

After Chernobyl, it might be thought that all reactors of the same design would be shut down. Actually, there are 11 such reactors still operating. The Russians are even thinking of building a new one.



Chernobyl Legacy

| by *Chris Cragg*

As the western energy correspondents waited to get back on the bus to take them back to Kiev, they paused to look back one more time at the sarcophagus looming over reactor 4, at Chernobyl. They had seen the memorial to the three atomised workers buried deep on the basement wall of reactor 3, the closest visible place available to where they had died. They had seen the windowless control room with its desks covered in plastic sheeting, where half a ton of burning graphite had fallen down the air conditioning shaft. They had even seen the makeshift stairs that were dug down towards the core, steps needed to reach the cameras that monitored it in eerie green light.

Now having scrubbed up and handed over their borrowed protective clothes, they were ready to leave. As the winter sun

started to fall below the famous red and white stack, there was a sudden gust of wind and an extraordinarily loud crash. As one, the entire party ducked down as all eyes swivelled towards the reactor, as if it had chosen that moment, of all moments, to have a repeat performance. In fact, the wind had brought down several hundred yards of corrugated iron sheeting that divided one part of the parking lot from another. There was much slightly hysterical laughter and claps on the back, journalists and workers alike. Chernobyl was and remains a very spooky place.

That was in November 1996. The journalists were there at the request of the Ukrainian Government whose primary concern was to direct the attention of the European Union to its need for money and equally its need to build new reactors. Of Chernobyl's

kilometre long set of four reactors, reactor 1 was shut, reactor 2 had been badly fire-damaged in 1991 and reactor 3 was still running and would be for another three years. Given what had happened to reactor 4, this was a surprise.

The town that had housed the workforce, Pripjat, was a ghostly ruin, much favoured by photographers and scientists looking at the effects of radiation on common household goods. Some thirty miles away, another had been built, Slavutych, which now housed the workforce that looked after the sarcophagus and ran reactor 3. It had been a gift from the rest of the Soviet Union, each quarter built from funds contributed by different republics. By Ukrainian standards, it was a classy place, of which its inhabitants were very proud. They wanted Chernobyl NPP kept alive



and 4,000 of them worked there, travelling in on a railway, specially built.

Whether their pleas to the journalists made any difference is unlikely. Certainly, Ukraine made the closure of Chernobyl itself a major bargaining counter with the EU for years after the fall of the USSR. However in this it was not alone. Both the EU and the US have been in a continuous bargaining process over the state of former Soviet nuclear power stations and industry, ever since that fateful explosion on 26th April 1986.

Intense controversy |

This is not the place to retell the accident. Suffice it to say that the operators were engaged in an unauthorised or semi-authorised experiment in running down a turbine to examine load-following capabilities at less than full power. The reactor design – RBMK-1000 – had ‘a positive void coefficient’, which effectively meant that, as it slowed down, pressure and heat built up inside the reactor, blowing off its

lid. (Explaining how the positive or indeed its reverse, the negative void coefficient works is extremely difficult and seems counter-intuitive.)

The damage that this did in terms of human health is still a source of intense controversy. The UN Chernobyl Group of experts put it at three at the scene, 20 workers shortly afterwards, 19 more between 1987 and 2004, with 4,000 cases of thyroid cancer and 5,000 other people affected in heavily contaminated areas. The International Agency for Research on Cancer puts it at 16,000 premature deaths in Europe. Others suggest it was as high as 150 Hiroshimas; a clearly unverifiable figure.

What is undoubtedly true is that full monitoring of the effects on health was not carried out under the circumstances. The release of Iodine 131, with a half-life of only eight days did undoubtedly affect a great many children in the thyroid gland. However an article in the medical

journal *Lancet* was still calling for a closer monitoring of such children in June 2002. Given that 45,000 people were evacuated out of Pripyat and spread all over the USSR often facing considerable hostility, the real medical impact is unlikely to ever be known.

What is known however is the design of the reactor, the graphite moderated RBMK-1000 had a lot of fundamental faults. So what happened to all Chernobyl’s brothers and sisters? Were they shut down on the grounds that if such an accident could happen to reactor 4, the same thing could happen to them? Well no, as it happens. Indeed, the Russians are considering completing the building of a new one, while six are either being refurbished or planned for refurbishment to last another 15 years, giving them all a 45 year life-span. There are currently eleven of this design now operating, or in some cases, partly operating in Russia, but before looking at these it is worth celebrating some of the departed. Severson



Abandoned town of Pripyat near Chernobyl. Photo by: Yann Arthus-Bertrand/Corbis



(Tomsk-7) two units AD-4 and AD-5, built respectively in 1964 and 1967 were finally closed down in 2008. These were a little unusual because they were really forerunners of the RBMK design, built primarily for the military production of plutonium. However they did provide heat and power for the city of Tomsk. The US provided \$285 million for a coal-fired plant to replace this civil use. The only question remaining is what to do with the plutonium. A similar one at Zheleznogorsk is due for closure in 2010.

Meanwhile in Lithuania, of the two RBMK reactors at Ignalina, the first was finally shut down in December 2004. Shutting both was a condition of entry to the EU and the second is due to go this year. However, given that Ignalina 2's 1,360 MW provides around 70% of the country's electricity, the Lithuanian Government is none too keen to see it shut and keeps threatening to run it until 2012, not least because of the gas supply issue. So far the

EU has given €225 million, plus a number of EBRD loans.

So far then the score is four down at Chernobyl, two ancient ones at Tomsk and one out of two in Lithuania. So where are the rest? Currently there are three in Smolensk, four in Kursk and four in St Petersburg (Leningrad). The first RBMK in Leningrad was operational in 1973 and is thus 36 years old. The rest are younger, but not by that much.

Contrary to the assumption that the RBMKs would slowly fade from view, virtually all the above are planned for refurbishment to extend their lives, by 15 years if not longer. Equally, the plan is to finally complete the fifth RBMK at Kursk whose construction stopped through lack of funds back in 1985. There was a brief period when it was widely believed that the EU would help fund this particular completion through Euratom, but it now appears that the job has been handed to

reluctant private investors. It has yet to be finished.

So far then the RBMK design with its highly combustible graphite moderation seems to have survived remarkably well. What has also survived remarkably well is used-fuel from this reactor type. Back in 1997, the nuclear watchdog Bellona, noted that 7,500 tons of used fuel had accumulated around the Leningrad, Kursk and Smolensk NPPs. This type of fuel had never been reprocessed and it was accumulating at the rate of 750 tons a year. Stocks must have doubled since then.

But then, according to Vladimir Putin, Russia needs to have 25% of its electricity from nuclear plant by 2030 compared with 16% now. Meanwhile, as the correspondents changed planes at Vienna, there was a terrible row at airport security. The guard at the gate wanted all the personal radiation monitoring badges put through the X-ray machine. ■



Inspector checking the interior of the Chernobyl plant twenty years after the explosion of reactor 4. Photo by: Gerd Ludwig/Corbis