Fukushima is a triumph for nuke power: Build more reactors now!

Analysis Japan's nuclear powerplants have performed magnificently in the face of a disaster hugely greater than they were designed to withstand, remaining entirely safe throughout and sustaining only minor damage. The unfolding Fukushima story has enormously strengthened the case for advanced nations – including Japan – to build more nuclear powerplants, in the knowledge that no imaginable disaster can result in serious problems.

Let's recap on what's happened so far. The earthquake which hit on Friday was terrifically powerful, shaking the entire planet on its axis and jolting the whole of Japan several feet sideways. At 8.9 on the Richter scale, it was some five times stronger than the older Fukushima plants had been designed to cope with.

If nuclear powerplants were merely as safe as they are advertised to be, there should have been a major failure right then. As the hot cores ceased to be cooled by the water which is used to extract power from them, control rods would have remained withdrawn and a runaway chain reaction could have ensued – probably resulting in the worst thing that can happen to a properly designed nuclear reactor: a core meltdown in which the superhot fuel rods actually melt and slag down the whole core into a blob of molten metal. In this case the only thing to do is seal up the containment and wait: no radiation disaster will take place[1], but the reactor is a total writeoff and cooling the core off will be difficult and take a long time. Eventual cleanup will be protracted and expensive.

In fact, though the quake was far beyond design limits, all the reactors went into automatic shutdown perfectly: triumph number one. Control rods slammed into the cores, absorbing the neutrons spitting from the fuel rods and pinching off the uranium-fission chain reactions powering the plant.

However, the cores were still producing heat and radiation at this point: intermediate radioactive isotopes of caesium and iodine are created during normal running. They have short half-lives and decay to insignificant levels within days of a shutdown, but for that time the reactor will still produce a few per cent of the heat it puts out in normal running – and this is still a lot of heat. If it is not dealt with, it can eventually melt down parts of the core, though the resulting mess will not be nearly as bad as a runaway meltdown.

Thus, even with the control rods in, the core still needs to be cooled for some days until the "residual" heating dies away and so power and water need to be supplied for this purpose. Backup cooling driven by diesels came on at all the plants without trouble, despite the way-beyond-spec hit from the quake: triumph number two.

For a few hours all was well. Then the tsunami – again, bigger than the plant had been built to cope with – struck, knocking out the diesel backups and the backup diesel backups.

Needless to say, this being a nuclear powerplant, there was another backup and this one worked despite having been through a beyond-spec quake and the tsunami. Battery power cut in and the cores continued to be cooled, giving the plant operators some hours of leeway to bring in mobile generators: triumph number three.

Unfortunately it appears that the devastation from the quake and tsunami was sufficient that mobile power wasn't online at all the sites before the temperatures inside the cores began to climb seriously. At this stage the cores are sitting immersed in cooling water inside their terrifically thick and strong airtight containment vessels. As the water is not being circulated and cooled any more, it is getting hotter, turning to steam, and pressure is building inside the vessel. Left alone the vessel interior will presently become hot enough to start melting the tough alloy casings of the fuel rods, at which stage the interior will fill with long-half-life radioactive materials – and will thus have to be buttoned up tightly and abandoned for a long time, creating a mess.

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What the Japanese powerplant chiefs decided to do at this point is vent off some of the steam from the containment vessels in order to cool the interiors down. At this point the steam is not contaminated with any long-lived nasties, but it has been well soaked in neutrons and thus it contains quite a lot of very short-lived (half-life measured in seconds) radioactive materials such as Nitrogen-16. Within a minute of being released, such steam is just steam again, but it is radioactive when it comes out.

This is obviously emotive stuff – radioactive gas leaks – even if it is harmless to anyone beyond the plant fence (the workers inside are in protected control rooms or wearing protective gear).

So the situation is being managed and the cores are being kept cool by venting off steam. Power is restored by mobile generators to most of the reactors and soon their cooling systems are running again for a smooth shutdown.

But in two cases the normal cooling systems couldn't be made to run again even once mobile power arrived on scene. The normal systems use very pure de-mineralised water, and the plant operators couldn't get a supply of this running again at these reactors. Water adulterated with other things – such as sea salt – is less desirable, as its use means that other radionuclides are generated in small quantities: also it will cause a lot of expensive equipment corrosion and so forth.

But after some time, water levels inside the three cores sank low enough from the venting that hot bits of core started to stick up out of the liquid. These parts were then being kept cool much less effectively, and trace amounts of the caesium and iodine isotopes powering the residual heat reaction were detected in the air outside the plants. This first happened on Saturday.

The plant operators thus bit the bullet and fell back on yet another backup system: they injected seawater mixed with boric acid (liquid control-rod material) into the cores. This meant a fair bit of expensive damage to the two reactors, and also that the steam emitted when venting would be slightly more radioactive due to the salt and other trace chemicals in the sea water.

This is why the Japanese operators have chosen purposely to release the steam from these reactors, not into the atmosphere, but into the interiors of their reactor buildings. These too can be made gas-tight in order to contain leaks from the containment vessel, though they aren't terrifically strong and able to hold massive pressures.

The idea was to hold the steam in the buildings for the necessary short periods until it was no longer radioactive at all before letting it out of the building – and then venting off some more steam into the building, so cooling the cores. Holding the steam in the buildings wasn't really necessary – more of a gesture than anything else – but it was done nonetheless.

Unfortunately this decision has proved to be a PR blunder rather than a bonus. Steam which has been superheated as in a reactor core can break up into hydrogen and oxygen, which is naturally an explosive mixture. At Chernobyl, this actually happened inside the containment vessel and the resulting explosion ruptured the vessel, leading to a serious release of core radioactives – though this has had basically zero effect on the world in general nor even much impact on the area around Chernobyl.

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But proper nuclear reactors are designed so that you can't get water breakup to hydrogen and oxygen inside the containment vessel, only outside it: triumph number four for the Japanese plants' designers. Thus the hydrogen explosions which subsequently took place, though visually spectacular, did nothing more than blow the roofs off the reactor buildings – the containment vessels and their systems remain unbreached and under command from the relevant control rooms. The risk of explosion was known and notified in advance: it was accepted by the plant operators and regulators in return for the very slight reduction in radiation exposure close to the reactor buildings.

All reactors' temperature is now under control and the residual heat reactions inside them continue to die away; soon, no further cooling will be required. The three worst affected will cost more to put right than the other ones, having been cooled with the backup-backup seawater system and lost their roofs, but the process of sorting them out will not be a lot more onerous than a normal periodic refuelling. All the other affected reactors have achieved quite normal shutdowns, though nuclear safety being nuclear safety it will be some time before they can be fired up again.

Radiation health effects have been pretty much zero. At times there have been heightened radiation levels inside the plants from short-life isotopes in the steam releases – sometimes enough that an unprotected person next to a reactor building might have sustained a year's normal dose from background radiation in an hour. This is not particularly terrifying, really – nobody is scared at the prospect of living another year on planet Earth – but it is being reported under scaremongering headlines. Another thing the weekend reporters have missed was the fact that all but tiny traces of the airborne radionuclides (from the salt in the seawater coolant) were disappearing before they could even cross the street; there is essentially no health hazard to people living nearby. Precautionary evacuations and tests were just that: precautionary.

In fact only one person so far has sustained any measurable extra radiation dose above normal: a plant worker, according to the IAEA, sustained about 10 per cent of a normal year's background radiation dose. Other workers have been injured by the hydrogen explosions and the quake/tsunami, and one killed in a crane accident, but quite frankly being a nuclear powerplant worker at Fukushima has been pretty safe compared to just being an ordinary citizen in quake-hit Japan.

So to sum up: all plants are now well on their way to a cold shutdown. At no time have their operators come even close to running out of options. No core has melted down and come up against the final defensive barriers: the safety systems did not come even close to failing, despite being tested far beyond what they had been designed to take. One person has sustained a small dose of radiation which need cause him no concern.

The whole sequence of events is a ringing endorsement for nuclear power safety. If this – basically nothing – is what happens when decades-old systems are pushed five times and then some beyond their design limits, new plants much safer yet would be able to resist an asteroid strike without problems.

But you wouldn't know that from looking at the mainstream media. Ignorant fools are suggesting on every hand that Japan's problems actually mean fresh obstacles in the way of new nuclear plants here in the UK, Europe and the US.

That can only be true if an unbelievable level of public ignorance of the real facts, born of truly dreadful news reporting over the weekend, is allowed to persist.

Spread the word. And if you doubt us on any of this, please read this excellent early description of the events, or follow the reports from the IAEA and World Nuclear News. Very few other channels of information are much use at the moment. ®

[1]There is an enduring popular myth suggesting that such a core would become so hot that nothing could resist it: being heavy, it would thus melt its way through the foundations of the reactor, through the planetary crust and notionally to the other side of the planet – the so-called "China syndrome". The idea that the core could burn through the base of its containment is about as credible as the idea that it would remain together in the planet's molten interior and then – having somehow done so and thus reached the centre of the Earth – then ascend back to the surface again at the antipodes.