

“CHERNOBYL: 30 YEARS LATER”

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EXECUTIVE SUMMARY

26 April 1986 – The worst nuclear disaster to date occurred in reactor unit 4 of the Chernobyl nuclear power plant. The accident took place in a RBMK reactor – a boiling-water-cooled, graphite-moderated, pressure tube reactor. Fourteen RBMK reactors were in operation at the time of the accident, four of them in Chernobyl.

The disaster was the result of a combination human error, the technical design of the reactor type and an inadequate safety culture. Two explosions destroyed the reactor. The graphite core caught fire and burned for ten days, spewing radioactive material into the atmosphere that spread over a vast area. Within six months, a lid was constructed under difficult conditions to cover the ruins – the sarcophagus. It was expected to provide protection for 20 to 30 years.

To this day, neither the total amount of radiation released by the devastating accident nor the exact amount of nuclear fuel remaining in the reactor has been fully determined. However, from the data collected we can conclude that there are still large amounts of radioactive material in the ruins of the damaged reactor. These pose a considerable threat to the environment around the site and must not be neglected.

Shelter Implementation Plan

In 1995, the G7, the European Commission and Ukraine signed a memorandum of understanding concerning the closure of the Chernobyl nuclear power plant. As no solution was found for dealing with the damaged reactor, the parties agreed on a step-by-step course of action. Since 1997, the **Shelter Implementation Plan** (SIP) has been the basis of international collaboration. The aim of the plan is to make the remains of the reactor safer in the medium term, so as to buy time to develop a long-term solution.

An essential part of the implementation of the medium-term goal is the construction of a new containment structure for the damaged reactor. The **New Safe Confinement** (NSC), an arch-shaped steel shell, is intended to contain and protect the reactor. Construction of the gigantic dome structure – 109 metres high, 162 metres long and with a span of 257 metres – began in April 2012. It is being assembled in the vicinity of the damaged reactor and, according to the current schedule, will be slid into place over the ruins of the damaged reactor, fitted over the existing sarcophagus and sealed in 2017. This is the most difficult part of the project and we will see whether it is successful next year.

The interior construction of the protective shell is currently underway. The new containment structure is not a passive structure; it is equipped with active systems. A **computerized ventilation system** is designed to prevent corrosion during the lifespan of the structure, which is approximately 100 years. In addition, a system of cranes is being installed inside the structure to dismantle large elements of the old sarcophagus. The other remaining parts of the sarcophagus and the damaged reactor unit are then to be demolished over the coming decades, and therefore are not provided for by the Shelter Implementation Plan (SIP).

The objective of the construction of the new protective shell is practical: it is intended to prevent water from penetrating the sarcophagus and radioactive dust from being released over the next 100 years. The protective shell is also designed to make possible the recovery of fuel-containing mass at a later time – but this aspect is not explicitly part of the international plan and financing for recovery work is not provided by the SIP. Thus, the new protective shelter will **not succeed in averting the threat** posed by the damaged

reactor unit **in the long term**. Another problem is that Ukraine now has to pay for the expensive operating and maintenance costs of the NSC.

To date, implementation of the SIP has proven to be problematic. It is now about 12 years behind schedule. The original estimated cost (USD 768 million) has nearly quadrupled – the SIP is currently expected to cost EUR 2.15 billion (about USD 3.09 billion) – and the most extensive part of the project (the erection of the NSC) has not yet been completed. The European Bank for Reconstruction and Development (EBRD) therefore set up the **Chernobyl Shelter Fund** and has taken over the administrative management of the SIP.

Dangers posed by the exploded reactor

The 'stabilization' consortium carried out urgently needed work to stabilize the decrepit sarcophagus from 2004 to 2008. The goal was to stabilize the sarcophagus for the next 15 years, in other words until 2023. The probability of a **collapse of the sarcophagus** before stabilization work was carried out was calculated to be about 0.1 per year. Stabilization measures were intended to lower the probability of collapse to 0.001 per year. However, certain parts of the remaining sarcophagus were found to be extremely unstable. Therefore it is doubtful whether the objective of the measures was met. Extreme weather conditions (such as hurricane-strength storms), earthquakes and other events also pose a threat to the integrity of the sarcophagus.



Thirty years after the Chernobyl nuclear catastrophe Greenpeace revisits the site of the Unit 4 with the New Safe Confinement (NSC or New Shelter) and the abandoned town of Prip'yat. The Chernobyl plant is visible in the far background.

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The accident caused a major part of the remaining nuclear fuel to melt with the graphite and the cement debris, forming a lava-like mass. There are also about 1.5 tonnes of **radioactive dust** inside the ruins. If the sarcophagus were to collapse, large amounts of radioactive material would be released. The **water and moisture** that leak in through the cracks in the crumbling protective shell are particularly damaging, accelerating the further deterioration of the building structure. Contrary to what was originally assumed, this also destroys the glass-like surface of the remaining elements containing nuclear fuel, little by little producing larger and larger amounts of radioactive dust (despite dust suppression systems) that can easily escape into the atmosphere. Moreover, radionuclides with very long half-lives were released and a radioactive liquid was formed. There are thousands of cubic metres of contaminated water in the lower parts of the sarcophagus. There is reason for concern that this water is seeping into the environment. **Fire** is another danger; it could

spread to the ruins, which contain nearly 2,000 tonnes of flammable materials. If the ruins were to catch fire, they could collapse, releasing a high amount of radioactive material. Another cause for serious concern is that the heat generated by a fire could release a large amount of radioactive dust particles, even if a collapse does not occur.

From today's perspective, it is inconceivable that the exploded reactor will ever be converted into an ecologically safe system that would keep it from posing any kind of threat in the long term.

The situation at the site of the Chernobyl nuclear power plant

The State Specialized Enterprise Chernobyl NPP (SSE ChNPP) has been the operator of the Chernobyl plant since September 2000. Not only are the damaged reactor unit 4 and the huge construction site of the New Safe Confinement located on the plant premises, but also **reactor units 1, 2 and 3**. The entire Chernobyl nuclear power plant was taken off line with the final decommissioning of unit 3 in late 2000. Three facilities (complexes) are being built with international funding on the site of the nuclear power plant. They will process and store radioactive waste generated by operational and decommissioning activities in units 1 to 3.

In late 2005, lacking a new interim storage facility, the operator began storing spent fuel in an already existing interim storage facility: the Russian **ISF-1 wet storage facility**, which first went into operation in 1986. Compact storage had to be used to increase the capacity of the storage facility, which was nearly full. It does not meet modern standards. German, French and Ukrainian certification organizations have identified substantial deficiencies, among other things, in the construction of the building and its design. This storage facility therefore poses a hazard.

The unloading of the intact fuel elements from the reactors was completed in September 2013. However, the fuel elements must now remain in the ISF-1 wet storage facility until at least 2025, by which time they will all have been moved to the new interim storage facility.

The new **interim storage facility for spent fuel** (ISF-2) was supposed to have been completed in 2003. The design for the storage facility produced by Areva NP (formerly Framatome ANP, France) turned out to be unsuitable. In early 2007, the contract with Areva NP was amicably terminated following years of dispute. The American company Holtec International was contracted in September 2007 to continue work on the interim storage facility, which according to the current schedule should be completed by the end of 2017.

A consortium of Belgian, French and Italian companies (Belgatom, SGN and Ansaldo) was supposed to have built a **liquid radioactive waste treatment plant** (LRWTP) on the site of the Chernobyl nuclear power plant by 2001. The plant was to process liquid radioactive waste from existing operations as well as waste generated during the decommissioning of units 1 to 3. For years, the facility was in a state of 'incomplete construction' and the contract with the consortium was terminated in 2006. SSE ChNPP, the operator, took over construction and completed the facility according to its own modifications. The plant did not go into operation until 2015. The overall project has yet to be completed.

In the spring of 2001, the German company Nukem was contracted to build an **industrial complex for solid radioactive waste management** from units 1 to 3 (ICSRM). The complex was scheduled for completion in mid-2005, but was not completed until April 2009. The facility is still being tested. In July 2015, Nukem was still working under warranty to rectify defects. An **engineered near surface disposal facility (ENSDF) for low and medium radioactive waste** at VEKTOR nuclear waste storage complex located 17 km from the site of the plant itself also forms part of the waste centre. The facility was completed and handed over to the operator at the end of 2007. According to certification organizations (from Germany and other countries), the storage facility (assessed by Western standards) demonstrates considerable deficiencies. For now, the supervisory authority has therefore only granted a temporary operating permit.

As we can see, the facilities constructed by Western companies do not meet safety and security standards. Moreover, it becomes clear just how complicated and protracted – as well as extremely

difficult and costly – it is to deal with radioactive waste at the site of an accident. **Facilities that will process and store radioactive material generated by the accident have yet to be constructed.**

The situation in the exclusion zone

A 30-kilometre area around the exploded reactor was completely evacuated following the disaster due to high levels of contamination; it was designated as an exclusion zone. Today, this area is anything but deserted: thousands of people work there on a daily basis and over one hundred, mostly elderly people live in the zone illegally, but their presence is tolerated. In 2012, the exclusion zone was opened to tourists. Now numerous tourists can be seen legally visiting the area every day.

Various repositories with radioactive material from clean up are located around the damaged reactor. Studies estimate that there are some 800 repositories within the exclusion zone. The huge, artificial cooling pond of the Chernobyl nuclear power plant was seriously contaminated by the accident and is particularly problematic.

Today (and for many centuries to come) there are many open 'sources' in the exclusion zone for the spread of radionuclides. For example, they can escape from the exclusion zone carried away by wind or accumulate in surface and ground water and then seep from these 'depots' into the Pripjat River during a flood.

One of the most important – but to this day insufficiently studied – problems in the exclusion zone is the effect of radiation on flora and fauna. A 2007 study shows that radioactivity has an impact on biodiversity and the population density of birds. Researchers therefore believe that constant exposure to radiation could have considerable effects on humans too. Plans for the resettlement and agricultural use of the exclusion zone do not yet exist. In 2013, plans were made for a biosphere reserve. National and international research projects are to be conducted there. In addition, the reserve comprises areas for agricultural activity in which the use of land and water as well as forestry are possible, with a view to preparing the regions for future resettlement.

Overall, we can see that there is a large discrepancy between research findings on the consequences of exposure to radiation on one hand, and the management of the contaminated regions on the other. It is also becoming increasingly clear how difficult it is in the long term to deal with an area considered to be uninhabitable for many generations to come.

Conclusion

The advantage of the SIP was that the most urgently needed work could be undertaken immediately without the existence of a final, comprehensive technical design for the exploded reactor. The idea of opting for a medium-term solution (the new protective shell) to buy time to come up with a long-term solution seemed sensible at first. In the meantime, it has become clear that hardly any work is being done on the development of a long-term solution to be implemented following the completion of the SIP. Even the pilot project for a test recovery of radioactive masses has been discontinued.

It is to be feared that once the SIP is completed, Ukraine will be more or less left alone with this problem. How recovery will be funded is still completely up in the air – according to estimates, several tens of billions of US dollars must be raised. Again, there is very little time left for the complicated and extremely dangerous recovery measures of the highly radioactive materials because the stabilization of the old sarcophagus is only designed to provide structural integrity until 2023. Recovery measures would be made much more difficult if the sarcophagus were to collapse under the new protective shell. But above all, such a collapse would endanger the lives of the people working at the site.

Despite the spectacular images of the gigantic structure of the new protective shell, the failure of the SIP is becoming increasingly apparent. Generally speaking, in view of the exorbitant cost of at least EUR 2.15 billion, the construction of a second temporary shell over the damaged reactor unit does not make much sense. This does not eliminate danger in the long term; a solution to the real

safety and security problem has only been postponed. It is unacceptable to leave this burden to future generations.

In short, we can conclude that even 30 years after the worst nuclear disaster the world has seen, the damaged reactor still poses a danger. A real solution to this situation is nowhere in sight. In view of the existing technical and economic conditions, it is doubtful whether a solution will or can even be implemented.

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