

## **Chernobyl Forests. Two Decades After the Contamination**

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**For the first seven years after the Chernobyl disaster no-one cared about the contaminated forest. Only in 1992 the tragic fire led to reintroduction of the forest management in the radiation-contaminated area. However, the problems of the proper action in the affected areas remain as no-one is experienced in dealing with such a large-scale disaster.**

Forests in Ukraine are entirely state-owned and encompass 10.8 million ha, with 18% forest cover percentage. The forests are mainly artificially grown and susceptible to fire. From 2000 until 2004 there were 17,111 fires on the area of 11,436 ha and they caused the loss of 2.26 million euros. The significant part of the fires breaks out in peat bogs and steppes, where fire-fighting actions are more difficult. Human activity is the main reason for the fires. According to regulations it is the forest administration who is entirely responsible for fire control and firefighting in the forest area. When the fire of the peat bog or soil surface exceeds 50 ha (and the total fire area exceeds 25 ha) this is regarded as an emergency situation and the fire service joins the action.

The zone surrounding the nuclear power plant in Chernobyl constitute the area of 240,600 ha (140,600 ha forest and 100,000 ha undeveloped land) and is exceptional in every way, including fire hazard. This year marks the 20th anniversary of this unprecedented disaster caused by the failure of the reactor. But there remains the problem of the proper conduct in the radiation-contaminated area, including the fire safety of the affected forests, arising due to lack of experience in this matter and on such a large scale.

### **Extremely Dangerous Cesium**

The conifer needles fall after the nuclear accident increased the fire risk. The fires caused the spread of the radioactive substances with the smoke and ashes over the large distances. The wind carried the conifer needles, which caused the extension of the contaminated area. This was the reason for the initial plans to spray defoliant on the forests. The fallen conifer needles would have been covered with latex and buried then. Fortunately, this plan has been abandoned because this could have increased the fire risk as the whole forest would have been virtually dead.

According to the research 95% of radionuclides were accumulated in living trees. The radioactive substances, first of all cesium, strontium and plutonium needed 1 to 1.5 year to be absorbed by the tree crowns. With time they were transferred through the tree trunk to the root system and then to the soil and water. Cesium turned out to be extremely dangerous as it is quickly assimilated by soil and plants and through the food chain it is absorbed by living creatures.

In the first stage after the disaster the withered and contaminated trees were removed and buried, which caused the infiltration of some of the radioactive substances to the groundwater and subsequently problems with forest rehabilitation due to lack of the humus layer. Similar situation arises when the fire burns down the humus layer, which causes desertification of vast areas (even over 10,000 ha).

### **Creeping Neglect**

From 1986 until 1992 no-one cared about the forests in the contaminated zone except for a special group, whose task was to detect and extinguish forest fires. Due to lack of any business activity the irrigation systems gradually declined and a great deal of deadwood (including blowdowns) gathered. The thick grass layer (as high as a man) built a highly inflammable 0.5 m deep stratum which cannot decompose because of the soil conditions (mainly sand). This caused unusual concentration of inflammable material acting as a fuse, which is active even during winter, when there has been fires as well. Many changes in the look of the forest vegetation and growing amount of fallen conifer needles have been observed. According to data from 1996 there was 222,000 cubic meters of standing deadwood and 92,000 cubic meters of lying one. Forest tracks have been overgrown and the forest, left on its own, has become impenetrable and extremely dangerous as far as fire is concerned.

### **Breakthrough**

The fires were an alarm signal. There had been several dozens of fires until 1992, but they were relatively small. The hot 1992 summer (which was tragic also for Polish forests) contributed to the increasing fire risk and subsequently to another disaster started by a fire on the surface of 12,000 ha. Due to the high intensity of the fire the radiation-contaminated products of burning were raised by thermal convective currents, transferred into the upper atmosphere and then spread over the distance of thousands of kilometers. This caused even a short-term panic, as the measurements taken by international laboratories showed sudden radiation increase, which was at first interpreted as another nuclear reactor disaster in Chernobyl. The

fact of this fire has not been well-known and it is difficult to assess, what was its influence not only on the immediate surroundings through the contamination with radioactive substances, but also on the neighbour countries, which were affected as well. Some people died and the rescue equipment was destroyed while extinguishing the fire. The sites of fires have never been restored or interfered in, since there has not been any idea of either dealing with them or feasibility of this action. That was the reason why there were burnt trees left. They fell down and rotted later, which contributed to appearance of insect pests on dozens of hectares of forests. However, there was not enough financial resources to eradicate them.

### ***Chornobyllis* and New Difficulties**

After the fire it turned out that the Chernobyl zone cannot be left on its own and there must be taken appropriate steps to take control of the situation. The *Chornobyllis* company was established in 1992 as a result of decisions at government level. Its primary aim was to ensure stability of the zone radioactivity. Special treatment was introduced to sustain vital functions of the trees and to improve their protective functions retaining radioactive elements. It has been proved that of all ecosystems the living forest is the most effective one when it comes to absorbing radioactive substances and preventing them from spreading. That is the reason why the foresters concentrated first of all on protecting the forest, including fire control, but also on the protection against insects and diseases as well as on the clearing of the land, sanitary cuts and rehabilitation of the affected forests.

Work started with clearing the sites of fires and collecting the remnants of trees and plants. Owing to the fact that they were gathered to form embankments, the potential fire risk was to some extent limited to specific places. As it turned out later, because of the large size of these embankments the rehabilitation of the forest was hindered. What is more, the dried up forest material turned to pose a danger of fire. That is why since 1999 the creation of the embankments has been abandoned. There was a forest planted on this area, consisting due to habitat conditions chiefly of pine trees. But at the same time as many deciduous species were introduced as possible, mainly birch. As was mentioned above, the desertification has caused difficulties in the process of afforestation. Favourable conditions to the rehabilitation of the forest arose where the remains of vegetation survived and the process of decay had already started. In those places even the natural rehabilitation was observed. Fire barriers were built on the sites of fires, which cover vast areas. At first the barrier was built of one strip of pines and two strips of deciduous trees, later its width was increased to 30m or in some especially dangerous spots even to 60m.

### **Finally less fires**

Dozens of kilometers of different fire-barriers were built altogether including renovation of old ones and mineralization of fire gaps under power lines. It was believed that the self-sowing birch would help reclaim the lands. As it turned out, moderately intensive self-sowing was observed only during the first years after the disaster. Later the growing thick layer of plant remains prevented the seeds from sprouting and, as it was estimated, the natural rehabilitation would be possible in 50 – 100 years after the fires, just as in the tropical forests where the fire often enables vegetation succession.

Until 1999 there had been a high fire risk and a total of 114 fires had broken out. From 2000 until 2005 the risk has decreased and the number of fires has fallen three and a half times to 33. Most of them were caused by human activity, as there are many people, who stay in the zone ignoring the ban. They hunt, fish, harvest fruits of the forest and even collect metals (the whole equipment used during the rescue action was left in the forest) or burn down grass. Undoubtedly, the decrease in the number of fires was influenced by introducing the fire control system in the Chernobyl zone. Its key elements include an own fire detecting system (27 fire lookouts and a helicopter), communication and alarm system as well as forest fire control bases with fire equipment located in such a way, that the places most exposed to fire are within easy reach. There are 265 people working shifts who are responsible for their security. Part of the equipment had been used under extreme conditions for over a decade and currently is not fit to be used any longer. But it cannot be withdrawn as there is not enough financial resources to replace it with new one.

### **Economic Use of Wood**

After the establishment of the company the forest clearing started. Apart from insufficient budget subsidies the earnings from selling wood are virtually main funding source of the *Chornobyllis* company. The logging has not been carried out only within the most contaminated ten-kilometer radius area surrounding the nuclear power plant. Before timber can be harvested the level of radioactive contamination is tested with dosimeter. Timber samples are collected from the area earmarked for the clearing and sent to be scientifically tested in the Radiological Centre in Chernobyl. The decision on which areas the forest can be cleared is based on the test results.

There are different levels of the contamination. That was the reason for establishing norms of permissible doses depending on the purpose of the material. The radiation level of, for example, the firewood cannot exceed 740 bequerels per kg and of mine wood 18,500 bequerels

per kg. The timber must be barked, although some scientists claim it is pointless, as the radioactive elements are transferred deep in and the contamination outside the trunk is the same as inside. Generally, less contaminated timber is exploited and used in economy, while more contaminated one, removed as deadwood or during sanitary cuts, is put in the ground to decay. For example in 2004 forests on the area of 462 ha were cut down and 9,000 cubic meters were obtained. It was sold for 1.16 million hryvnias (about 230,000 US dollars). The money was invested in 4.4 kilometer long firebreaks, mineralization of 12 km long fire gaps under power lines or maintenance of existing 3,155 km long fire-barriers. Since 1994 the forest has been revived on the area of 3,111 ha.

### **Employment**

The management of *Chornobylis* assess those actions, although effective, are insufficient compared to the needs. It results from limited financial capacity, which led to decrease in employment from 732 to 521 employees between 1999 and 2004. That is why 2,800 ha of the forest falls to one forester, while in Ukraine it is 500 ha. Despite difficult working conditions staffing fluctuation does not exceed 8.8 % and in 2005 it stopped on the level of 0.6%. The employees live up to 100 km away from Chernobyl and work 15-day shift with 15 days off. Every one of them is equipped with dosimeter and if the threshold dose is exceeded they have to leave the contaminated area. There are cases when people do not put on dosimeters for economic reasons, in order not to exceed the threshold dose and they work to earn more. Further employment reduction will inevitably narrow the scope of work, which will contribute to the deteriorating sanitary condition of forests and increasing fire risk.

### **On the Brink of Ruin**

The actions of the forestry have given notable effects so far. The sanitary condition of tree stands has improved, their stability and fire safety has been ensured. The food base has increased, which caused the rapid growth in the number of wild boars, deer and elks. There are also lynxes, beavers, minks, otters and badgers. A lot of birds appeared, such as eagle, black nightjar or crane. The number of introduced Przewalski's horses tripled.

In spite of all those encouraging results *Chornobylis* company has been on the brink of ruin for four years. As far as the preservation and revitalization of forests is concerned, the future does not look bright. The scientists claim the rehabilitation can last up to 100 – 150 years. The work of the company is impeded by lack of local research unit. It would provide support for pioneering economic actions, which cannot be based on any known and proven model. Due to

the significance of the problem as well as the cross-border influence of the radiation-contaminated area the international financial assistance should be provided to support local actions.

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### **Bibliography**

– V.O. Chepovsky, O.I. Shkorup, *Ogólna sytuacja w zakresie ochrony przeciwpożarowej lasów i torfowisk na Ukrainie. (General situation of the fire control of forests and peat bogs in Ukraine)* The report presented in 2006 in the Forest Research Institute in a seminar concerning fire control of forests as a part of task WP 1.3 *Monitoring of Forest Fire* of the project *Proforest*.

– Дронжкевич Ю. (Dronzhkevich Ju.), *Ліс нас рятує. Але йому треба допомагати (The forest saves us. But it needs help)*, „Visnik Chornobyla” no. 44 (1348), 29.10.2004, [www.mns.gov.ua/cgi](http://www.mns.gov.ua/cgi).

– Калетник М.М. (Kaletnik M.M.), manager of the *Chornobylis* state company of the Ministry of Emergencies of Ukraine, *Чорнобильські ліси не тільки не зникають, а й примножуються (Not only do not the forests of Chernobyl disappear, but they also grow)*, [www.mns.gov.ua/cgi](http://www.mns.gov.ua/cgi).

– Огородник М. (Ogorodnik M.), *Таємниці зеленого „острова” (The mysteries of the green “island”)*, „Visnik Chornobyla” no. 35 (1239), 12.09.2002, [www.mns.gov.ua/cgi](http://www.mns.gov.ua/cgi).

– Рой Ю., Кримчак В. (J. Roy, V. Krymchak), *Кореневим для самоназви лісової зони України – „полісся” є слово „ліс” (Word “lis” <Ukrainian: “forest”> is a root of the name of the “Polesie” forest zone in Ukraine)*, „Nadzwychayna sytuacija” no. 4 (66), April 2003, [www.gms.gov.ua/cgi](http://www.gms.gov.ua/cgi).

### **Chernobyl disaster**

The disaster occurred on April 26, 1986. The failure of reactor number 4 at the Chernobyl nuclear power plant in Ukraine (which was part of the USSR at that time) caused emission of radioactive substances like iodine, caesium or strontium into the atmosphere. Area of about 100 thousand square kilometers was contaminated, 70% of which in Belarus. A plume of contaminated air reached Scandinavia and Central and South-Eastern Europe. About 130 thou-

sand residents of Chernobyl area were evacuated. However, the contaminated zones are still inhabited.

It was one of the worst accidents in the history of world nuclear power, but it has not been clear how many human lives it took. According to WHO even 9 thousand people could have died of cancer caused by the radioactive contamination, International Atomic Energy Agency says about 4 thousand people. Reports of other organizations, like United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR) consider those data to be overstated and claim the results of the disaster were considerably less serious in fact.

(editor-compiled)

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Undoubtly, the decrease in the number of fires was influenced by introducing the fire control system in the Chernobyl zone. Its key elements include an own fire detecting system (27 fire lookouts and a helicopter), communication and alarm system as well as forest fire control bases with fire equipment located in such a way, that the places most exposed to fire are within easy reach. There are 265 people working shifts who are responsible for their security.