushima. Japan’s new Nuclear Regulation Authority (NRA) is a very strong regulator and carefully evaluates extensive new safety requirements before allowing any plant to restart. A strong industry organization, the Japan Nuclear Safety Institute (JANSI) is now in operation, modeled after the highly successful U.S. Institute for Nuclear Power Operations. Between NRA and JANSI, the Japanese people should be reassured that safety is the highest priority and that only the safest of operations are allowed. And second, when studies are done comparing the mortality rates from different energy sources, nuclear energy has the lowest rate. Nuclear energy’s death rate is decades below any fossil energy source and lower than any of the renewables as well. (Calculation of these mortality rates represents a total life cycle mortality, and uncertainties in these calculations certainly exist. While the exact numbers may be open to question, the general trends are still clear.) And I hope it is well known in Japan that the accident at Fukushima should have been prevented by

a stronger regulator (like the NRA today) and, even at Fukushima, there were zero fatalities associated with radiation.

The absence of strong construction programs in both countries and the difficulties experienced by the industry in both countries lead to weakening the nuclear industry in both countries. In both countries, that reduces fuel diversity, grid reliability, and a valuable source of clean energy. In Japan, this is leading to increased use of fossil energy, with a negative impact on air quality, carbon emissions, and balance of payments. The absence of a strong domestic industry makes it more difficult for either country to export their designs, which results in a loss of high tech jobs and weakens university systems. And of greatest importance, both countries lose control of global nonproliferation and safety norms and cede that leadership to other nations that are exporting.

Both countries can take actions to regain their leadership positions in nuclear power, starting with recognition of the vital attributes that nuclear power contributes to each nation. This implies that a solution to the Toshiba/Westinghouse issues must be found that results in both continuing as strong nuclear plant vendors.

A strong domestic building program is vital in both countries to introduce modern passively safe (i.e., not dependent on operator actions in an emergency) plants. (No commercial reactor in either country is passively safe.) Construction should include large passive light-water designs like the Toshiba/Westinghouse AP1000 and the Hitachi/GE ESBWR, as well as the very promising, ultra-safe, Small Modular Reactors. (The SMRs, while of strong interest in the U.S., have not attracted interest in Japan. The tremendously enhanced (passive) safety of the SMRs, plus their ability to operate inland with air cooling, far from any concerns with tsunamis or potential contamination of water supplies, should make them of interest in Japan as well.) A strong building program would restore the strength and experience of domestic vendors while revitalizing supply chains. In the U.S., it is important to equally value all clean energy sources. In addition, both countries need to offer strong financial support for nuclear technology exports.

Both countries also need to advance their plans for management of used nuclear fuel to assure their citizens that effective systems will become operational. While Japan has stated their plan for reprocessing (at Rokkasho) and eventual use of fast reactors to minimize wastes and maximize reuse of used fuel, the cancellation of the Monju reactor project makes that plan somewhat nebulous. The ongoing Government studies for alternatives to Monju are important, and hopefully will result in a realistic path forward for management of Japan's used fuel. In the U.S., operation of both interim storage and a repository must be demonstrated. In addition, U.S. laws should be changed to allow used fuel from foreign reactors to be disposed in the U.S. With other countries, particularly Russia, offering "take-back" of used fuel from plants that they build and use Russian-origin fuel, the U.S. (and U.S.-Japan joint ventures) will have difficulty competing without offering a comparable option for U.S.-Japan designed and constructed plants.

In conclusion, both nations need a strong nuclear energy industry and both benefit greatly from the many positive attributes of nuclear energy. Government actions can help each nation rebuild its global leadership in nuclear technologies and assure strong domestic nuclear energy programs into the future.

#### 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.