

NUCLEAR MONITOR

A PUBLICATION OF WORLD INFORMATION SERVICE ON ENERGY (WISE)
AND THE NUCLEAR INFORMATION & RESOURCE SERVICE (NIRS)

wise
World Information Service on Energy
founded in 1978



MARCH 11, 2011 | No. 724

CHERNOBYL: CHRONOLOGY OF A DISASTER

MONITORED THIS ISSUE:

Чернобыль
25 лет
200 000 км² загрязненной территории
600 000 ликвидаторов
\$ 200 млрд. ущерба
350 000 человек эвакуированы
50 млн. кюри радиоактивности

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CHERNOBYL; CHRONOLOGY
OF A DISASTER 1

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Chernobyl - 200,000 sq km contaminated; 600,000 liquidators; \$200 billion in damage; 350,000 people evacuated; 50 mln Ci of radiation. Are you ready to pay this price for the development of nuclear power? (Poster by Ecodefence, 2011)

At 1.23 hr on April 26, 1986, the fourth reactor of the Chernobyl nuclear power plant exploded.

The disaster was a unique industrial accident due to the scale of its social, economic and environmental impacts and longevity. It is estimated that, in Ukraine, Belarus and Russia alone, around 9 million people were directly affected resulting from the fact that the long lived radioactivity released was more than 200 times that of the atomic bombs dropped on Hiroshima and Nagasaki.

Across the former Soviet Union the contamination resulted in evacuation of some 400,000 people. About 200,000 km² of land was, and is, contaminated by radioactive Caesium-137 above 37,000 Bq/m² (intervention level). In area terms, about 3,900,000 km² of Europe was contaminated by caesium-137 (above 4,000 Bq/m²) which is 40% of the surface area of Europe. Curiously, this latter figure does not appear to have been published and, certainly has never reached the public's consciousness in Europe.

This contamination will persist for centuries, and many countries as well as Belarus, Ukraine and Russia will need to continue with food restriction orders for decades to come. The economic consequences of the accident remain a massive burden on the countries most affected; Ukraine and Belarus continue to spend a large percentage of their Gross National Product on trying to deal with the consequences of the accident.

About the health consequences of the Chernobyl accident, much research has been conducted, many reports have been written and still many uncertainties exist. Although official accounts points to 4,000 expected cancer deaths from Chernobyl in Belarus, Ukraine and Russia, the real prediction in IAEA/WHO reports is more than 9,000. Many other studies are expecting a multiple of that number. A 2009 publication that looked to Russian and Ukraine language reports, left out of the official studies, calculate a number of casualties of up to 900,000. The full impact of the Chernobyl disaster may never be known.

power plants are designed to withstand natural disasters (hurricanes, floods, earthquakes, etc.) and to withstand aircraft crash and blasts from outside. The safety is increased by the possibility in Russia to select a site far away from bigger towns." (page 647: "Zur Betriebssicherheit sind die Kraftwerke (VVER and RBMK) mit drei parallel arbeitenden Sicherheitssysteme ausgeruestet. Die Kraftwerke sind gegen Naturkatastrophen (Orkane, Ueberschwemmungen, Erdbeben, etc) und gegen Flugzeugabsturz und Druckwellen von aussen ausgelegt. Die Sicherheit wird noch durch die in Russland moegliche Standortauswahl, KKW in gewisser Entfernung van groesseren Ortschaften zu erstellen, erhoehrt."

In the June 1983 issue of the IAEA-bulletin, Mr. B. Semenov, Deputy Director General, Head of IAEA Department of Nuclear Energy and Safety, sums up "many factors favoring the channel-type graphite-uranium boiling-water reactors" and concludes: "The design feature of having more than 1000 individual primary circuits increasing the safety of the reactor system – a serious loss-of-coolant accident is practically impossible." (page 51)

1972

In 1972 a discussion took place in Kiev about the type of nuclear plant to be built at Chernobyl. Chernobyl's director, Bryukhanov, supported construction of Pressurized Water Reactors (PWRs). He informed the Ukraine Minister of Energy, Aleksei Makukhin, that an RBMK (a boiling water reactor) releases forty times more radiation than a PWR. However, the scientist Alekzandrov opposed this, saying that the RBMK-1000 was not only the safest reactor, it produced the cheapest electricity as well. For this reason it was decided to build the RBMK pressure tube reactors.

1979

February-March: according to data in the possession of the KGB, design deviations and violations of construction and assembly technology are occurring at various places in the construction of the 2nd generating unit, and these could lead

The Chernobyl nuclear power plant:

	Type & Capacity	Start Construction	Criticality	Shut down
Block 1	RBMK-800	March 1970	September 1979	November 1996
Block 2	RBMK-1000	February 1973	December 1978	October 1991
Block 3	RBMK-1000	March 1976	December 1981	December 2000
Block 4	RBMK-1000	April 1979	December 1983	April 1986
Block 5	RBMK-1000	December 1981	-	-
Block 6	RBMK-1000	December 1983	-	-

RBMK's (also called Light-Water-Cooled, Graphite-Moderated Reactors, or LWGRs), use light water as a coolant and graphite as a moderator

1- PRELUDE

Chernobyl is safe.... Well, until April 26, 1986, that is...

Before the Chernobyl accident very little was known about the Chernobyl type reactor, the RBMK. One of the few publications before 1986, in the December 1983 issue of the German nuclear industry monthly atomwirtschaft was written by H. Born from one of the main German utilities VEW. He writes: "For operational safety, the nuclear power plants (VVER and RBMK) are equipped with three parallel safety systems. The

to mishaps and accidents. Similar report on Unit 1 (both units are in operation, at the time).

1983

December: The construction of Unit 4 at Chernobyl was completed by December 1983. On 21 December a press report was released which stated that the previous day the nuclear power plant had become operational. This news was reported by the media on 22 December, a festive day for workers in the energy industry. In the Soviet Union it was customary for all

sections of public employment to have their own special day, when they receive public acclaim for their work and are given extra bonuses.

That the production of electricity started on 20 December is quite remarkable, because usually there is a time lapse of about six months between the completion of the construction and the plant becoming operational. On this subject Zhores Medvedev noted that it was common practice in the Soviet Union for people to declare an industrial project to be ready for operation on the understanding that any problems will be solved as quickly as possible. In this way, the production plan already set can still be met. Besides which, not signing the declaration on 31 December 1983 would have resulted in thousands of employees missing their chances of bonuses and other extras. This concerns bonuses of up to three months salary extra. Later it became apparent that in the period up to 1985 the turbine had been tested, but without results. The question is still why the test was not repeated again immediately, but had to be left until April 1986.

Chernobyl-4 Goes Critical

On December 14, 1983, *Pravda* reported that the fourth unit of the Chernobyl nuclear power plant in the Ukraine had "just achieved criticality". All four Chernobyl units have a capacity of 1000 MW each. Thus the Chernobyl nuclear power plant has become the second (after the Leningrad NPP) in the USSR to reach a 4000-MW capacity.

Chernobyl-4 is the third Soviet nuclear power unit to go into operation during 1983 – news of more might well be announced by year-end after we have gone to press.

Since the start-up of Chernobyl-1 in 1977, the station has produced 80 billion kWh of electricity. Chernobyl-2 started-up in 1979 and unit No. 3 in 1981. P. F.

Nuclear Europe, January 1984

1984

In April 2003, secret KGB documents released in Ukraine show that there were problems with the Chernobyl nuclear plant. One 1984 document notes deficiencies in the third and fourth block, and also of poor quality of some equipment sent from Yugoslav companies.

1985

April: The Minister of Energy, Anatoly Mayorets, decreed that information on any adverse effects caused by the functioning of the energy industry on employees, inhabitants and environ-

ment, were not suitable for publication by newspapers, radio or television. On 18 July 1986, shortly after the Chernobyl accident, this same minister forbade his civil servants from telling the truth about Chernobyl to the media.

1986

February: Vitali Sklyarov, Minister of Power and Electrification of Ukraine, in reference to the nuclear reactors in Ukraine, is quoted in *Soviet Life* magazine (page 8) as saying: "The odds of a meltdown are one in 10,000 years."

27 March: *Literaturna Ukraina* (Ukrainian Literature) publishes an article written by Ms Lyubov Kovalevska (believed to be a senior manager at Chernobyl NPP) in which she writes that substandard construction, workmanship and concrete, along with thefts and bureaucratic incompetence are creating a time bomb "The failures here will be repaid, repaid over the decades to come."

It remains uncertain whether the information on the course of the accident is completely reliable. In 1987, five possible courses of events leading up to the accident were put forward. However, the following account is the one generally accepted.

25 April (Friday)

13.05 hours (local time): Preparations for the turbine test

The turbine test

One of the tests incompletely carried out before the reactor becoming operational was on the functioning of the turbine in the case of a defect.

That the production of electricity of the fourth Chernobyl reactor started on 20 December 1983 was, as said, quite remarkable, because usually there is a time lapse of about six months between the completion of the construction and the plant becoming operational.

All the components have to be tested before the actual production process is started. But, in Unit 4 at Chernobyl there was a celebration in March 1984 (only three months after the reactor was operational) to mark the fact that already one million kilowatt hours had been produced, even though at that time not all the components had been thoroughly tested.

One of the tests incompletely carried out before the reactor becoming operational was on the functioning of the turbine in the case of a defect.

If a defect is present, the turbine should then slow down, but continue to produce electricity. This electricity is necessary to work the circulation pump and control rods, and to provide lighting for the control room and control panel. This supply of electricity is essential for the safety of the reactor, and on no account should it fail.

Because it takes twenty seconds for the control rods to reach their most extreme position in the case of a defect, it is of vital importance to know whether the turbine can produce the necessary electricity for those twenty seconds, until the emergency generator is able to take over the supply of electricity. This test was carried out on the night of 25 - 26 April 1986, and was the cause of the disaster.

This test should have been carried out before the power plant was put into operation. In actual fact, such a test was carried out earlier - but failed. This became apparent in July and August 1987 during the trial of six people held to be responsible for Chernobyl. The judges' verdict states that on 31 December 1983, director Bryukhanov signed a document declaring that all the tests had been carried out successfully.

begin. For this test, the plant's capacity must be reduced and for this reason one turbine is turned off.

14.00 hours: The controller of the Ukraine electricity network requests that the test be delayed. All electricity from Unit 4 is necessary. It is not clear why it was not predictable before-

Times-zones

Local times: At the time of the 1986 accident, Ukraine was one of the Republics of the USSR (Union of Socialist Soviet Republics) and had Moscow-time (GMT+3). Although Ukraine changed its time to GMT+2 after it declared independence from Moscow in August 1991, times mentioned in the Chronology are historical local times (GMT+3).

Times mentioned concerning Sweden's Forsmark, are also GMT+3. Time difference (in 1986) between Chernobyl and Sweden was 2 hours.

hand that work would have to continue all through Friday afternoon in order to achieve the production planned for April.

16.00 hours: The day shift leaves. The members of this shift have been given information about the test during the previous days, and know about the entire procedure. A special team of electronic engineers is present.

23.10 hours: Preparations for the test start again. The ten hour delay has a large number of consequences. Firstly, the team of engineers is tired. Secondly, during the test, the evening shift is replaced by the night shift. This shift has fewer experienced operators, besides which they were not prepared for the test. Achier Razachkov, - Yuri Tregub and A. Uskov are the operators who were responsible for carrying out the test earlier in the day: later in interviews they declared that test procedures were only explained to the day and evening shifts. Yuri Tregub decides to stay and help the night shift.

26 April (Saturday)

01.00 hours: During preparations for the test, the operators have difficulty keeping the capacity of the nuclear plant stable. While doing this they make six important mistakes.

1. The control rods which can stop the reactor are raised higher than regulations permit. Operator Uskov of the day shift said later that he would have done the same. He said: "We often don't see the need to follow the instructions to the letter, because rules are often infringed all around us." As well as this, he pointed to the fact that during training it was repeated over and over again that "a nuclear power plant cannot explode". Operator Kazachkov said: "We have often had fewer control rods than were required, and nothing ever happened. No explosion, everything just went on as normal."

2. The plant's capacity decreases to below the safe level. Because of this the core becomes unstable. Preparations for the test should have been stopped by now. It should have been obvious that all attention should be given to measures for regaining the plant's stability.

3. In order to raise the capacity, an extra circulation pump is turned on. Because of the strong cooling down, the pressure falls, thus reducing the reactor's capacity rather than increasing it. Normally at this stage the scram system should start working, but in order to still be able to carry out the test, this system is turned off.

4. The automatic emergency shut-down system is turned off in order to prevent the reactor stopping itself.

5. The systems to prevent the water level decreasing too much and the temperature of the fuel elements becoming too high are also turned off.

6. Finally, the emergency cooling system is turned off to pre-

vent it working during the test.

1.23.04 hours: The real test now begins. The power plant's capacity suddenly increases unexpectedly.

1.23.40 hours: Leonid Toptunov, responsible for the control rods, presses a special button for an emergency shutdown. The test has been going on for 36 seconds.

1.23.44 hours: The control rods start to descend, but shocks can be felt. The operators see that the control rods have become stuck. The fuel tubes have become deformed because of the large increase in the steam pressure.

1.24.00 hours: The test has now been going on for 56 seconds. Pressure in the reactor is now so high that the fuel elements burst and small particles land in the cooling water. The cooling water turns into steam and pressure in the tubes increases: they burst.

The 1000 ton lid above the fuel elements is lifted: the first explosion. The release of radiation starts. Air gets into the reactor. There is enough oxygen to start a graphite fire. The metal of the fuel tubes reacts to the water. This is a chemical reaction which produces hydrogen, and this hydrogen explodes: the second explosion. Burning debris flies into the air and lands on the roof of Chernobyl Unit 3. (There was barely any attention paid to this hydrogen explosion in the Soviet report about the accident. In studies commissioned by the US government, however, it was concluded that the second explosion was of great significance, and that the original explanation of the accident was incorrect. Richard Wilson of the Harvard University in the US said this second explosion was a small nuclear explosion.)

The head of the night shift, Alexander Akinhov, and the engineer responsible for industrial management, Anatoly Diatlov, do not believe that an accident has taken place. When somebody claims the core has exploded, they send out operators to examine the core. These people are killed by radiation. On hearing the report that the reactor has been destroyed Akimov cries out, "The reactor is OK, we have no problems."

Akimov and Diatlov, assisted by manager Bryukhanov and engineer N.Fomin, keep ordering the operators to add more cooling water. They remain convinced that there is nothing wrong. Akimov and Toptunov, who was responsible for the control rods, both died of radiation illness. Diatlov and Fomin were both sentenced to ten years imprisonment for infringement of the safety regulations. However, at the end of 1990 they were both released.

2- THE ACCIDENT AND IMMEDIATE CONSEQUENCES

Unit 4 of the Nuclear power plant at Chernobyl explodes. Debris flies into the air and lands on the roof of Unit 3 which is right next to the exploded Unit 4. The units share a communal machine turbine hall with a roof of bitumen, a flammable material. Thirty fires develop. The fact that the accident happens at night has one great advantage: in the daytime, 2000 people are working on the construction of Chernobyl Units 5 and 6. These people are now at home.

01.25 hours: The fire alarm rings at the local fire station. Meanwhile more people are killed: The nuclear plant's fire fighters arrive with three fire engines. The leader, Lieutenant Pravik, quickly realizes that his team is too small and asks the fire brigades from Pripjat, the town of Chernobyl and the entire area of Kiev for their assistance. Pravik and his team climb onto the roof of the machine hall and start their attempts to extinguish the fire. The fire brigade, from Pripjat arrives minutes later and fights the fires in the reactor building. Pravik and several

firemen from Pripjat die later of radiation illness.

01.45 hours: New teams of fire fighters from the area arrive. They know nothing about the danger of radiation, have no protective clothing or dosimeters. One of the fire engine drivers, Grigory Khmel later said: "We arrived at ten minutes to two in the morning. We saw graphite lying everywhere. I kicked a bit of it. Another fireman picked up a piece and said 'hot'. Neither of us had any idea of radiation. My colleagues Kolya, Pravik and others all went up the ladder to the roof of the reactor. I never saw them again."

02.15 hours: The Pripjat department of the Ministry of Home Affairs calls a crisis meeting. It is decided to organize a road block in order to prevent cars from entering or leaving the town. Police assistance is requested. Thousands of police arrive; and, as with the fire fighters, they have no knowledge of radiation, no dosimeters or protective clothing. Later, in 1988, it is admitted that a total of 16,500 police were deployed.

At that moment (1988) of those, 57 people had developed chronic radiation illness, 1500 of them suffered from chronic respiratory problems and 4000 suffered from other symptoms.

03.12 hours: An alarm signal goes off at the army headquarters in the central area of the Soviet Union at 03.12 hours. General Pikalov decides to send in troops to help. They arrive in Kiev at 14.00 hours. These are the first people to arrive well prepared for their task. About the same time, the responsible authorities such as the Energy Minister, A. Mayorets, hear that an accident has occurred, but are led to believe it is a small defect.

05.00 hours: In spite of the fires, Chernobyl Unit 3 is not closed down until five o'clock am.

06.35 hours: No fewer than 37 fire brigades, with a total of 186 fire fighters, have been called in to extinguish all the fires; the fire in the reactor could not actually be extinguished. The importance of the deployment of these fire fighters cannot be emphasized enough. The roof of Unit 3 caught fire immediately, which meant that this reactor could have been seriously

damaged as well. The nuclear plants' machine hell is also connected to Units 1 and 2. An explosion in the machine hall could have led to the destruction of all four Chernobyl reactors. An explosion was only averted by spraying nitrogen at the last minute. Four of the eight people who did this died shortly afterwards.

20.00 hours: A government committee is established, led by Valery Legasov; at eight o'clock in the evening the committee arrives in the area. They are surprised by the bits of graphite they see lying around. None of them suspect a graphite fire.

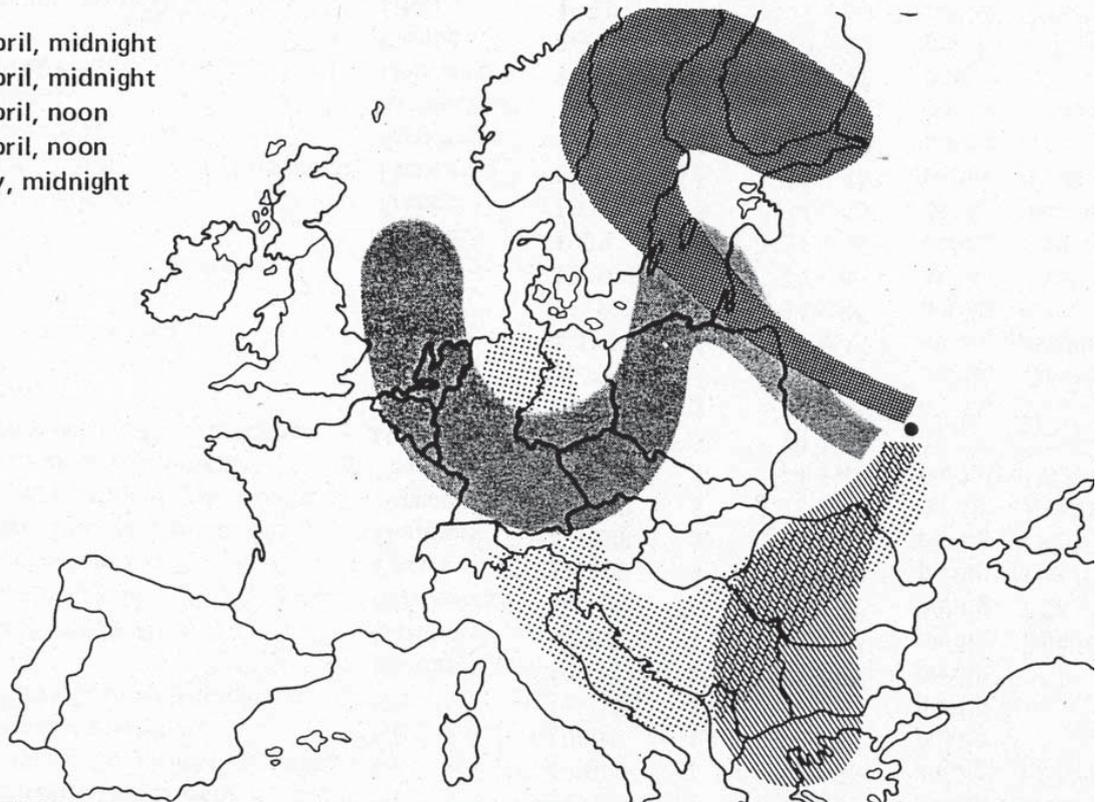
26 April to 4 May 1986: Most of the radiation is released in the first ten days. At first, southerly and southeasterly winds predominate. The first radioactive cloud went high into the atmosphere and winds blew it northwest away from Ukraine toward Sweden. It was Kiev's good fortune that the wind carried the radioactive cloud away at first rather than directly to the Ukrainian capital and its 3 million population as it did several days later. At the end of April the wind switches to the north and northwest. There are frequent but local showers. This results in a very varied regional and local distribution of the radiation.

27 April (Sunday)

A radius of 10 km around the plant (cities of Pripjat and Yanov) evacuated ("for three days" they are told) (50.000 people) to the town of Poliske (50 km west – coincidentally -?- wind is blowing in that direction too). Dosimeters are confiscated.

01.13 hours: The operation of Units 1 and 2 had already been stopped at 01.13 and 02.13 hours, twenty-four hours after the start of the accident at Block 4

07.00 hours: General Pikalov sets out in a truck fitted out with radiation apparatus. He rams through the closed gates and stops at the plant to measure the radiation. He establishes that the graphite in the reactor is burning, and that an enormous amount of radiation and heat is being given off. Shortly



The varying direction of the winds about Chernobyl between 26 April and 1 May 1986.

afterwards - the government in Moscow is warned. The government committee discusses the necessity of evacuation of the nearby town of Pripjat. Everyone supports evacuation except Professor A.L.Ilyin, chairman of the Soviet Council for Radiation Protection. He thinks the radiation situation will improve. By now, as it is understood that graphite is burning and that radiation is being released, further steps are taken. Firstly, extinguishing water is added. This is a dangerous mistake. Due to the high temperature, the water separates into hydrogen and oxygen, and this mixture of gas can explode; an explosion like this releases heat. Thus, the fire is not extinguished, but fanned by the water. After three fruitless attempts to extinguish the fire, the authorities decide to throw sand, lead and boron carbide onto the reactor from helicopters. Boron carbide can absorb neutrons and stop the uranium fission. Lead absorbs heat, enabling the temperature to drop. Sand is to extinguish the fires. Between 27 April and 1 May, about 1800 helicopter flights deposit around 5000 tons of extinguishing materials such as sand and lead onto the burning reactor.

28 April (Monday)

Forsmark NPP Sweden (times are Chernobyl-times)

09:00 hours: An alarm was sent from Reactor 1, where a routine check revealed that the soles of the shoes worn by a radiological safety engineer were radioactive.

Lars Wahlström, radiology supervisor at Forsmark, has given this summary of the events:

"Something indicated that radioactivity had leaked out from one of the blocks at Forsmark. Rumors about the activity circulated between noon and 14 hours and people said 'Now let's leave here.' At the same time news arrived that radioactivity had been detected in Finland. I said, I want evidence. Among other things I called Studsviks Energiteknik AB, where management was sitting in a crisis meeting and where they said 'We think it's coming from one of our laboratories.' But that wasn't so. Soon I also began to have doubts that there was anything wrong in any of the Forsmark reactors, which I told the National Institute of Radiation Protection. We had even been inside the chimney and checked. Then the Institute said the fallout had come from somewhere in the east, and by around 15.30 it was determined that the fallout definitely did not come from Forsmark."

20:00 hours: Radio Moscow broadcasts a Tass' statement that there has been an accident at the Chernobyl nuclear power station and that there have been casualties. "Measures are being taken to eliminate consequences of the accident. Aid is being given to those affected. A government commission has been set up" according to Tass. From about 30 minutes later west-European news agencies are reporting an "incident in a Ukrainian nuclear reactor"

23:00 hours: A Danish nuclear research laboratory announces that an MCA (maximum credible accident) has occurred in the Chernobyl nuclear reactor. They mention a complete meltdown of one of the reactors and that all radioactivity has been released.

29 April (Tuesday)

- The sixth item on the main television evening news program, Vremya, says that 2 people died during the accident, a portion of the reactor building was destroyed, and residents of Pripjat and three nearby towns were evacuated.

- The first real information in the western world came on Tuesday morning, when a powerful American reconnaissance satellite provided Washington analysts with photos of Chernobyl. They were shocked to see the roof blown off above the reactor and the glowing mass still smoking. The first Soviet

photos of the Chernobyl accident were censored by removal of the smoke before being printed in the newspapers.

- The first official statement by German authorities: Minister of the Interior Zimmermann states there is no danger for the German public: "danger only exists in a radius of 30-50 km of the reactor".

- Polish authorities decide to distribute iodine tablets in the north-east of the country to infants and children to protect them from thyroid cancer.

30 April (Wednesday)

- Tass carries a government statement denying western reports on mass casualties. The statement repeats the earlier assertion that only two people died during the accident and that 197 have been hospitalized and levels of radiation are decreasing

- Press reports on fire in second unit: scientist see second fire on satellite images, claims are later denied

17.00 hours: The reactor fire seems to be extinguished.

May - December 1986

1 May: The accident did not interfere with the May Day parades held on the 1st of May in the Ukrainian capital Kiev and the Belarusian capital Minsk. Apparently the government wanted to emphasize that all was "normal" although the reactor was still burning and invisible, deadly radioactivity was pouring into the air. However, the Soviet Communists bureaucrats and the nomenclature immediately after the accident removed their children from Kiev and other threatened areas while assuring others that everything was normal until several days later

- The authorities claim the situation is stable. But the amount of radiation released is still enormous, besides which, the wind has changed direction and is now blowing in the direction of Kiev. The material thrown onto the plant does not completely extinguish the fire and in fact generates a rise in temperature. Scientists and engineers become aware of a new danger. The hot reactor core could melt into the cement and end up in the water reservoir underneath. A steam explosion would follow, even more powerful than the first explosion.

2 May: More and more radioactivity is released into the area. Fire fighters start pumping the water out of the storage reservoir underneath the reactor, a long and dangerous task, not completed until 8 May. As a reward, the fire fighters receive 1000 rubles each (approximately 2000 US dollars according to the official rate of exchange).

- Politburo members Ryzhkov and Ligachev visit Chernobyl. Ukrainian party leader Volodymyr Shcherbitsky visits the area also. Shcherbitsky survived the Chernobyl crisis and was not criticized in the Western press as was Gorbachov for his long 18 day delay in speaking publicly about Chernobyl

- A 30 kilometer zone around the reactor is designated for evacuation (90.000 people).

- According to the Russian permanent representative at the IAEA, chain-reaction inside the reactor has stopped

4 May: The first film footage, shot from a helicopter, is shown on Vremya. The commentator says the film disproves Western reports of massive destruction

- A second step taken to prevent a steam explosion is that of making holes in the earth under the reactor. Fluid nitrogen is pumped into them to freeze the earth.

- Radioactive cloud reaches Japan (8-9,000 km from Chernobyl)

5 May: A government report says an embankment is being constructed on the Pripjat River to prevent it from being contaminated

- To start with, there is a great deal of radioactivity released, nearly as much as on 26 April. However, the release later

stops almost entirely. No acceptable explanation has yet been found for this fact. According to Grigory Medvedev, who was a member of the government committee, the fire was extinguished because the graphite had burnt up.

- Canada: health officials found that Ottawa rains carried six times as much radioactive iodine as is considered acceptable for drinking-water

- Increased radiation levels are measured in the USA, too
- Hans Blix, director-general, and a IAEA delegation arrives in Moscow. Unsure if they can visit the area

6 May: The first extensive report on the situation appears in Pravda.

- schools in Gomel and Kiev closed, all children are sent elsewhere. This brings total number of people forced to leave: 500.000. 140.000 of which are not allowed to return

- Kiev radio finally, eleven days late, warned its audience not to eat leafy vegetables and to stay indoors as much as possible. The Soviet government was very slow to warn its citizens of the precautions they should take: keep children and pregnant women indoors, avoid fresh vegetables and milk, don't drink rainwater, and wash your clothes and your shoes every time you come in.

7 May: Tass reports that many Kiev residents are trying to leave the city and that additional trains and flights have been scheduled. The (Russian) media drops its insistence that everything is under control.

- Bavarian Environmental minister Alfred Dick criticizes maximum radiation levels for vegetables and meat of the (German) Radiation Protection Agency. He says: "If we now start to have maximum levels for Cesium too, we will not even be able to eat meat shortly!"

8 May: In an interview with Izvestiya, Academician Yevgeny Velikhov, vice-president of the Soviet Academy of Sciences and chief scientist sent to Chernobyl, says the disaster is "without precedent".

9 May: IAEA states that Moscow started to encapsulate the reactor, especially pouring concrete under the reactor, preventing it from reaching groundwater

10 May: According to the IAEA the fire is extinguished, but temperature in reactor is still rather high. Meanwhile Ukrainian government official states: reactor is still burning and fire-fighters are continuously trying to put the fire out.

11 May: three local officials in charge of the transport combine at the plant, are expelled from the party, or reprimanded for mistakes concerning evacuations

14 May: Gorbachov speaks for the first time publicly about the accident on Vremya. He insisted there was no cover-up: "The moment we received reliable data we gave it to the Soviet people and sent it abroad". He declared his desire for "serious cooperation" with the IAEA, with respect to four specific proposals:

1. The creation of an international regime for safe development of nuclear energy involving close cooperation among all nuclear energy-using states;
2. A highly authoritative special international conference in Vienna under the aegis of the IAEA to discuss these "complex questions";
3. An increased role and scope for IAEA;
4. Safe development of "peaceful nuclear activities," involving the United Nations and its specialized departments, such as the World Health Organization (WHO) and the United Nations Environmental Program (UNEP)

These proposals suggested that Gorbachov was broadening the scope of the accident to one of international concern, but at the same time he was implying that such accidents were common enough to warrant the establishment of a global regime to deal with them.

15 to 16 May: New fires break out and more radiation is released.

22 May: Russian First Deputy Health Minister denies popular believe that vodka (& red wine) is a good cure for radiation exposure.

23 May: A Soviet government committee orders the distribu-

Mikhail Gorbachov

Mikhail Gorbachov had been in office only 13 months when Chernobyl occurred. He had arrived to a warm response from Western political leaders. Much younger and more active than his predecessors, he appeared to herald a time of change in the USSR. In 1986, however, he inherited an ossified Soviet state that was Leonid Brezhnev's legacy. Gorbachov's reaction to Chernobyl was very cautious but, in addition to the defensive posture adopted by his government initially, he also indicated a willingness to cooperate with the IAEA. It should be noted that in 1985 the USSR had agreed to IAEA inspections of some of its nuclear reactors, and thus this policy was not necessarily a new departure. Similarly, aid offered from long-established "friends of the USSR" abroad was also accepted, while that of individual governments was turned down.

tion of iodine preparations. At this point, such prophylaxis is of no medical value. Radioactive iodine is only active for ten days, and will already have accumulated in the thyroid glands of the inhabitants of the contaminated territories.

27 May: A month after the accident the danger is not yet over. A concrete foundation will be made, the idea of the sarcophagus is born

30 May: An unprecedented concert took place in Moscow's Olympic Stadium. The pop concert was organized by leading Soviet rock bands to raise funds for the Chernobyl victims

April-October

Soviet authorities try to hush up the scale of the tragedy, admitting reluctantly that about 30 people had died in the first few weeks after the blast. Hundreds of thousands of people (many military reservists) from all over the Soviet Union, now popularly known as "liquidators," are mobilized by the Communist Party to clean up the disaster.

The 'Liquidators' are those people who were recruited or forced to assist in the cleanup or the "liquidation" of the consequences of the accident. As a totalitarian government the Soviet Union forced many young soldiers to assist in the cleanup of the Chernobyl accident, apparently without sufficient protective clothing and insufficient explanation of the dangers involved. Over 650,000 liquidators helped in the cleanup in the first year. The total number is estimated to be over 1 million. Many of those who worked as liquidators became ill and according to some estimates about 8,000 to 10,000 have died in the first few years after the accident from the radioactive dose they received. Many more of these young healthy men died in the following years.

9 June: 'By accident' a foundation of lead was established under the reactor. Tons of lead thrown on the burning reactor, melted and leaked under the reactor. When the temperature decreased it solidified.

15 June: Almost the complete management team of the reactor has been dismissed for 'irresponsibility and lack of control', Pravda announces. Amongst them Chernobyl Director Victor Bryukanov and deputies (senior engineer) Nikolai Fomin who

will be brought on trial a year later.

20 July: Report (which will be published in full later) of the Government commission of inquiry found that human error caused the disaster.

20 August: The full report on the cause of the accident was submitted (in Russian) to the IAEA. It states there was an extraordinary sequence of carelessness, mismanagement and violations of safety codes leading to the accident.

26 August: Estonian press tell of strikes and demonstrations by Estonian military reservists forcibly conscripted Chernobyl for clean-up labor. In November reports claim 12 people were executed.

20 September: The Soviet Union paid already US\$3 billion, mainly for relocation, compensation and loss of power.

29 September: Block 1 of the Chernobyl NPP restarts again, and connects to the grid on Oct. 1.

10 October: Construction-work on Block 5 & 6 is resumed.

9 November: Block 2 restarts.

14 December: A concrete roof ("sarcophagus") is completed over the fourth reactor. It is built to protect the environment from radiation for at least 30 years. 300,000 tons of concrete and 6,000 tons of metal constructions were utilized.

1987

March: Vladimir Chevchenko, a Russian filmmaker who made the documentary: Chernobyl, chronicle of frightening weeks, dies due to radiation illness

21 April: Reactor 3 is supplying electricity again

24 April: Construction work on Block 5&6 halted after it was resumed on Oct 10, 1986. On May 23, 1989 it is decided not to complete the reactors

30 July: it was reported that three Russians, Chernobyl Director Victor Bryukanov and deputies Nikolai Fomin and Anatoly Dyatlov were brought to trial and "were found guilty of gross violation of safety regulations which led to the explosion" and were sentenced to 10 years in labor camp. They were released at the end of 1990.

16 September: The Chernobyl disaster will cost the Soviet Union UKPounds 200 billion economic damage, a senior Moscow official disclosed.

November: The U.S. government officially doubled its estimate of the 'background' radiation.

5/6 December: Still problems with radiation escaping from reactor 4

1988

Norway increased the limit for cesium in reindeer meat for consumption to 6000 Bq/kg. This is extremely high. Sweden also increased their limit to 1500Bq/kg from 300Bq/kg in May 1987. Most countries have a limit of 600 Bq/kg. And even this figure is heavily criticized. But due to this limit much of the reindeer meat can be sold in Scandinavian countries

5 January: Block 3 (which shared a turbine-hall with Block 4) is restarted.

February: In the period May-August 1986, between 20,000-40,000 more Americans than usual died. Statistics can't prove whether or not it was caused by Chernobyl, but "you can't escape the fact that something happened in the summer of 1986"

27 April: Two years after the accident Valery Legasov commits suicide. He was the director of the Kurchatov Institute for Nuclear Energy, where the RBMK reactors were designed. He was also chairman of the scientific team sent to Chernobyl immediately after the accident on 26 April 1986 He left behind his memoirs in which he expresses his anger and despair about the safety of nuclear energy in the Soviet Union. He wrote that he wanted to study the safety problems of the

RBMK reactors, and for this reason was opposed by people who said there were no problems. Legasov also wrote that there was a certain inevitability in working towards the accident at Chernobyl. Valery Legasov was the head of the Soviet delegation presenting the research report to the congress in Vienna..

August: Sweden: With the opening of the deer hunting season came alarming news. The Samen in northern Scandinavia are hard hit by the fall-out as their culture and livelihood depends on reindeer. The majority of animals killed contained more than the consumption limit of 1500 Bq/kg caesium-137. The level of cesium in lake fish has also increased over last year.

September: Soviet authorities decided to turn the 30 km zone into a national park. All human activity, including farming is banned there.

22 December: Soviet scientists announce that the sarcophagus now enclosing the reactor was designed for a lifetime of only 20 to 30 years.

1989

Start of the second resettlement phase. About 100 000 people have to leave their villages in the severely contaminated territories of Belarus, Ukraine and Russia.

26 January: Politburo unexpectedly announced a new campaign (concentrated on Belarus) to cope with the consequences of the disaster.

February: The first maps highlighting radiation fallout from Chernobyl are published in the Soviet press.

23 February: First visit of Soviet president Michael Gorbachov to Chernobyl. He spends one hour at the site.

May: Norway: According to the Isotope Lab of the Agricultural University of Norway, 95% of radioactive elements are still present in upper soil layers and weathering processes within the next few years may increase the uptake of the Chernobyl fallout in the food chain (major grazing areas for livestock and domestic reindeer have been particularly affected).

23 May: Decision not to complete the two units under construction. Construction work on Block 5 & 6 resumed on Oct 10, 1986, and already halted on April 24 1987

26 October: Tass reports that during the following year 100,000 people will be evacuated from contaminated areas in Belarus.

3- TRYING TO MINIMIZE THE CONSEQUENCES

1990

Collaboration between Western scientists and experts from Belarus, Ukraine and Russia begins. A delegation of German scientists visits the Chernobyl nuclear power station and the affected regions.

April: According to Yuri Shcherbak, vice-chairman of the Supreme Soviet Commission on Environment & Nuclear Energy said some US\$320 billion will be needed to handle the consequences of Chernobyl in the next 10 years.

26 April: A marathon broadcast of 24 hours to raise awareness and money for Chernobyl victims. On Soviet national television Telethon Chernobyl on Channel 3 collects about US\$100 million.

19 August: IAEA claims the sarcophagus is due to high temperatures and radiation no longer reliable. A new catastrophe cannot be ruled out.

September. Computer data stolen in Minsk and destroyed about health situation and radiation levels from over 670,000 people living in the eastern part of Belarus. Also contamination details from 20,000 settlements were on the disks.

21 September: The IAEA and the Governments of the Soviet Union, the Belarussian and Ukrainian SSR sign a framework agreement on the international consequences of the accident. "The Chernobyl area affords" according to the IAEA press release, "unique possibilities for carrying out scientific research under post-accident conditions, including some areas where radiation levels have subsided but are still above normal background levels."

1991

A specialized enterprise was organized, and all further work in the zone was done on a professional basis. (All people who worked in the zone until 1990, no matter what task, got status as "liquidator" and the right to social benefits.)

April: Soviet authorities announce 200,000 people have been evacuated, in 1991 another 112,000 will be evacuated and in 1992 about 12,000.

April: Laka Foundation publishes in the WISE News Communique an extensive list of contaminated foodstuffs dumped on the world market (especially in southern countries) in the first five years. (see: <http://www10.antenna.nl/wise/349-50/cont.html>)

15 April: rumors circulating since May 1986 about Soviet air force producing artificially rain from radioactive clouds moving towards Moscow in the first days after the accident early May 1986 are confirmed by soviet scientists during a conference in Berlin, Germany. At the same conference Professor Chernousenko claims, already 7,000 – 10,000 people have died as a result of Chernobyl.

26 April: On the fifth anniversary of Chernobyl there are mass demonstrations in Kiev and Minsk. The world press focuses on the event, highlighting new evacuations, alleged sicknesses in contaminated zones, and the continuing operation of Soviet RBMK reactors, including those at Chernobyl.

26 April: a special stamp to commemorate the accident is launched in the Soviet Union.



Soviet stamp to commemorate Chernobyl accident, 1991

21 May: IAEA/IAC releases study: "Assessment

of Radiological Consequences and Evaluation of Measures for the Chernobyl Accident"

IAEA conclusions:

- there were no health disorders that could be directly attributed to radiation exposure. There were no indications of an increase in the incidence of leukemia and cancers;
- there were significant non-radiation related health disorders in the populations of both the surveyed contaminated settlements and control settlements;
- the accident had substantial negative psychological consequences in terms of anxiety and stress due to continuing and high levels of uncertainty, relocation and other measures;
- early evacuations undertaken by the authorities – in cases

which could be assessed by the projects – were broadly reasonable and consistent with internationally-established guidelines

- protective measures taken or planned for the longer term, generally exceed what would have been strictly necessary
- official procedures for estimating doses were significantly sound
- etc

Main criticism on the report:

- study excluded from its subject of investigation the liquidators (estimated up to 600,000)
- study excluded the 30 km contaminated zone
- study excluded the evacuees from the zone (up to 95,000 – 100,000)
- study excluded hot spots
- There is some ambiguousness about the settlements chosen for the study: it would seem the selection was deliberate and arbitrary
- The report substantially underestimate the amount of exposure, particularly the lifetime dose. It appears that external exposure is estimated at one-third to one-fourth, and internal exposure at about one-tenth
- It is not clear how control groups were obtained. Thus, even though the study recognizes many illnesses and deaths, it was not able to link them to radiation
- Friends of the Earth claims that the IAEA scientists are scientifically incompetent because they draw concrete conclusions on the basis of what they themselves admit are "not always adequate data".
- The scientist had little or no access to pre-accident health records, leaving them unable to compare pre- and post-accident levels of disease and health disorders
- Etc.

According to Greenpeace the only aim of the study was to "produce a thirty-second sound-bite which is pleasing to the ear of the Soviet authorities – 'we didn't find radiation-induced health effects' is constructed to avoid implicating radiation in the disaster

24 August: Ukraine declares independence from the Soviet Union after a failed hard-line coup in Moscow.

29 August: On top of the 'want'-list of the independent Ukraine is the closure of Chernobyl

12 October: After a fire breaks out in the second Chernobyl reactor, this unit too has to be shut down for good.

18 November: Ukraine plans to close the remaining reactors at Chernobyl in 1993 at the latest.

12 December: Two Bulgarian ex-ministers are sentenced to imprisonment of 3 and 2 years, because they found guilty of hushing up the dangers of Chernobyl to the Bulgarian population after the 1986 accident

1992

March: Ukrainian government reports that cracks have appeared in the sarcophagus. An international competition is to be held for a design for a replacement roof.

May & August: forest fires lift radiation levels in Belarus, again

July: Ukrainian government launches an international competition ('Shelter-2 competition') for the best project to prevent the ruins of the reactor from threatening public health and the environment. A new shelter ('sarcophagus') is urgently needed.

18 September: US experts estimate the economic damage for Ukraine due to Chernobyl at about US\$150 billion

15 October: Block 3 is brought back online. Number 2 will follow at the end of the month

29 November: Ukrainian nuclear experts warn for Ameri-

cium-241. This Pu-241 daughter emits alpha-radiation and is seen as more dangerous as its parent. Experts say alpha-radiation will be much higher in 50-70 years from now and hope it will not spread outside the 30km zone. (see August 4, 2005)

1993

January to March: Establishment of a thyroid centre in Gomel by the Otto Hug Strahleninstitut, Munich. Gomel is a large city with a population of 500 000 in the most severely contaminated region of Belarus.

April: World Health Organization expects sharp rise in both leukemia and cancers, after numbers in both are increasing

18 June: The international Shelter-2 competition ends. But Ukrainian government does not award a first prize. The French consortium Campenon Bernard receives a second prize. None of the 19 concepts on the shortlist fulfils all Ukrainian requirements. Unclear what happens next. Ukraine is looking to establish an international fund to raise money.

22 October: Ukrainian government decided, due to electricity shortage not to close the remaining Chernobyl reactors and suspends a moratorium on new built

9 December: Russian geochemist Valerin Kopejkin claims that if international radiation limits for Strontium-90 would be installed in the Ukraine, Kiev has to be evacuated.

1994

February: The U.S. Massachusetts Institute of Technology (MIT) releases report: emissions at Chernobyl five times higher than official IAEA estimate of 50 million curies. MIT claims 185-250 million Curies was released.

9/10 October: Decision that remaining Chernobyl reactors will not be closed before 1996 at the earliest

1995

February: The first phase of the European Union-study for stabilizing the sarcophagus ends. The study claims it is a huge open radiation source. The consortium is pointing to the danger of collapse of the first sarcophagus and the problems of radioactive waste in case of constructing a second containment. Start of construction is foreseen in April 1996.

March: 100 times more thyroid cancers in Gomel, Belarus, WHO claims in report published in British Medical Journal.

13 April: President Leonid Kuchma declares Ukraine is ready to shut down the remaining reactors of the plant by the year 2000. His statement follows a meeting with European Commission officials in Kiev.

25 April: Ukrainian minister of public health Andrej Serdchuk: 125,000 people died due to Chernobyl, 432,000 still treated, 3.66 million affected.

July: In a resolution adopted at a Kiev Conference organized amongst others by WHO, it is said that mental disorders spreading among Chernobyl-affected people

20-23 November: new findings presented at a WHO conference in Geneva, suggest that radiation could also be increasing the incidence of strokes, heart attacks and liver disease, as well as damaging the brains of babies at the womb

22 December: At a meeting in the Canadian capital Ottawa, Ukraine and the G7 group of the world's leading industrialized nations sign a Memorandum of Understanding, agreeing to close Chernobyl. It involves commitments worth a total of some US\$2.3 billion in aid from the G7 to support Chernobyl's closure by the year 2000. The agreed package of loans for Ukraine's energy sector includes the completion of two more modern nuclear reactors at Rivne (R4) and Khmelnytsky (K2) stations in the west of the country. The aid package includes US\$498 million in G7 member grants and \$1.8 billion in loan financing from international agencies. Most of the grant money

-- US\$349 million - will be for nuclear decommissioning and safety. More than US\$1.9 billion will be spent to upgrade nuclear plants and the energy sector as a whole.

1996

April: 20 seconds before the 1986 accident an earthquake occurred in that region. According to Russian scientists it is not impossible the seriousness of the accident could have been increased as a result of that.

April: Genetic mutations have occurred twice as often in children of families exposed to the radioactive fallout as elsewhere

8-12 April: The International Atomic Energy Agency (IAEA), together with the World Health Organization (WHO) and the European Commission (EC), organized the conference "One Decade after Chernobyl: Summing up the Consequences". The conclusions of the IAEA on the health effects of the Chernobyl disaster are as follows:

- The death rate among "liquidators" did not exceed that for a corresponding age group.

- Thus far, the only admitted health effect due to radiation is an increase in thyroid cancers in children. 890 cases were detected. In the coming decades, several more thousands of cases of thyroid cancer (4,000-8,000) can be expected.

- No significant increase in leukemia has been found.

- Future cancer deaths will be about 6,660: 2,200 among liquidators and 4,460 among residents and evacuees of contaminated areas.

- Other health effects are related to psychological stress: fear of radiation and a distrust in the government.[1]

See box: IAEA underestimates health consequences

25 April: A French government minister acknowledged that the French were misled about the impact of the disaster. Whether forecasters on state television even told viewers that the radioactive cloud had stopped at France's borders.

26 April: The President of the UN General Assembly, Diogo Freitas do Amaral (Portugal), delivers a statement at the special commemorative meeting on the tenth anniversary of the Chernobyl accident. In his speech he states: "There continues to be an acute need for further assistance to the peoples and countries for whom Chernobyl represents a crushing burden [...]. To ignore this continuing humanitarian tragedy would be to reduce these people and the areas most affected to mere objects of scientific research."

November: Chernobyl shuts down reactor Number One. Only reactor Number Three remains in operation.

11 November: Cases of thyroid cancer among children in Ukraine, Belarus and Russia are up by roughly 200 per cent compared to the 1980s. The WHO estimates that around 4 million people in these three countries have been affected by the nuclear disaster. Roughly one million are undergoing medical treatment for consequential health impairments.

December: Authorities of Belarus launched a campaign to return people to regions which have suffered from Chernobyl. Nesterenko (director of Institute for Radiation Safety) warns for a serious error.

1997

April: Belarus has to spend 25% of its national annual budget on dealing with the effects of the 1986 disaster.

June: President Kuchma says Ukraine is spending US\$1 billion a year to combat the aftermath

November: At a conference in New York, dozens of nations collect \$350 million to rebuild the rapidly deteriorating concrete sarcophagus. The reconstruction cost is estimated at \$760 million.

November: an international assistance program for the affected areas is launched by the UN Department of Humanitarian Affairs

IAEA underestimates health consequences

The IAEA conclusions on Chernobyl's health effects are very conservative and are contradicted by other studies. The co-organizer of the conference, WHO, presented completely different figures last year. WHO, UNESCO and UNICEF submitted their findings in a 1995 report to the UN General Assembly. WHO noted an increase in illnesses and deaths among liquidators. According to the Chernobyl Union (the union of liquidators), ten percent of the liquidators have become less able-bodied and are unable to do full-time work. [2] The vice-advisor of Chernobyl Affairs of the Ukrainian parliament, Wladimir Usatenko, says that according to federal registers, 60,000 of the 360,000 Ukrainian liquidators have died (not only due to Chernobyl). Another 49,000 have become less able-bodied and are unable to work. [3] The amount of tumors among Belarus liquidators is also higher than normally could be expected [4].

The conclusion of the IAEA that the death rate among liquidators is not higher than normal and its silence on the high incidence of diseases indicate a lack of appreciation for the work they did. The IAEA denies that a significant increase in leukemia among liquidators has been found. But a study on a group of liquidators shows that five years after their work, cases of leukemia reached a peak and subsequently decreased. The expected time between receiving a high dose of radiation and the development of leukemia is five years. A relation therefore seems clear. [5] The IAEA conclusion that other health problems are related to psychological stress is questionable. It is certainly true that liquidators and inhabitants of contaminated areas are fearful of the consequences of the disaster. This will contribute to the illnesses that already exist or that can be expected in the future. But to claim that all diseases other than thyroid cancer and leukemia are caused by stress is pure nonsense. The rate of birth defects, for instance, show a correlation with the amount of contamination. In highly-affected areas, more birth defects have been diagnosed and the defects are worse in nature. In Belarus an increase of 161 percent has been recorded. [6] Sharp increases in diseases among children also belie IAEA's "psychological stress" claim. UNICEF statistics on the health conditions of Belarus children from 1990 till 1994 show an increase in different diseases or defects [2]. It seems that the IAEA wants to relate the increase in

diseases mainly to psychological stress. Radiation would only be the cause of higher incidence of thyroid cancer and leukemia. In this way, the number of deaths caused by radiation would be low. If the IAEA is to be believed, the other diseases/deaths are simply caused by stress. The IAEA projections on future cancer deaths are very low when one considers the dose that the liquidators and inhabitants received. With the received collective dose, and calculations can be made on the expected number of cancer deaths in the future. When these calculations are made with dose-effect figures from the official pro-nuclear International Commission on Radiation Protection (ICRP), a death total of 50,000 to 70,000 can be expected - only due to radiation exposure in the first two years after the accident. [7] The American radiation expert John Gofman made even more dramatic calculations. Because the ICRP dose-effect figures are too low, he made calculations with a figure for risk for received radiation six times higher. He calculated that 317,000 to 475,000 deaths can be expected worldwide. [7]) The amount of 6,660 mentioned by the IAEA would certainly be too low. Sources:

1. IAEA, "One decade after Chernobyl: summing up the consequences of the accident. Conclusions." 1996;
2. UN, "Strengthening of the coordination of humanitarian and disaster relief assistance ... regions". 1995;
3. Der Standard Online on Internet (Austria), 12 April 1996;
4. A. Okeanov, Belarussian Centre for Medical Technologies, Minsk. "The health status of the liquidators according to the Belarussian Chernobyl registry data (preliminary analysis)", 1995;
5. Buzunov et al, "Chernobyl NPP accident consequences cleaning up participants in Ukraine health status". March 1996;
6. G.I. Lazuk et al, "Frequency changes of inherited anomalies in the Republic Belarus after the Chernobyl accident". 1995;
7. Greenpeace International, "Chernobyl, 10 years after." 1996 article first published in: WISE News Communiqué 451, 26-4-96

nitarian Affairs. The program covers more than 50 projects in such areas as the health sector, social-psychological and economic rehabilitation, and the environment, and is based on the findings of an inter-agency needs assessment mission to Belarus, Russian Federation and Ukraine, undertaken in May. **December:** The Chernobyl Shelter Fund (CSF) was set up with the purpose of funding the Shelter Implementation Plan (SIP). The total costs of the SIP are estimated by the EBRD at US\$768 million. Others however think the costs will be much higher. Vladimir Asmolov of the Russian Kurchatov Nuclear Institute and involved in the original construction of the shelter thinks that the costs could reach as much as US\$2.5 billion.

1998

26 November: Scientific seminar on: "Thyroid Diseases and Exposure to ionizing Radiation: Lessons learned following the Chernobyl accident" in Luxembourg, organized by the European Commission. One of the major health consequences of the Chernobyl disaster is the sudden and great increase in the number of persons, particularly children, with thyroid carcinoma. The presentations made at the seminar reviews the existing knowledge on the subject of radiation induced thyroid

diseases especially in relation to the Chernobyl accident. The subject is treated from the four points of view: genetic and environmental factors influencing the radiation induced cancer risk; thyroid doses reconstruction and risk after the Chernobyl accident; age and molecular biology; and lessons learned following the Chernobyl accident.

14 December: for the first time Ukraine speaks about closure of the remaining Chernobyl reactors under conditions: money from the international community to finish construction of two reactors to replace Chernobyl (K2/R4)

1999

April-May: Reconstruction of the sarcophagus begins. The European Bank for Reconstruction and Development (EBRD) releases US\$130 million in grants for this first phase (improvements of the existing shelter).

14. May: In an internal memo to France prime-minister Jospin environmental Minister Dominique Voynet states: "a program to improve energy efficiency, would fit better to the Memorandum of Understanding for closure of Chernobyl, as K2/R4 replacement nuclear reactors".

5 August: Belarus: After being arrested on July 13, on August 5, 1999, however, Professor Bandazhevsky was formally

charged under Article 169 (3) of the Belarusian Criminal Code with allegedly accepting bribes from students seeking admission to the Gomel Medical Institute. Professor Bandazhevsky founded the Gomel State Medical Institute and was serving as its rector at the time of his arrest. His scientific work focused on the effects of the Chernobyl disaster on the health of the people living in and around the city of Gomel, a region close to the nuclear reactor and thus seriously affected by its radioactive emissions. According to Amnesty International, Bandazhevsky was outspoken in his criticism of the Belarusian authorities' handling of the Chernobyl disaster's impact on the population's health and had repeatedly stressed the need to find "innovative solutions" to the problem. He reportedly was particularly critical of the way that the Ministry of Health spent the scant resources available for research in this area. Shortly before his arrest, Bandazhevsky wrote a report about research conducted by the Belarusian Ministry of Health's Scientific and Clinical Research Institute for Radiation Medicine on the effects of the Chernobyl nuclear accident. In this report, he criticized the manner in which the government's research was carried out and its conclusions.

He was held for more than five months in pre-trial detention under harsh conditions that included temporary isolation, a poor prison diet, and no access to legal counsel. During his detention he reportedly suffered from heart ailments, stomach ulcers, and depression and lost approximately 44 lbs, resulting in his hospitalization. Professor Bandazhevsky was conditionally released from prison on December 27, 1999, pending trial.

20 September: Nobody is allowed to live permanently within 15 km of the power plant site. And yet, in the early 1990s, elderly people began to re-occupy their houses in the said zone. According to the authorities, there have been some 1500, two thirds of them women. About 50 people again took up residence in Chernobyl itself. This resettlement is being tolerated by the authorities.

18 November: A Coordination Committee Meeting at the Ministerial Level on International Cooperation on Chernobyl takes place in New York. US\$9.51 million is required for the 1999 Appeal distributed in May. Though the international community has largely contributed to the shelter fund, the affected populations have been chronically under funded. The nine priority projects in the 1999 Appeal are: the modernization of the Bragin Hospital, the establishment of child rehabilitation centers, the rehabilitation of contaminated sectors in the Gomel area (Belarus); providing diagnosis, treatment and rehabilitation of liquidators, improving management and use of contaminated forests, and studying the health status of the posterity of persons affected by radiation. (Ukraine); the screening of 100,000 children exposed to radiation for early diagnosis of thyroid pathology, strengthening the network of centres for social and psychological rehabilitation, and production lines for measuring and packaging of dairy products for the Bryansk region.

2000

13 January: The Ukrainian Government commissions an overall concept: parts of the Chernobyl area are to be re-cultivated.

March: According to documents from the Ukrainian Atomic Energy regulatory commission, published by Greenpeace, the safety of the remaining Chernobyl reactors is not guaranteed after August

March: Belarus: Girls in affected areas had five times the normal rate of deformations in their reproductive systems and boys three times the norm. "It is clear we are seeing genetic changes, especially among those who were less than six

years of age when subjected to radiation", says Vladislav Ostapenko, head of Belarus' radiation medicine institute
April: Kuchma reaffirms Chernobyl is to be closed by the year end, but gives no date.

April: The UN Office for the Coordination of Humanitarian Affairs (OCHA) releases the report "Chernobyl disaster – a continuing catastrophe". The authors concludes: "The radiological conditions in the area immediately surrounding the plant have largely improved, thanks to the international commitment to improved safety at Chernobyl, which allowed for the reconstruction and now reinforcement of the sarcophagus. However, the human consequences of the accident continue to be relentlessly harsh. The EBRD expects to complete the refurbishment of the Chernobyl plant site by 2007. A sum of US\$400 million has already been pledged for this operation. A contribution from donor countries of just 3 per cent of this amount would have a substantial impact on the alleviation of human suffering that has resulted from this accident."

26 April: While visiting the Chernobyl zone, president Lukashenko of Belarus announces plans to re-locate people to the zone. "People moving from other parts of the Commonwealth of Independent States will be given the Belarus nationality within one week", he says.

May: Swedish radiation protection authorities have issued recommendations for the handling of ashes from biomass-fueled electricity plants. It was calculated that 5-7% of the yearly amount of bio fuel ash has to be stored as radioactive waste.

6 June: Kuchma tells visiting U.S.-President Clinton that the ex-Soviet state will shut down the station on December 15. Clinton says the U.S. will give Ukraine \$78 million in fresh funds to help improve safety at the plant.

5 July: The EBRD administers the Chernobyl Shelter Fund. As of July 2000, 37 countries had contributed US\$715 million to the fund, which is 93% of the overall project cost estimate. Most of the money comes from the European Union and the G-7 countries.

The first phase of the Shelter Implementation Plan (SIP) consisted of an expedited review of the collapse risk and the most critical repairs were conducted. Further, studies were conducted and designs been made for a structural stabilization of the shelter, to be conducted in the second phase. Two projects of the first phase which had to start without delay were repairs of the beams supporting the roof of the shelter (1999) and stabilization of the ventilation stack (1998), whose possible collapse was also threatening the then still operating reactor 3. The second phase will consist of the actual strengthening of the present sarcophagus and the construction of the new covering shelter.

November-December: Chernobyl engineers prepare to shut down the last functioning reactor, Number Three, on December 15. The last fuel rods will not be removed until 2008 and it will be between 30 and 100 years before the station is completely decommissioned. The EBRD and the European Union each pledge to lend Ukraine hundreds of millions of dollars to finish construction of Soviet-era reactors at Rivne and Khmel'nitsky (K2/R4) in western Ukraine, to replace lost capacity from Chernobyl. The EBRD loan is for US\$215 million, while the EU pledges \$585 million. Environmentalists protest against the loans, which they say are going toward reactors which, although safer than Chernobyl's, are still based on ageing technology.

12 December: The Chernobyl reactor complex is shut down.

4- AFTERMATH: NO LESSONS LEARNED 2001

April: At an international conference, "Fifteen Years After the Chernobyl Accident - Lessons Learned" in Kiev, experts, UN

organizations and the IAEA reach a minimal consensus in the evaluation of health effects. A direct link between the accident and thyroid cancer among children is recognized internationally. Indications for other consequences are being observed, however with limited resources.

4-8 June: International Scientific Conference on "Health Effects of the Chernobyl Accident: Results of 15-Year Follow-Up Studies" in Kiev, Ukraine. One of the many findings: Liquidators' state of health worsened considerably since the accident, high levels of general somatic diseases, morbidity increased more than 17 times between 1991 and 2000.

18 June: After being arrested in July 1999, Professor Bandazhevsky was brought to trial in Gomel in February 2001. On June 18, 2001, the Military Board of the Belarusian Supreme Court convicted him and sentenced him to eight years' imprisonment. His property was confiscated, and he is prohibited from exercising his political rights and assuming any managerial position for five years following his release.

October: After visiting the affected regions, a delegation of national and international experts sponsored by the United Nations Development Program (UNDP) and the United Nations Office for the Coordination of Humanitarian Affairs (OCHA) calls for a new approach in aid programs. They recommend a developmental approach, shifting the emphasis from "help for victims" towards helping people to help themselves.

2002

6 February: The United Nations calls for an entirely new approach to helping millions of people impacted by the Chernobyl accident, saying that 16 years after the incident those affected remain in a state of "chronic dependency," with few opportunities and little control over their destinies. The report "The Human Consequences of the Chernobyl Nuclear Accident" notes that some 7 million people are in some way or another recipients of state welfare connected with Chernobyl.

See box: **Human consequences of the Chernobyl accident**

2003

April: secret KGB documents released in Ukraine show that there were problems with the Chernobyl nuclear plant. One 1984 document notes deficiencies in the third and fourth

block, and also of poor quality of some equipment sent from Yugoslav companies.

27 June: The International Chernobyl Research and Information Network (ICRIN) is launched by the UN Inter-Agency Task Force on Chernobyl in Geneva. The objective of the international network is to make Chernobyl research results systematically accessible both to the affected population and to the authorities and decision-makers, and also to identify

gaps in existing research findings. The www.Chernobyl.info website serves as an information platform for ICRIN members and the public at large. The activities and addresses of scientific institutions and organizations can be accessed in a database on the website.

August: The European Bank for Reconstruction and Development (EBRD) said it would give Ukraine US\$ 85 million this year to cover the gaping hole in reactor 4. The construction of the new shelter will start in 2004.

2004

27 April: In New York, over 600 invited guests from numerous countries attended the first public viewing of the film "Chernobyl Heart" since it won this year's Academy Award for the best documentary two months ago.

November: Scientific evidence that fallout from Chernobyl may have raised cancer rates in western Europe may have emerged. Researchers in Sweden showed a statistically relevant correlation between the degree of fallout and an observed rise in the number of total cancer cases.

2005

April: European Commission confirms that restrictions in the UK on the

transport, sale and slaughtering of sheep remain in force 'in numerous cattle breeding enterprises especially in the North of Wales' In Ireland and certain Scandinavian regions, monitoring is also still conducted.

April: In certain game, wild grown berries and mushrooms and in carnivorous fish (from regions in Germany, Austria, Italy, Sweden, Finland, Lithuania and Poland) the levels of Caesium-137 still vastly exceed normal levels. In the regions worst hit by the fall-out from Chernobyl, contamination levels will remain high and relatively unchanged for the next decades, the EC believes.

Human consequences of the Chernobyl accident.

The United Nations calls for an entirely new approach to helping millions of people impacted by the Chernobyl accident, saying that 16 years after the incident those affected remain in a state of "chronic dependency," with few opportunities and little control over their destinies. The UN warns that populations in Belarus, the Russian Federation and Ukraine would continue to experience general decline unless significant new measures are adopted to address health, the environment and unemployment. The study emphasizes the need for the recovery phase to focus attention on two broad groups:

The first group includes some 100,000 to 200,000 people caught in the downward spiral. These are people who live in severely contaminated areas; people who have been resettled but remain unemployed; and those whose health remains most directly threatened, including victims of thyroid cancer. Some 2,000 people have been diagnosed with thyroid cancer, and the report states that as many as 8,000 to 10,000 additional cases are expected to develop over the coming years. The report states that this group of up to 200,000 people, spread across all three countries, is "at the core of the cluster of problems created by Chernobyl," and focusing on their needs and helping them take control of their futures must be a priority.

The second group identified for priority action includes those whose lives have been directly and significantly affected but who are already in a position to support themselves. This group has found employment, but still must be reintegrated into society as a whole so that their ongoing needs are addressed through the mainstream provision of services using criteria applicable to other members of society. This group includes hundreds of thousands of individuals.

The report also identifies a third group, encompassing millions of people, who have been indirectly impacted by the stigma, uncertainty and fatalism that have become associated with Chernobyl. This group, too, needs to be aided through clearer information and more open and continuous disclosures about the evolving situation in the region, the report argues. The report notes that some 7 million people are in some way or another recipients of state welfare connected with Chernobyl.

The study, carried out by an international panel of experts in July-August 2001, was commissioned by the UNDP and the UNICEF, and was supported by the WHO and the OCHA (the United Nations Office for the Coordination of Humanitarian Affairs)

12 May: At a pledging meeting in London the European Commission announced an additional €49 million to the international Chernobyl Shelter Fund (CSF). A total of about US\$200 million are donated at the donor meeting. The project is estimated to cost US\$1,091 million and is planned to be

Shelter Implementation Plan

In 2005, the SIP (Shelter Implementation Plan) entered its final stage. All major Chernobyl site infrastructure facilities and programs (radiation and industrial protection, medical training, emergency response) have either been completed or will be at final acceptance over the next few months. These facilities and programs will, according to the EBRD "ensure adequate protection of people during the construction activities", which have commenced and which will significantly increase during the year. Site services in the construction zone have been renewed and a change facility constructed. The physical work on stabilisation of the existing shelter is ongoing under the contract signed in July 2004. When completed in 2006, it will eliminate one of the principal risks - the collapse of the shelter. A comprehensive monitoring system (nuclear, radiation and seismic) as well as the site access control and physical protection system are under construction and scheduled for completion during the first half of 2006. The tenders for the new safe confinement - the largest component of the SIP - are at an advanced stage of evaluation with contract award scheduled for Autumn 2005. The confinement is an enormous arch - with a span of 260 meters and height of 100 meters - to enclose the existing 'sarcophagus' and its radioactive contents for a period of minimum 100 years. It is being constructed off site to limit workers' exposure to radiation. The arch-shaped confinement will be erected and slid into position over the old shelter via specially built rails. Once in place, safer working conditions will enable the deconstruction of unstable parts of the shelter.

completed by 2009.

4 August: Alpha-radiation from plutonium-241 decay products is increasing. Pu-241 emits Beta-radiation and has a half-life of only 14.4 years. It decays in Americium-241 which emits alpha-radiation and has a half life 432.2 years. Result: in Belarus alpha-radiation is currently three-times as high as in 1986 and in the year 2276 the level will still be twice as high as shortly after the 1986 disaster. The zone's americium-241 will reach its maximum level in 2059. Am-241's alpha radiation is even more powerful than plutonium's, and it decays to neptunium-237, which also decays by way of an energetic alpha particle and has a half-life of more than 2 million years. However, the vast majority of radiation exposure is from beta-emitting caesium-137 which is declining with a half-life of about 30 years.

5 August: As a result of amnesties, Professor Bandazhevsky's eight-year prison sentence was reduced to seven years in July 2002 and, in early 2004, his sentence was reduced to six years. According to the Belarusian government, Articles 90 and 91 of the Criminal Code of the Republic of Belarus stipulate that Professor Bandazhevsky's sentence could be reduced when he had served half of the term of the prison sentence handed down by the court, and conditional early release ("parole") reportedly was possible after two thirds of the sentence had been served, on January 6, 2005. But it was not until August 5, 2005, under an amnesty declared by President

Lukashenka to celebrate the 60th anniversary of World War II, that Professor Bandazhevsky was released.

30 August: The latest radiation measurements in the area immediately surrounding the Chernobyl nuclear power plant indicate that the levels of radioactive contamination are falling. Ukraine's authorities are therefore opening some of the evacuation zone of 2,800 square kilometers, from where all inhabitants were relocated after the 1986 nuclear accident, for partial resettlement. However, those who return will lose the welfare benefits they have been entitled to so far.

31 August: The WHO completes its working draft Health Effects of the Chernobyl Accident and Special Health Care Programs Report of the UN Chernobyl Forum Expert Group "Health". From this report and others in this series, IAEA creates Chernobyl's Legacy: Health, Environmental and Socio-economic Impacts and Recommendations to the Governments of Belarus, the Russian Federation and Ukraine [date of release: 5 September 2005]. Again the work of the WHO is overshadowed by the so-called WHA 12.40, which is the agreement between WHO and IAEA that allows either to keep information from the other, which would hurt their respective mandates. Since it is the IAEA's mandate "to accelerate and enlarge the contribution of atomic energy to peace, health and prosperity throughout the world", it is doubtful that IAEA could conduct unbiased health studies on the effects of the Chernobyl nuclear explosion. In fact, IAEA has no mandate to conduct health studies at all.

September: Ukrainian authorities retrieve radioactive fuel believed to be stolen from Chernobyl. A plastic bag, containing 14 pieces of fuel, were found during a routine search of the reactors perimeter. The material is believed to be stolen in 1995 but left in the plant when additional security measures to detect radiation were installed after the theft in 1995

5 September: According to the IAEA's press release Chernobyl: The True Scale of the Accident, introducing the controversial report "Chernobyl's Legacy: Health, Environmental and Socio-Economic Impacts" a total of up to four thousand people could eventually die of radiation exposure from the Chernobyl accident. And "as of mid-2005, however, fewer than 50 deaths had been directly attributed to radiation from the disaster".

See box : IAEA study "rubbish"

November: Eleven farms, covering 11,300 hectares in Scotland, are still so contaminated by the Chernobyl accident that their sheep are considered unsafe to eat.

15 December: In an official statement Ukraine president Yushchenko says no foreign fuel will be stored at Chernobyl. A week earlier, he stated that the government was studying the possibility of storing foreign nuclear fuel at Chernobyl. After a loud public outcry he apparently discarded the idea.

16 December: France: The SCPRI (Central Service for Protection against Radioactive Rays) knew of high levels of contamination in Corsica and southeastern France but kept the information under wraps. The study was commissioned by a magistrate who since 2001 has been examining allegations that the atomic cloud from Chernobyl caused a surge in cases of thyroid cancer in parts of France. According to the report the SCPRI issued imprecise maps that concealed high levels of fallout in certain areas.

2006

January: The EBRD stated the Shelter Implementation Plan (SIP) had reached a crucial point, with the awarding of the contract for the NSC (New Safe Confinement) expected within the next few months. The EBRD has said completion of the main construction projects is scheduled for 2008 or 2009. Stabilization work on the sarcophagus has begun, with two of eight stabilization activities already complete. The aim is to

IAEA study "rubbish"

Chernobyl relief organizations and many radiation scientists dispute and criticize the data and figures in the report, calling them "poor", "quite inappropriate" or simply "rubbish". The report is accused of playing down the true dimension of the catastrophe. Some statements of the study are challenged as "demonstrably false". Experts are also concerned that the UN's IAEA, may have had "too great an influence" on the study.

Dr. Rosalie Bertell, a well known expert, has made many comments on the IAEA's press release. One of these comments is on the following quote: "Approximately 1000 on-site reactor staff and emergency workers were heavily exposed to high-level radiation on the first day of the accident; among the more than 200,000 emergency and recovery operation workers exposed during the period from 1986-1987, an estimated 2200 radiation-caused deaths can be expected during their lifetime". Bertell: "Radiation-caused deaths is a loaded statement. It assumes that only death is considered to be detrimental, and eliminates the consideration of all severe and debilitating morbidity. Moreover, these scientists, trained by the documents released by International Commission on Radiological Protection (ICRP) over the last fifty years, have accepted without question that the only health effects "of concern" attributable to radiation are deaths from cancer. Non-fatal cancers are basically of no concern. These are administrative decisions and not science.[..]"

Dr. Angelica Claussen from the German branch of the IPPNW remarks: "Studies conducted for the International Chernobyl Project of the IAEA took place from January 1990 to the end of February 1991. In 1990 alone the rate of new cases of thyroid cancer in children in Belarus was 30 times higher than the 10 year average." The IAEA report states however: "The official data that were examined did not indicate a marked increase in the incidence of leukemia or cancers. (..)"

Reported adverse health effects attributed to radiation were not substantiated either by those local studies that were adequately performed or by the studies under the Project. (..) The children who were examined were found to be generally healthy. (..) Later independent research by the BBC has proved that the IAEA and its international commission of experts were already in possession of all of the relevant facts at the time of the conference and the presentation of the report, including the histopathological evidence for a marked increase in the rate of thyroid cancers. It is alarming to ascertain that this deliberate deception of the general public was practiced by such experts as Professor Mettler (Director of the medical expert group of the International Chernobyl Project) and other experts from the EU and Japan.

make the sarcophagus stable for 15 years, allowing time for the NSC to be constructed. A winner of a tender was said to be announced on a donor conference on February 14. However, there were too many unsolved problems to announce the companies name.

6 April: The New Scientist magazine is quoting two independent scientists from the UK, Ian Fairlie and David Sumner, who are accusing the IAEA and the WHO of downplaying the impact of the Chernobyl accident. They say that the death toll from cancers caused by Chernobyl will in fact lie somewhere between 30,000 and 60,000, up to 15 times as many as officially estimated. Fairlie and Sumner accuse the IAEA/WHO report, released 5 September 2005, of ignoring its own predic-

tion of an extra 5000 cancer deaths in the less contaminated parts of Ukraine, Belarus and Russia, and of failing to take account of many thousands more deaths in other countries, where more than half of Chernobyl's fallout ended up. Zhanat Carr, a radiation scientist with the WHO admitted that the deaths were omitted because the report was a "political communication tool". Fairlie and Sumner's accusations are backed by other experts.

6 April: Also released on this day is the report Health Effects of Chernobyl – 20 Years After the Reactor Disaster by the IPPNW in Germany and the German Society for Radiation Protection (GfS). They also belie the claim by the IAEA that less than 50 people died as a result of the accident at Chernobyl. The facts presented by the composers of the report show that the IAEA figures contain serious inconsistencies. For instance, the IAEA claim that future fatalities due to cancer and leukemia in the most heavily exposed groups are expected to number 4000 at the most. However, the study by the WHO, that this claim is based on, forecasts 8930 fatalities.

"And when one then reviews the reference given in WHO report, one arrives at 10,000 to 25,000 additional deaths due to cancer and leukemia", says Dr. Pflugbeil from the GfS.

The IPPNW report documents the catastrophic dimensions of the reactor accident, using scientific studies, expert estimates and official data. Some of them are mentioned here:

- 50,000 to 100,000 liquidators (clean-up workers) died in the years up to 2006. Between 540,000 and 900,000 liquidators have become invalids;

- Congenital defects found in the children of liquidators and people from the contaminated areas could affect future generations to an extent that cannot yet be estimated;

- Infant mortality has risen significantly in several European countries, including Germany, since Chernobyl. The studies at hand estimated the number of fatalities amongst infants in Europe to be about 5000;

- In Bavaria alone, between 1000 and 3000 additional birth defects have been found since Chernobyl. It is feared that in Europe more than 10,000 severe abnormalities could have been radiation induced;

- In Germany, Greece, Scotland and Rumania, there has been a significant increase in cases of leukemia;

18 April: A new Greenpeace report has revealed that the full consequences of the Chernobyl disaster could top a quarter of a million cancer cases and nearly 100,000 fatal cancers. The challenges the UN IAEA Chernobyl Forum report, which predicted 4,000 additional deaths attributable to the accident as a gross simplification of the real breadth of human suffering. The new data, based on Belarus national cancer statistics, predicts approximately 270,000 cancers and 93,000 fatal cancer cases caused by Chernobyl. The report also concludes that on the basis of demographic data, during the last 15 years, 60,000 people have additionally died in Russia because of the Chernobyl accident, and estimates of the total death toll for the Ukraine and Belarus could reach another 140,000. The report also looks into the ongoing health impacts of Chernobyl and concludes that radiation from the disaster has had a devastating effect on survivors; damaging immune and endocrine systems, leading to accelerated ageing, cardiovascular and blood illnesses, psychological illnesses, chromosomal aberrations and an increase in fetal deformations.

28 October: There are 36 areas of upland Norway where Chernobyl contamination still requires controls on sheep. According to the Norwegian Radiation Protection Authority (NRPA), levels of caesium-137 reached 7 kBq/kg in sheep this year, more than twice the maximum levels in previous years. The discovery of such high levels of radioactivity so long after the Chernobyl accident came as a surprise, a NRPA spokes-

man says.

10 November: Ukrainian President Victor Yushchenko issues a decree establishing 14 December as an annual holiday called "Liquidators' Day".

30 November: Today is the 20th anniversary of the technical acceptance (licensing) of the sarcophagus, built under extreme conditions and designed to last 30 years, though the Ukrainian Institute for Nuclear Power Plant Safety considers it impossible to define a service life for the facility. Currently about 100 contract workers in addition to 80 plant staff work daily on the sarcophagus. The reinforcement work will considerably reduce the risk of the sarcophagus's roof collapsing. The next stage in the Shelter work is erection of a so-called New Safe Confinement. A French-led consortium called Novarka and a group led by CH2M Hill of the US are vying for the job.

2007

21 April: In *Science of Superstorms*, a BBC2 documentary Russian military pilots describe how they create rain clouds to protect Moscow from radioactive fallout after the Chernobyl disaster. More than 10,000 km² of Belarus were sacrificed to save the Russian capital from toxic radioactive material.

23 April: A study of birds around Chernobyl suggests that nuclear fallout, rather than the impact of relocation and stress and deteriorating living conditions, as suggested by the IAEA, may be responsible for human birth defects in the region. Timothy Mousseau, at the University of South Carolina, Columbia, and his colleagues examined 7700 barn swallows from Chernobyl and compared them with birds from elsewhere. They found that Chernobyl's swallows were more likely to have tumors, misshapen toes and feather deformities than swallows from uncontaminated parts of Europe. "We don't fully understand the consequences of low doses of radiation," says Mousseau. "We should be more concerned about the human population."

2 June: The impact of the Chernobyl disaster is often seen as a problem in Belarus, Ukraine and Russia. The medical effects of Chernobyl disaster, however, have spread all around the world. *Courier-Life Publications* reports on a story of a New York based medical specialist: "There are between 150 and 200 thousand people in the NY metropolitan area who come from the affected region, and the 'cancer rates are going up and up'"

4 June: The incidence of cancer in northern Sweden increased following the accident at Chernobyl. This was the finding of a much-debated study from Linköping University in Sweden from 2004. Two studies using different methods has shown a statistically significant increase in the incidence of cancer in northern Sweden, where the fallout of radioactive cesium-137 was at its most intense.

16 August: Swedish children born in the months following the 1986 Chernobyl disaster suffered mental impairment from the radioactive fallout, a study found. The report by economists Douglas Almond and Lena Edlund from Columbia University, New York, and their Stockholm University colleague Märten Palme carried out an analysis of more than 560,000 Swedish children born between 1983 and 1988. They found that academic performance was generally weaker in all children still in utero at the time of maternal exposure to Chernobyl fallout, and this effect was most pronounced for those fetuses at 8 to 25 weeks post conception. This is the peak period of brain development when cells may be particularly vulnerable to being killed by relatively low doses of radiation. The researchers say it appears prenatal exposure to radiation levels previously considered safe was actually damaging to cognitive ability.

17 September: The French-led consortium Novarka signs

a contract to build a new Shelter around the site of Reactor 4 for more than Euro 430 million. Ukrainian President Viktor Yushchenko and the French trade minister, Herve Novelli, oversee the signing by the consortium, which includes French builders Bouygues and Vinci. The consortium will build an arch-shaped metal structure 105m tall, 260m wide and 150m long to cover the existing containment structure, which stands over the reactor and radioactive fuel that caused the accident. The new sarcophagus will weigh about 18,000 tons -- more than twice the weight of the Eiffel tower and will resemble a half-cylinder and slide over the existing sarcophagus. According to official estimates, the reactor still contains about 95% of the original nuclear fuel from the plant. The EBRD is contributing Euro 330 million (about US\$460m.) to the project and says it will take about 1,5 years to design the shelter and another four years to build it.

Officials also signed a US\$200m contract with the US firm Holtec International to build a storage facility for spent nuclear fuel from Chernobyl's NPP three other reactors, which kept operating until the station was shut down in 2000.

2008

23 February: Publication of "Anecdotes and empirical research in Chernobyl" by researchers from the Royal Society in *Biology Letters*. The scientists mop the floor with all the studies on the consequences of Chernobyl that has been done so far and have received wide attention by the international media. They state: "Although Chernobyl is perhaps the largest environmental disaster ever, there has been minimal monitoring of the status of free-living organisms or humans in stark contrast to Hiroshima and Nagasaki, where careful monitoring has continued for over 60 years." And asking themselves: "Why has there been no concerted effort to monitor the long-term effects of Chernobyl on free-living organisms and humans?" Further on: "The official reports by IAEA, WHO and UNDP were narrative renditions of parts of the literature [...]. Scientific enquiry depends on rigorous analysis of data rather than rendition of anecdotal evidence."

5 March: Atomstroyexport has begun work to extend the service life of the Chernobyl protective concrete shelter. This contract envisages the repair of the roof over the confinement, installation of protection systems, and the reinforcement of supporting beams. The project will buy time for the next stage: the construction of a new confinement, or arc. The project moderator is the International Chernobyl Shelter Fund and is financed by the G8 and European Union countries. The EBRD has already accumulated US\$1b. for the project.

April: The English Edition of *Le Monde Diplomatique* states in a background article: "For 50 years dangerous concentrations of radionuclides have been accumulating in earth, air and water from weapons testing and reactor incidents. Yet serious studies of the effects of radiation on health have been obscured - not least by the World Health Organization." The whole article, entitled Chernobyl: the great cover-up, can be found at: [<http://mondediplo.com/2008/04/14who>]

25 April: The Food Standards Agency Wales reveals that up to 359 Welsh farms are still operating under restrictions imposed in the wake of Chernobyl, almost 22 years after reactor 4 went into meltdown. Heavy rain washed radioactive material from clouds onto fields. The radiation is absorbed from the soil by plants, which are then eaten by sheep. For the hundreds of Welsh farmers still living with Chernobyl's legacy, the restrictions mean their animals are only allowed to enter the food chain after rigorous safety tests.

26 April: Ukraine pays homage to victims of the Chernobyl nuclear catastrophe, 22 years after the disaster. "The Chernobyl catastrophe became planetary and even now continues

to take its toll on people's health and the environment," the Health Ministry said in a statement.

Activists from across Russia, Ukraine and Belarus turned out in force in urban centers across the former Soviet republics to hold ceremonies commemorating 22nd anniversary of the Chernobyl disaster and express outrage at Russia's current nuclear plans.

UN chief Ban Ki-moon marks the anniversary by pledging UN assistance for the stricken region's renewal. In a statement to mark the anniversary, he notes that the UN General Assembly has proclaimed 2006-2016 a "decade of recovery and sustainable development" for the Chernobyl area.

2 October: Researchers from Case Western Reserve University in Cleveland, Ohio, have tracked the Chernobyl fallout to reveal that much more plutonium was found in the Swedish soil at a depth that corresponded with the nuclear explosion than that of Poland. They took soil samples in various locations in the two countries, measuring the presence and location of cesium-137, plutonium (239, 240Pu), and lead-210Pb. Radionuclides occur in soil both from natural processes and as fallout from nuclear testing. The collected soil samples reveal insights based on several conditions, such as how the radionuclides were delivered to the soil, whether from a one-time event like the Chernobyl disaster or from atmospheric bomb testing. As the team examined a range of soil types from the two countries, they found a spike in 239, 240Pu in Sweden's soil at a depth that coincides with the Chernobyl disaster, yet no similar blip in Poland's soil. Meteorological research showed that it rained in Sweden while the radioactive cloud was over that country. Leached of much of its radionuclides, much less plutonium fell on Poland when the cloud later crossed over its borders.

2009

30 January: President of Ukraine Victor Yushchenko signs the law on the government program for decommissioning of the Chernobyl NPP, and transformation of the Shelter confinement facility into a safer object. The law, coming into force on January 1, 2010, says the nuclear plant will be finally shut down by 2065. The decommissioning will take four phases. The nuclear fuel rods will be removed in 2010-2013 and the reactor systems will be put in dead storage in 2013-2022. After a cool down of the reactor systems in 2022-2045, the systems will be demounted in 2045-2065 concurrently with decontamination of the nuclear power plant's site.

2010

January: 'Chernobyl: Consequences of the Catastrophe for People and the Environment' written by Alexey Yablokov, Vassily Nesterenko and Alexey Nesterenko is published by the New York Academy of Sciences. The book is in contrast to findings by the WHO, IAEA and United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR) who based their findings on some 300 western research papers, and who found little of concern about the fallout from Chernobyl.

While the most apparent human and environmental damage occurred, and continues to occur, in the Ukraine, Belarus and European Russia, more than 50 percent of the total radioactivity spread across the entire northern hemisphere, potentially contaminating some 400 million people. Based on 5000 published articles and studies by multiple researchers and observers, mostly available only in Slavic languages and not available to those outside of the former Soviet Union or Eastern bloc countries, the authors estimated that by 2004, some

985,000 deaths worldwide had been caused by the disaster. All life systems that were studied – humans, voles, livestock, birds, fish, plants, mushrooms, bacteria, viruses, etc., with few exceptions, were changed by radioactive fallout, many irreversibly. Increased cancer incidence is not the only observed adverse effect from the Chernobyl fallout – noted also are birth defects, pregnancy losses, accelerated aging, brain damage, heart, endocrine, kidney, gastrointestinal and lung diseases, and cataracts among the young. Children have been most seriously affected – before the radioactive Chernobyl releases, 80% of children were deemed healthy, now in some areas, only 20% of children are considered healthy. Many have poor development, learning disabilities, and endocrine abnormalities.

September: Clearance of the assembly site for the New Safe Confinement (NSC) right next to the shelter of Unit 4 and excavation work for the foundations have been completed. Piling for the foundations and the lifting cranes started. Funds for the construction of the NSC are still lacking. The completion of the Shelter Implementation Plan, of which the NSC represents about two thirds of total costs, requires an additional 600 million euro, with current overall cost estimates about 1.6 billion euro. So, despite all positive reports on financial contributions and donor-countries, fact is that only 60% of the necessary funds have been collected. A 'pledging event' will take place in Kiev in April to coincide with the 25th Anniversary of the accident.

2011

January: Ukraine legalizes tourist tours to Chernobyl and Pripjat. Visitors have to sign a waiver, exempting the tour operator from all responsibility in the event that they later suffer radiation-related health problems. Driven round at breakneck speed, and told not to touch any of the irradiated vegetation or metal structures, "tourists" are invited to briefly inspect the stricken number four reactor as the Geiger counter, which guides carry, clicks ever higher. The most arresting "attraction" is not the ruined plant, however, but nearby Pripjat. Visitors can walk through the debris-strewn corridors of its Palace of Culture, admire its crumbling Olympic-sized swimming pool, and wander through the empty classrooms of one of its biggest schools.

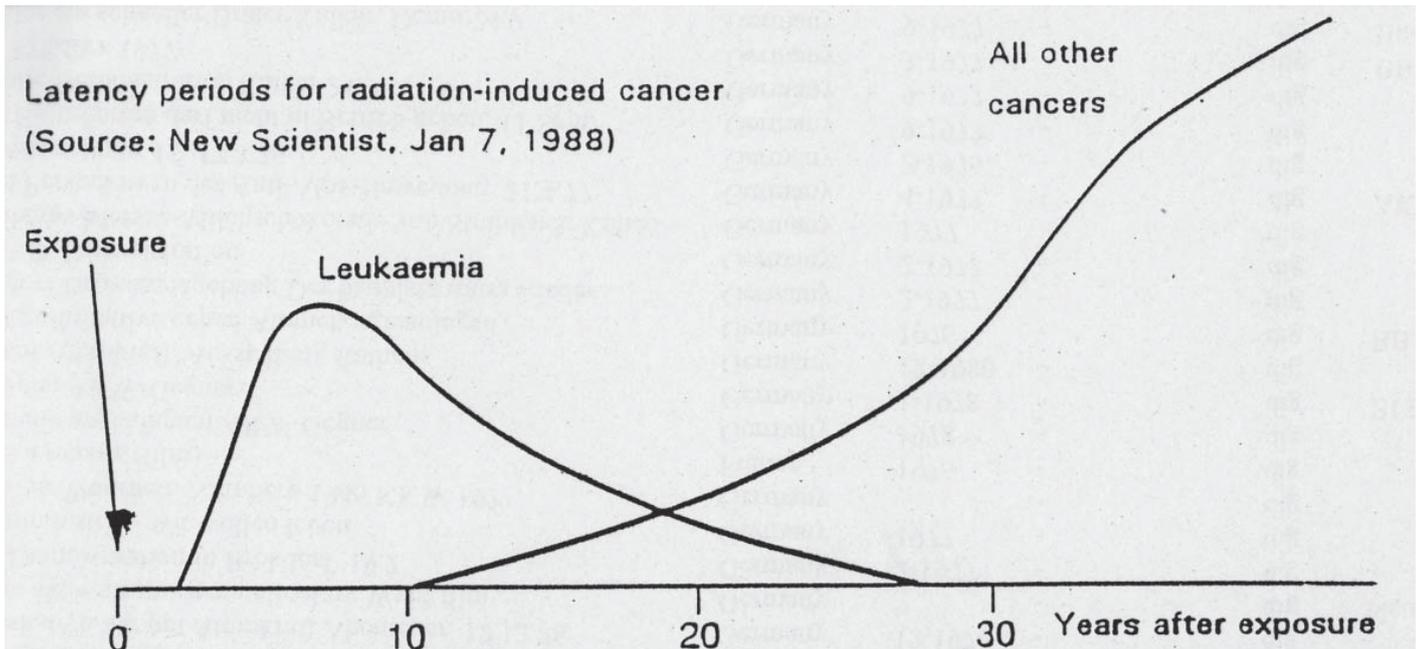
4 February: Birds living around the site of the Chernobyl nuclear accident have 5% smaller brains, an effect directly linked to lingering background radiation. The finding comes from a study of 550 birds belonging to 48 different species living in the region. Evidence for developmental errors in the nervous systems of people exposed to radiation is widespread, including reduced head size and brain damage. Low levels of ionizing radiation cause changes in both central and autonomous nervous systems and can cause radiogenic encephalopathy. Electroencephalographic studies revealed changes in brain structure and cognitive disorders. However, psychological effects of radiation from Chernobyl have recently been attributed to post-traumatic stress rather than developmental errors, and increased levels of neural tube defects in contaminated areas may be ascribed to low-dose radiation, folate deficiencies or prenatal alcohol teratogenesis. Surprisingly, studies of high school performance and cognitive abilities among children from contaminated areas in Scandinavia that were in utero during the Chernobyl disaster show reductions in high school attendance, have lower exam results and reduced IQ scores compared to control groups. These cognitive effects are assumed to be due to developmental errors in neural tissue caused by radiation during early pregnancy.

5- POSTSCRIPT

April 26, 2011 will not be the end for the suffering as a consequence of the Chernobyl accident. Ironically, it is likely that Chernobyl's public health impacts will be further downplayed at the IAEA-sponsored conference in Kiev (20-22 April): "Chernobyl, 25 Years On: Safety for the Future". This conference is intended to be "a forum for the scrutiny of the disaster mitigation measures implemented after the Chernobyl disaster, and the examination of how the lessons learned can be used to improve nuclear and radiation safety around the world."

Due to further downplaying of the health consequences by organizations linked to the nuclear establishment and the fact that the Chernobyl accident will fade away in the public debate and the collective memory, it will be extremely difficult to raise any public awareness on this matter in the future.

Let's make sure that past and future suffering due to Chernobyl will not be in vain by making April 26 the international 'phase-out nuclear' day and increase our efforts to end the nuclear age.



WISE/NIRS NUCLEAR MONITOR

The Nuclear Information & Resource Service was founded in 1978 and is based in Washington, US. The World Information Service on Energy was set up in the same year and houses in Amsterdam, Netherlands. NIRS and WISE Amsterdam joined forces in 2000, creating a worldwide network of information and resource centers for citizens and environmental organizations concerned about nuclear power, radioactive waste, radiation, and sustainable energy issues.

The WISE/NIRS Nuclear Monitor publishes international information in English 20 times a year. A Spanish translation of this newsletter is available on the WISE Amsterdam website (www.antenna.nl/wise/esp). A Russian version is published by WISE Russia and a Ukrainian version is published by WISE Ukraine. The WISE/NIRS Nuclear Monitor can be obtained both on paper and in an email version (pdf format). Old issues are (after two months) available through the WISE Amsterdam homepage: www.antenna.nl/wise.

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For individuals and NGOs we ask a minimum annual donation of 100 Euros (50 Euros for the email version). Institutions and industry should contact us for details of subscription prices.

WISE AMSTERDAM/NIRS

ISSN: 1570-4629

Editorial team: Dirk Bannink and Peer de Rijk

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An extended version of the Chernobyl Chronology is available at the website of Laka Foundation: <http://www.laka.org/chernobyl/chronology.html>

Next issue of the Nuclear Monitor (#725) will be mailed out on March 18, 2011

The "Elfi Gmachl Foundation for a Nuclear-free Future" / PLAGE-Salzburg supports the Nuclear Monitor financially.

See: <http://www.plage.cc> (not available in English (yet))

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