Chernobyl, 29 Years On

The situation at the site – no foreseeable solution and a race against time

April 2015

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November 2011, Radiation Measurement in Chernobyl © Jan Grarup/Greenpeace

The reactor accident

On 26 April 1986, the worst nuclear disaster the world has yet seen occurred in reactor block number 4 at the Chernobyl nuclear power plant. The accident happened in a Russian-designed RBMK, a water-cooled pressure reactor moderated with graphite. Operating errors combined with a flawed technical design and an inadequate safety culture led to the disaster. Two explosions destroyed the reactor, and the graphite block caught fire and burned for ten whole days. Radioactive material was released into the atmosphere over a vast area. Within six months, a lid was constructed under difficult conditions to cover the remains in an attempt to contain the radioactive releases. This protective sarcophagus was expected to last for 20 to 30 years.
[i]

In addition to the destroyed reactor at the site, there remained reactor blocks 1 to 3. It was not until the end of 2000, when reactor 3 was shut down, that the entire Chernobyl nuclear power plant was taken off the grid. In February 2014, the Ukrainian regulatory authorities approved the decommissioning of blocks 1 to 3. The three reactor blocks are deemed to be ‘safely contained’.

The Shelter Implementation Plan (SIP)

In the ten years after the accident, no comprehensive solution was found that was economically and technically acceptable for dealing with the damaged reactor in the long-term. For this reason it was agreed to proceed in several stages. In 1997, the Shelter Implementation Plan (SIP) became the basis for international collaboration on how to begin to manage the site. Its objective in the medium-term is to better contain the highly radioactive remains – in order to buy some time to develop a long-term solution. An essential part of implementing the medium-term objective is the construction of a new containment structure for the damaged reactor. A new curved, protective shell made of steel, the New Safe Confinement (NSC), is to be placed over the reactor. Novarka, a French consortium, was awarded the contract to construct the new protective shell.[ii]

Due to the high level of radiation, the new containment cannot be constructed directly above the deteriorated sarcophagus. . The new safety shell – a massive, self-supporting, domed, hall-like structure 257 metres wide, 165 metres long, and 110 metres high – is being manufactured in two parts to the side of the damaged reactor. These two parts are supposed to be pushed together and joined, then slid over the damaged reactor. [iii] When it is completed, it will be the largest movable structure on earth. Implementing the SIP is proving to be much more difficult than expected. At the outset (1997), the projected timeframe for the NSC was eight to nine years, meaning completion by 2005/2006. [iv]
Yet work on the gigantic structure did not even begin until April 2012. At the time, the completion date for the NSC was then planned for October 2015. But construction of the new sarcophagus for what remains of the Chernobyl nuclear power plant is taking longer than anticipated. It is now expected that the completion date will be November 2017.[v]

Despite the unrest in eastern Ukraine, construction of the new protective shell went ahead.[vi] In 2014, both halves were put together up to their maximum height and placed together on the assembly platform. [vii] Both halves of the NSC are at present being joined together. [viii]

Beginning in 2015, the structure is supposed to be sealed by means of a double-walled outer shell and equipped on the inside with a crane facility. [ix] The most difficult part will then begin: the whole structure, some 31,000 tonnes in weight, is to be pushed into place over the damaged reactor using hydraulic lifting equipment, in a process lasting three days.

The costs of the SIP have also risen considerably, and its financing is being continually called into question. The European Bank for Reconstruction and Development (EBRD) took charge of administrating the SIP. In 1997, it set up the Chernobyl Shelter Fund (CSF).

According to a new investigation held in 2014, the total costs for the SIP have now been put at EUR 2.15 billion (USD 3.09 billion). In 2012, the costs were calculated at EUR 1.54 billion (about USD 2.1 billion). [x] The costs for the SIP have already more than quadrupled the original estimates of USD 768 million.. [xi]

Due to delays and the enormously increased costs, there is now a huge financing shortfall of EUR 615 million. In the meantime, the EBRD has agreed to provide EUR 350 million, with the expectation that there will be EUR165 million forthcoming from the G7/EU. At a donor conference being held on 29 April 2015, led by Jochen Flasbarth, a state secretary in Germany's environment ministry (in the context of Germany's presidency of the G7), this amount is to be the subject of negotiation.[xii] The remaining EUR100 million is to come from non-G7/EU states, or otherwise also borne by the EBRD. [xiii]

Dangers arising from the exploded reactor

From 2004 to 2008, the ‘Stabilisation’ consortium carried out urgently needed work to stabilize the on the crumbling sarcophagus for the next 15 years, i.e. until 2023. However, the remains are in some places extremely unstable, and it is therefore doubtful that this goal has been achieved. [xiv]

In a completely unexpected incident on 12 February 2013, pieces of the wall and the roof of the engine room adjoining the sarcophagus crashed down. The collapse of the engine room released radioactive substances, but at a level that is below the limit values. [xv]

The heavy snowfalls and resulting weight of the snow on the buildings were not, as first thought, the only cause of what happened. [xvi] Investigations revealed a combination of causes regarding the collapse. The explosion in 1986 seriously damaged building structures, and work to be carried out on the building after the accident was not able to go ahead as planned due to high radiation levels. The condition of the building further deteriorated through ageing and corrosion. Structures previously damaged in the accident, for example by cracking, were only now being discovered due to the inaccessibility of the site. Measures for supervising the buildings were not adequate.

The unforeseen collapse of the engine room and its causes raise serious questions about the integrity of structures on the site. A collapse of the sarcophagus, leading to a release of radioactive substances into the environment around the site, cannot be ruled out in principle. [xvii] And clearly, the engine room collapse demonstrates how real the danger of the sarcophagus collapsing actually is. If the damaged reactor were to break down beneath the new protective shell, recovery would become that much more difficult. More important, however, is the threat to the lives of those working on the sarcophagus, if it were to collapse. There are more than 1.5 million tonnes of radioactive dust inside the ruins. If the sarcophagus were to collapse, a high volume of radioactive material would be released. This could lead to an exposure to radiation as far as 50 kilometres away.

Extreme weather conditions such as hurricane-force storms also present a danger to the sarcophagus, as do earthquakes or fire. There are nearly 2,000 tonnes of flammable materials inside the sarcophagus. The release of a high level of dust particles resulting from the heat generated by a fire, even if there is no collapse, is also a cause for concern. [xviii]

Small quantities of radioactive dust particles are continuously being released from openings in the sarcophagus. Water and moisture, in particular, penetrate through the cracks in the sarcophagus, further accelerating decay of the building structure. Some 20,000 m³ of water are inside the reactor. Annually, around 2,400 m³ of water penetrate through cracks in the building (50%), and the rest comes from condensation and the operation of the particle suppression system. [xix]

Thousands of cubic metres of contaminated water are in the lower part of the sarcophagus. Studies carried out to date have revealed that some of this water is seeping into the ground below the ruins. [xx] To protect the River Prypjat, a subterranean wall made of clay, approximately 13 kilometres in length, has been put into place, although what effect it is having has not been proven. It remains to be seen whether the new protection shell provides the barrier that is lacking to prevent further spread of radioactive substances into the environment.

When the SIP is completed in 2017, Ukraine will be responsible for the New Safe Confinement with its high operating and maintenance costs. Estimates of the annual costs are not yet known.
On 12 March 2001, Ukraine adopted a plan to convert the damaged reactor into an ecologically safe system in a three-phase approach. The first phase, stabilising the existing structures, has been completed, but with very limited success.

The second phase is now under way. This comprises not only erecting a new protective shell (part of the SIP), but also developing the technology needed for recovering fuel-containing material, as well as erecting the facilities this will require. It is only in the third phase that the plan sees to actually recovering the fuel-containing materials, and then sorting, conditioning and storing them by activity inventory in line with legal requirements. [xxi] In order to reach the last stage in the strategy, a geological repository for the fuel-containing materials needs to be built.

The ‘Shelter Safety Status Database’ contains detailed information on the sarcophagus, its current condition, and its immediate environment.[xxii] Further data needs to be collected, however. Since the start of 2014, a research project supported by NATO on the modelling of the spread of radioactive emissions in the NSC has been carried out. Germany’s Gesellschaft für Anlagen- und Reaktorsicherheit (GRS) [association for plant and reactor safety] is also taking part in the project. [xxiii]

Even if the development of a recovery strategy is successful, the financing of this new project presents a major problem. The international SIP project ends in 2017, with the technical approval of the New Safe Confinement. Afterwards, it is no longer the EBRD, but Ukraine that is financially responsible for the continuation of the next phases to deal with the damaged reactor. [xxiv] At present there is no reliable estimate of the costs involved in attempting to convert the damaged reactor into an ecologically safe system.

Conclusion

In light of the huge costs involved, it is shocking that the goals for the NSC are so limited, which include only preventing the penetration of water into the sarcophagus, as well as the external release of radioactive dust particles for a period of 100 years.

The major drawback of the SIP, however, is that recovering the fuel-containing material is not part of the project, although the greatest threat to the environment and people comes precisely from these fuel-containing, highly radioactive substances. While the protective shell is designed to make it possible for this fuel-containing material to be recovered at a later point in time,. the financial means to actually implement fuel containing material recovery are not provided by the SIP. Thus, the long-term threat posed by the destroyed reactor block will not have been averted by the current efforts underway.

In short, it must be stated that 29 years after the worst nuclear disaster the world has yet seen, the damaged reactor is still a danger. A real solution to the situation is nowhere in sight.

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[xvii] BMU 2013, s. o.
[xviii] Becker 2012, s. o.
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