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The danger of 'it can't happen here'



The No. 1 reactor at Kyushu Electric Power's Sendai power station, shown here, became the first reactor to operate under tighter safety regulations that Japan adopted following the Fukushima disaster in 2011. © Reuters

As I write this article, I am watching the Sendai Nuclear Power Plant Unit 1 on television. The Sendai staff is now removing the control rods in the reactor of Unit 1.

This will make it the first Japanese reactor to resume operation following the shutdown of the country's entire fleet after the March 2011 accident at the Fukushima Daiichi plant. Kyushu Electric Power, the operator of the Sendai plant, said the 890MW pressurized water reactor will begin generating electricity on Aug. 14. Power output from Sendai 1 will be gradually increased, and it is expected to return to normal operation in early September.

Safe restart of nuclear plants in Japan is one of the primary concerns of the Japanese government and the business-industrial community. The new regulator, the Nuclear Regulation Authority, has stated that "we will be tireless in our efforts to improve our regulatory measures so that Japan's nuclear regulation standards will be among the world's highest." The Japan Nuclear Safety Institute has been created and focuses on building safety cultures at the plants and operating companies. The Ministry of Economy, Trade and Industry has worked with the Federation of Electric

Power Companies to create the Nuclear Risk Research Center, led by George Apostolakis, former commissioner of the U.S. Nuclear Regulatory Commission.

Questions remain

The new regulations are a challenge to the operating companies, involving new analyses and, in many cases, costly retrofits. I have been involved in fire safety analyses and earthquake fault analyses at over 10 nuclear power units in Japan to support restart. We have found the operating staffs and headquarter personnel deeply concerned with safety and doing the right thing. They are doing an excellent job to correct the weak points of the plants, both in engineering and organizationally.

These same activities are being performed at nuclear plants all over the world under names such as "stress tests" or "FLEX" programs. But questions remain: "Are the nuclear plants safe? Will these programs protect us from the next unexpected event?" This remains to be seen.

Let me step back to 2011 and 2012. I spoke at several nuclear safety meetings and conferences in the Asia-Pacific region. I found many people had a barely hidden attitude of superiority that the accident happened in Japan; it was a kind of schadenfreude -- deriving pleasure from the misfortune of Japan's nuclear industry. Many had the attitude of "it can't happen here."

This kind of attitude is dangerous for three reasons.

First, it leads directly to overconfidence, then to neglect, and finally to failures. The real fact of the matter is that an accident of this magnitude could happen at any nuclear plant. It has been said that Fukushima was an accident "made in Japan." But this is not exactly so. For other countries to dismiss the accident as peculiarly Japanese is to miss the point: All mature, complex systems are prey to unexpected events. Chances are the next major nuclear accident will not involve tsunami.

This leads to the second reason: Unexpected events come in many different forms. They can come from ill-advised actions, such as at Chernobyl; or from lack of knowledge of what to do, as at Three-Mile Island; or near misses, such as at Blayais in France and Fort Calhoun in the U.S. because of floods. Or the near miss at the Maanshan plant in Taiwan, when a station blackout was caused by salt-bearing seasonal sea smog. An extra emergency diesel generator worked at the last minute and saved the plant.

Last, attitudes of superiority and overconfidence lead to an unquestioning belief in our own analyses. Just last week at a meeting discussing Generation III reactors, I was told that the core damage accident frequency at an APR1000 reactor was $1.0e-9$ per year. This means a core damage accident was expected once every 100 million years. One hundred million years is a long time.

Prepare for the unexpected

Earthquakes and the fires that result pose the greatest danger to nuclear plants, but earthquakes cannot be predicted. Earth is 4.6 billion years old, but we have only about

100 years of instrumental seismicity data. The present state of seismological science does not allow us to reliably differentiate the risk level in particular, focused geographic areas.

Nuclear safety cannot be measured by an absence of accidents, which is largely dependent on luck, but is the result of constant, active identification of hazards and their elimination. Near misses are *not* testimonials to safe practices.

To be prepared for unexpected events, we must constantly challenge our analyses, question assumptions, change assumptions, and understand the uncertainty.



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