

Nuclear meltdowns and some thoughts for science center responses

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Many science centers and science museums have exhibitions on energy. A few include nuclear energy, with greater or lesser amounts of detail. Most of us have avoided getting into the thicket of issues surrounding this option. At this moment, events in Japan might make us wish we had done more, since there are certainly public concerns about the damaged Japanese reactors, and those concerns are (or should be) worldwide. Ideally we would be prepared to respond by providing effective forums and public education.

I was trained as a physicist, and while I did not specialize in nuclear physics, I have at several points in my career been called upon to try to explain nuclear issues to the public. I thought I might share with you a few thoughts on what is happening in Japan right now. I'd urge any science center asked to comment or deal with this issue to enlist a nuclear scientist or engineer, and not try to do this on your own unless you have a resident physicist or engineer. Finding a working nuclear expert who can talk effectively with the public will take some care, as it does in all fields of science (see the "Portal to the Public" project at the Pacific Science Center for a model of this kind of care).

At the moment the situation of several reactors in Japan is extremely serious. There will not be a nuclear detonation (there is no known way for that to happen, short of bringing in an actual nuclear bomb and exploding it there), but the kinds of failures happening in several Japanese reactors lead to the possibility of non-nuclear explosions. Those could spread large amounts of radioactive material locally, regionally, or even globally. The Chernobyl disaster spread a plume of radioactive material far beyond its country of origin, and health consequences will continue for decades downwind of Chernobyl.

The March 13 *New York Times* had several exemplary articles on what's happening, the dangers presented, and some of the ways to mitigate them, especially the simple measure of people taking potassium iodide pills if they are in any significant danger of exposure to one of the most dangerous potential emissions. You couldn't do much better than to recommend these articles to people who ask for information. Here are three good articles to cite:

On the history and context of nuclear reactor accidents, especially in Japan:
<http://www.nytimes.com/2011/03/13/world/asia/13nuclear-industry.html?hp>,

On what's happening now with the four damaged reactors:
http://www.nytimes.com/2011/03/14/world/asia/14nuclear.html?_r=1&hp

On what's more or less dangerous in escaped radioactive material from these plants, and the use of potassium iodide pills:
<http://www.nytimes.com/2011/03/13/science/13radiation.html?ref=asia>

These stories are high quality science journalism. I wish I could say the same for what I'm seeing on television. For example, I've seen several commentators and reporters use the words "nuclear" and "explosion" in close proximity while failing to distinguish between nuclear detonations (like a nuclear bomb, which can't happen) and non-nuclear ones (like a steam or hydrogen gas explosion inside the plant, which can and perhaps already have happened). Both kinds of explosions are extremely dangerous, but for very different reasons. The measures to prevent them, the kind of damage they cause, and the steps to mitigate that damage are also different. It may keep viewers glued to their sets, waiting for video of a mushroom cloud, but this kind of sloppy journalism can also cause panic, accelerate false rumors, and hinder appropriate responses. What would we do without the kind of quality reporting in the *New York Times* that seems to be available from a shrinking number of sources today?

Here are a few personal observations, for what they are worth. Nuclear power is a tantalizing but problematic solution to the need for energy. In one sense it should be one of the cleanest forms of energy: essentially no emission of global warming gasses, and widespread sources of the basic fuel, which can be mined relatively easily and safely compared to deep coal mines, hydrofracking for gas, or deep drilling off-shore for oil. Countering these arguments for nuclear power are two major concerns: the storage of nuclear waste produced by the reactors, and the safety of operations of nuclear plants.

The storage issue is complex and long-standing. I think there may be solutions to this problem which, while not perfect, are in totality less risky in both the short and long term than the continued use of fossil fuels as we are doing today. But it takes political courage and will to choose a solution, and that has been lacking.

The safety issues of operations are equally complex and long-standing. One important reason why safety remains a big concern is that cutting corners in order to save money is always a temptation in every industrial endeavor, even in the nuclear power industry where the consequences of failure are so high. Both the Three Mile Island and Chernobyl accidents can in large part be attributed to such corner-cutting. I've also always been worried about for-profit operation of nuclear plants, because no matter how responsible a corporation tries to be, there apparently will always be some in the organization who are intent on improving short-term return-on-investment, even at the risk of courting some kind of disaster. We can all think of examples, in both nuclear and non-nuclear fields, from oil drilling to packaging loans to toothpaste manufacturing.

I had thought Japan's tight regulation in most areas would reduce this risk for their nuclear plants. Their regulation of building design seems to have been very effective in mitigating damage to buildings and people from the earthquake itself. But as the first *Times* story cited above discusses, in the case of the nuclear industry commercial operators may have been too cozy in their relationships with regulators, and the operators have been less than transparent in revealing practices and problems. We've heard a lot of that much closer to home in the past few years (again think of finance, off-shore drilling, etc.).

France has, as far as I know, had an enviable record of safety in its nuclear power program. France obtains more than three-quarters of its electric energy from nuclear power plants (a far

higher percentage than Japan does). These plants are all state-owned and run. The system isn't perfect, and has its detractors, but it certainly seems like a model the rest of the world should examine urgently and closely. But given this week's events in Japan, that may not happen anytime soon, if ever. Which makes conservation and renewable energy options even more essential. Alas, our own fractured government seems incapable of dealing with energy policy. And our own job of public education and providing reasoned forums becomes all the more important and urgent.

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