Nuclear Meltdown

https://www.e-ir.info/2011/03/14/nuclear-meltdown/

DAVID ELLIOTT, MAR 14 2011

The Japanese nuclear disaster has occurred at a time when attempts were being made to re-launch nuclear power as a new 'clean' energy source that might help deal with climate change and underpin energy security.

The accident in Japan may not prove to be as serious as that at Chernobyl in 1986, in that its direct radiological impacts will not be felt across such a wide area, but its political and economic effects could well be just as significant. If technologically advanced Japan can't handle nuclear power safely, who can?

What happened in Japan?

When nuclear plants are shut down, there is still a lot of heat to be dispersed for many hours afterwards. Normally this is easily dealt with by the cooling system pumps, but if grid electricity supplies to the pumps are interrupted, as happened in Japan on March 11th after the 8.9 magnitude earthquake, then emergency on-site backup generators start up.

Most of Japans nuclear plants successfully followed this pattern, but the plants at Fukushima 150 miles or so north of Tokyo were unfortunate in that the subsequent tsunami damaged the emergency generators, which went off-line.

Temperatures and pressures in one of the reactor cores rose, and there was a risk of a catastrophic fuel meltdown. Local evacuation plans were initiated as a precaution. Mobile generators were hastily brought on site to maintain cooling, and some gasses were vented to reduce pressure, but on March 12th a hydrogen gas explosion occurred, demolishing parts of the outer shell of the reactor building.

A similar fate engulfed a second reactor on the site, with an explosion there on March 14th, and, as I write, the third reactor there is facing a possible full or partial meltdown, with fuel rods said to be exposed.

Fortunately in each case so far, the reactor core containments have remained intact, and only relatively small, but not trivial, amounts of radioactive material seem to have escaped, although radiation levels outside the plant were said at one point to be above permitted levels. Cooling operations continue, pumping in sea waster mixed with boron, and hopefully will successfully avoid further problems.

The immediate impacts are still unclear- and it is still an ongoing situation. But in addition to at least one death and some injuries from the first explosion, there have been reports that 160 people had been contaminated by radiation. 200,000 or so people were evacuated from a 20km zone around the plants and many evacuees are being monitored for contamination.

After Chernobyl, most of the EU-15 countries backed off from nuclear, with, for example, phase out programmes being initiated in Germany, Spain and Belgium. Subsequently they, along most other western EU countries, have retained an anti- nuclear posture, with Ireland, Portugal, Austria, and Denmark, refusing to have any nuclear plants. France, Finland and more recently the UK were the main exceptions, along with some eastern EU countries with left-over Soviet nuclear programmes.

However views in Europe have been changing. Sweden decided to allow replacement reactors, Italy is due to hold a referendum shortly and the phase out programme in Germany was slowed- despite bitter opposition and 100,000 strong street demonstrations.

Globally, nuclear has been touted as the new option across the world – with the Middle East being the latest target zone, following Israel and Iran's lead, along with the newly emerging countries in Asia, led by China.

Japan had been something of a high technology path leader in the East in the past. Will the Japanese accident now halt the much-trumpeted nuclear renaissance? In recent days it seems so. German Foreign Minister Guido Westerwelle, and Senator Joe Lieberman who chairs the US Senate's Homeland Security panel, have both raised the possibility that further investment in either extending or expanding nuclear power in their respective countries will be reviewed, if not suspended. Further, officials in other countries with civilian nuclear power, such as Switzerland and South Korea, have sounded with caution.

It can't happen here

The ostensible cause of the Japanese nuclear accident was the earthquake and tsunami. Surely that's a unique event? Japan is certainly more prone to major earthquakes than most places. The 7 reactor Kashiwazaki-Kariwa complex in central Japan, was hit by a Richter scale 6.8 earthquake in July 2007, which fortunately only led to a relatively small radioactive leak into the sea. But Japans Citizen's Nuclear Information Center commented. 'Japan is simply too quake bound to operate nuclear plants.'

There are reactors near fault lines in other places around the world e,g. in California, and even in the UK- there was recently a small quake near the Sellafield nuclear facility in Cumbria, an area being considered for Geological Repository for nuclear waste.

However, you don't need an earthquake or tsunami to create a similar situation to that at Fukushima, as was demonstrated in Sweden in 2006 when a 'common failure mode' breakdown occurred with the emergency cooling system when grid power was cut off at the Forsmark nuclear plant. Fortunately a disaster was averted.

Major nuclear accidents are seen as potentially high impact but low probability events, and perhaps therefore as disproportionately expensive to avoid. Most of Japans reactors are only designed to withstand quakes of 6.5 magnitude. A proposal some years ago to raise the quake proofing design standard for nuclear plants in Japan to magnitude 7.1 level was shelved because of the high costs.

Climate change is likely to introduce a new set of problems. As in Japan, nuclear plants are often located on the coast to get access to cooling water. However rising sea levels and increasing storm surges could lead to sudden flooding episodes, much as with the tsunami.

Some risks can be avoided by better design. Pretty clearly emergency cooling systems ought to be protected from floods. So lessons will be learnt. Certainly nuclear plant designers try hard to predict and protect against possible problems, and, even given the cost limits, they do very well in most cases.

In reality though nothing can be 100% safe, despite this being one area where we would like to think it can be. We nevertheless continue to hope that we can avoid or limit errors or failures, human or technical. However, nuclear technology is unforgiving, and, Nature often shows us the error of our ways, as we have just seen. And it may not only be malevolent nature we have to worry about. If you also add in the potential for terrorists action against nuclear facilities, including nuclear waste stores and shipments, then the risks begin to look even more worrying- and far from remote.

Do we need to face them? In the short term there seems likely to be a 'dash for gas'- fuelled by the discovery of shale

gas reserves. But that's no long-term solution to climate change and it has its own health and safety problems. Long-term there is no climate friendly alternative we know of at present to a shift to renewable energy- reserves of uranium and thorium on this planet are inevitably finite, and using them will leave us with radioactive waste to deal with for many centuries after all the nuclear fuel has be exhausted. Some look to nuclear fusion as a long-term solution, but that is decades away and uncertain, with its own set of safety issues. Why try to build a sun on the earth when we get enough energy from the sun in the sky to meet all our needs? Why not switch to technologies, available now, which can use some of this free energy and have none of the safety, security or fuel depletion problems, costs and risks associated with nuclear power?

Actually, it's not being going very well in any case, with plant retirements and closures outstripping new start-ups. In the EU the new reactors being built in France and Finland are now years behind schedule and massively over budget. There have also been major delays in getting a new nuclear programme going in the USA. Russia recently decided to throttle back on its expansion programme to save money, while China, often seen as the flagship of the nuclear renaissance, has indicated that it too would slow down its nuclear drive, given that it was having problems with some of the US designed systems it was relying on.

The crucial issue has been economics. Nuclear plants are very capital intensive and nuclear programmes have usually had to have state support in some form- most recently, federal loan guarantees in the USA. Will governments and their taxpayers be willing to continue to back nuclear if its reputation has once again been besmirched by the widely disseminated image of the Japanese explosions and pictures of children being monitored for radiation contamination?

The fall back argument is that there is no alternative to nuclear in an energy and climate constrained world – whatever its costs. That has to be put in perspective. At present nuclear power supplies around 14% of global electricity, less than we get globally from hydro plants. The case for nuclear expansion is beginning to look less credible, given the series of new energy scenarios now indicating that renewable energy sources, if coupled with energy efficiency, could supply nearly 100% of all global electricity needs by 2050, at reasonable costs. Even the conservative International Energy Agency says renewables could supply 75% of the world's power by 2050, while some scenarios are now talking of getting near 100% of total energy (not just electricity) from renewables by 2050.

In this context it is perhaps worth noting that, although China is planning to expand its use of nuclear from 2% of its power as at present to 4% by 2020, it's planning to expand its reliance on renewables by much more – to meet maybe 15% of total energy needs by 2020. It has already overtaken the USA as the lead country in wind power.

Some other countries are already doing very well, with for example several in the EU already obtaining more then 50% of their electricity from renewables. But nothing like 100% from renewables globally is even vaguely possible unless there is a major commitment from governments and companies – and people- around the world. For generations, nuclear power has had the lions' share of funding for new energy technologies, although that is gradually changing, as renewables become cheaper. The tragic accident in Japan might be a trigger that could shift priorities more radically. If so, the painful lesson that we can't rely on nuclear technology may not have been in vain.

Professor David Elliott *worked in the nuclear industry in the UK before moving to the Open University, where he worked on courses and research projects related to renewable energy development. He has published widely on sustainable energy policy, including a recent monograph 'Nuclear or Not?' (Palgrave 2010). He is editor of the journal Renew and, now retired from the OU, writes a weekly 'Renew Your energy' Blog on the Institute of Physics 'Environmental Research' web site.*

Further reading on sustainable energy:

http://www.stanford.edu/group/efmh/jacobson/Articles/I/susenergy2030.html
http://www.wwf.org.uk/research_centre/research_centre_results.cfm?uNewsID=4565

The Japanese nuclear disaster has occurred at a time when attempts were being made to re-launch nuclear power as a new 'clean' energy source that might help deal with climate change and underpin energy security.

The accident in Japan may not prove to be as serious as that at Chernobyl in 1986, in that its direct radiological impacts will not be felt across such a wide area, but its political and economic effects could well be just as significant. If technologically advanced Japan can't handle nuclear power safely, who can?