THE ACCIDENT ON 26 APRIL 1986.

During the night of 25 and 26 April 1986, the fourth reactor of the nuclear power plant at Chernobyl in the Ukraine exploded. The disaster, caused by the introduction of an excessive amount of radioactive material, provoked the dispersion of nuclear fuel in unit no. 4 of the plant with a consequent explosion of steam. In a few seconds, the energy output of the core of the reactor, a 1000-MW RBMK type installation, rose to 100 times the normal maximum level. There was a huge increase in reactor temperature. The 2,000 tonnes of metal cladding sealing the top of the reactor was torn apart by two explosions that scattered hundreds of tonnes of graphite in the reactor into the atmosphere. The fire and leakage of radioactive material continued over the next 10 days.
Two people died in the explosion but immediately afterwards a further 187 presented acute symptoms of irradiation. Thirty-one of these individuals would die in the days that followed. Many of the victims were the first relief workers, the firemen who attempted to bring the fire under control.
Quantitative estimates of the explosion at Chernobyl indicated that about 3.5% of the total radioactivity escaped beyond the walls of the nuclear power plant.
But according to more recent data, that figure reflects only the amount of "heavy" radionuclides released into the atmosphere (uranium, transuranium, caesium).
The leakage of volatile isotopes such as iodine 131 and caesium 134-137 reached a level of 50-60% whereas the release of noble gases such as xenon and krypton was 100%.
The total amount of isotopes released has been estimated as being equivalent to radioactivity of 11 Ebq (one billion billion Bequerels).
Fallout of radioactive material leaked by the reactor that exploded at first involved the regions lying closest to the power plant, causing significant contamination in territories belonging to the Ukraine, Belarus and Russia, and the irradiation of residents in the immediate area of the power plant (120,000 people). On 27 and 28 April, radioactive air masses arrived in Scandinavia.
On 28-29 April, the radioactive cloud was split into two by a cold air current heading from west to east. One part of the cloud moved off to the north-east and the other headed towards Poland and Germany.
On 30 April to 1 May, the radioactive cloud arrived in northern Greece and Italy, Switzerland, western Austria and Czechoslovakia, where a significant increase in the level of radioactivity was recorded. In the following days, the cloud spread towards the north-west and south-east of Europe.
Simultaneously, a rise in the level of background radioactivity was recorded in Great Britain, Belgium, Ireland and the south-western regions of France.
In south-eastern Europe, the impact of the explosion at Chernobyl was felt mainly between the 3 and 5 May. Peak fallout values were recorded during that period in Greece, Yugoslavia, Italy, Turkey and Albania.
From 6 to 8 May, the fallout moved a considerable distance from the site of the accident. Increases in levels of background radioactivity were recorded in China, Japan, India, Canada and the USA.
Despite the fact that radioactive fallout affected regions that are geographically very distant from Chernobyl, 70% of the radioactivity released after the explosion of the reactor fell on Belarus.
Intervention initiatives undertaken to bring under control the disaster caused by the accident and evacuate the high-risk population - which involved about 800,000 people including the personnel of the power plant and numerous teams of relief workers - were significantly delayed both because of organizational difficulties and by the cynical decision of the Soviet government to censure the news, even in the areas most at risk.
In the days that followed the accident, very little official information was issued except for communiqués designed to minimize the gravity of what had happened.
Intervention units generally comprised an engineer in charge of a group of 10 engineers, each of whom co-ordinated 100 workers. Data on the fate of these individuals, the so-called "liquidators", is conflicting. According to the Chernobyl Committee of the Republic of Belarus, 10,000 liquidators died and 400,000 are suffering from a wide range of diseases. It emerged from the EC/CIS international conference held at Minsk in 1996 that 43 are thought to have died and 134 are believed to be suffering from irradiation-related diseases.
The engineer who explained to Legambiente how the intervention groups were organized, who had himself led one of these thousand-worker teams, was its only survivor.
Research carried out by Ukrainian and Israeli scientists has highlighted that one third of the liquidators, mainly young people, were affected by diseases of the reproductive system. Another clinical study carried out by a Ukrainian research group co-ordinated by S. Komisarenko detected a widespread tendency among these subjects, who were directly involved in the early stages of relief work, to fall ill with a range of diseases all related to deficiencies of an immune system no longer able to protect the body against external agents.
At the IAEA meeting in Vienna in August 1986 a few months after the explosion, Soviet officials showed an unusual eagerness to supply data on the accident - this was during Gorbachev's glasnost period - but the relatively plentiful data on what had happened and on the amount of radioactive leakage detected in the area were still a long way from the true figures on the disaster.
The alarm was raised about the radiological consequences and reinforced by the immense organizational effort of the Soviet authorities, rich in episodes of individual heroism on the part of those who took part in the early hours of intervention. Human error was the reason cited for the accident.
The human error hypothesis, strongly supported by the Soviet government in order to safeguard its technological prestige, was well received and generally taken up by the West, which had itself suffered or guessed at the occurrence of other less serious but potentially equally devastating nuclear events. The West, too, therefore had a strong interest in demonstrating the "intrinsic" safety of nuclear technology.
Most of public opinion found the hypothesis convincing and consistent with the image of demotivated, incompetent Eastern Bloc personnel.
A lot of years later, it is obvious from a number of studies that we should at least talk about the co-responsibility of the plant's managers and designers. A.R Sich of the MIT has published the results of a study of the management of the Chernobyl disaster, emphasizing the consequences both of the errors of the plant's technical staff and the total lack of preparation of personnel to intervene in case of nuclear events of this type.
This has always been the defence of the power plant's directors, who were subsequently removed by the authorities and imprisoned as scapegoats, in their battle to show there was a complete absence of the basic notions necessary to face emergency situations.

Even today, the western technical and scientific communities, as well as numerous experts in the East, believe that many of the secrets regarding what happened during the accident and its consequences have not been made public. That is why it is so difficult to establish the precise relationships between causes and effects.
The nuclear reactor in the fourth block of the Chernobyl power plant belonged to the RBMK-1000 type. It was an adapted version of a military reactor and was therefore originally intended to produce weapons-grade fissionable material. It had no reinforced protective structures to control the effects of a nuclear accident.
The reactor was almost totally destroyed by the explosion on 26 April 1986.
The 2,700-tonne roof (Helena), which comprised the reactor's protective structure and linked its various component parts, collapsed in on itself.
It remained, together with the rest of the reinforced concrete structure, dangling in an almost upright position. As a result, the base of the reactor sank to a level 4 metres lower than its original position.
All this led to the destruction of the reactor's support structure. The section underneath collapsed and the roof of the control room caved in.
The area of the reactor that was destroyed was the zone where irradiation levels were highest. It was immediately rendered inaccessible by extremely high temperatures and the enormous amount of radiation that was released, for the airtight insulation system had ceased to function.
An incandescent magma of ferrous material, reinforced concrete, nuclear fuel and gas erupted into the atmosphere to be deposited all over the power plant buildings and the surrounding area.
During the first weeks after the accident, irradiation levels in the zone around the reactor remained of the order of thousands of Roengten (100,000 Roengten/h). In the power plant's area of extension, it reached tens of thousands of Cu/km2 and the wall of radioactive materials, which rose up to a height of almost 2 km, was scattered over a radius of 1,200 km.
The most urgent problem was to insulate the damaged reactor and stop the leakage of radioactivity, to safeguard the environment and population of the surrounding areas.
As many as 18 protection plans were drawn up and the final choice was the "Sarcophagus" design, a sort of pyramid to be placed over the ruins of the reactor.
Parts of the destroyed reactor were incorporated in the first layer of the sarcophagus, which meant that the risk of contamination actually rose.
In the construction of subsequent layers and the two perimeter walls, a total of 300,000 tonnes of cement and over 100,000 tonnes of metal structures were used.
This gigantic containment structure caused a tenfold increase in the weight supported by the foundations, which rose from 20 t/m2 to 200. As a result, the ground level, which is clay-bearing soil, began to sink progressively. It is now 4 metres lower.
The gradual subsidence has caused damage to many parts of the sarcophagus, whose surface in January 1996 had about 1,000 m2 of cracks and holes from which radioactive dust, water and gas continue to emerge.
The most imminent danger at the present time is the collapse of the roof inside the sarcophagus. This would cause further subsidence and jeopardize the stability of the neighbouring reactor. More significantly, it would uncover 180 tonnes of nuclear fuel now reduced to a radioactive dust, 11,000 m^3 of water and 740,000 m^3 of highly contaminated rubble. Ukrainian scientists have estimated that the total radioactivity of the substances enclosed in the sarcophagus could exceed 20 million Curies.
Two reactors are still functioning at Chernobyl (the third was closed in 1992 after a fire) and 5,000 people are working there. One hundred staff monitor the sarcophagus. If it should collapse, they would be exposed to doses of radiation of the order of 800 R/h with peaks as high as 2,400.
The sarcophagus was designed to ensure the safety of the reactor for a period of 20-30 years but it is currently estimated that it will not even be able to do so until the year 2000.
In 1994 after an international competition, one of six designs was selected for the construction of a new sarcophagus screening structure that will have a useful life of at least 100 years.
The budgeted construction cost of the new protective structure comes to more than 300 million dollars and about 5 years' work will be required for its completion.
Data made public by scientists such as Prof. Belyavsky - a member of the International Academy of Sciences and Information Technology Systems in Ukraine - confirm that at the present time there is an enormous, incalculable danger looming over the areas directly involved and the whole of Europe.
In the case of another nuclear accident, which is far from unlikely given the poor condition of the reactors that are still being used, the consequences could be even more dramatic than they were 10 years ago.
The government of the Ukraine has admitted that it is unable to ensure the safety of the reactor because it lacks both the technical skills and the necessary funds to do so.
The sum of 4 billion dollars has been requested from the international community to repair the sarcophagus, treat the radioactive waste and decommission the reactors that are still functioning as well as for the retraining of power plant staff and the building of new power plants to ensure the same energy output.

The situation in the area.

The area comprises over 260,000 km2 distributed across the Ukraine, Belarus and Russia. Ten years after the accident, this region has levels of caesium 137 contamination in excess of 1 Curie per km2.
In the Ukraine, an area of more than 35,000 km2 has this level of radioactivity (more than 5% of the country's entire surface area). Most of this (26,000 km2) is agricultural land. The zone includes 13 regions and 1,300 towns or villages where more than 2.6 million people live.
The area falling within a radius of 30 km from the Chernobyl power plant has been almost entirely cleared and 60 centres of population with a total of 167,000 residents outside the 30-km zone have been evacuated.
Within the 30-km radius there are about 800 waste and rubble landfill sites. These were established at the height of the emergency and were not therefore provided with any safety or protection devices other than a layer of local clay.
The radioactive landfills may be the reason for the very high levels of contamination in the sediment of the river Dnepr and its tributary the Prypyat, which provide the water supply for 30 million people.
Belarus, where 70% of the radioactive fallout descended, is divided into 6 regions (Minsk, Gomel, Mogilev, Grodno, Brest and Vitebsk). Twenty-three per cent of its 236,000-km2 surface area has contamination levels of more than 1

Cu/km2. Of this total, 16,000 km2 has more than 5 Cu/km2; 6,400 km2 has more than 15 Cu/km2 and 2,200 km2 is in excess of 40 Cu/km2.
Out of a total population of more than 10 million, 24,700 persons from 107 localities in the districts of Bragin, Narovlia and Khoiniki in the Gomel region were evacuated after the accident and about one in five is still living in contaminated areas. In fact only the Vitebsk region has radioactivity-free zones.
Research into the level and nature of radioactivity in Belarus underlines that the danger of contamination is due not only to the quantity of isotopes released by fallout but also depends to a considerable extent upon the chemical structure, and thus the ability to penetrate topsoil, of the isotopes.
The chemical structure determines the mobility of the isotopes and their ability to disperse in the soil, watercourses at ground level and underground, plants and so through the entire biological chain.
Twenty per cent of the afforested land surface (1.3 million hectares) is contaminated; 257,000 hectares of agricultural land in the Gomel and Mogilev regions are no longer cultivable and a similar proportion of the area in a 30-km2 radius of the disaster zone is uninhabitable.
Agricultural output and livestock farming have suffered enormous losses and are still unable to meet domestic demand. Economic losses amount to more than 200 billion dollars (over 300 billion Italian lire).
Official data from government sources tend to play down the gravity of the current situation but they contain are obvious contradictions. It is therefore difficult to make a reliable estimate of the actual damage suffered by the environment and the population.
Similarly, all data concerning clean-up, control and general reconstruction activities would appear to be inflated.
Anything to do with the Chernobyl accident was held for years under maximum security and from the very few top-secret documents that have become available it is clear that official data have been spin-doctored in such a way as to present a worrying situation that is nonetheless under control.

Rilascio giornaliero di radionuclidi nell'atmosfera a seguito dell'incidente al reattore