Chapter 3

Explosion

Introduction

Reliable eyewitness accounts of a catastrophe supplement the later objective data and can provide a real sense to the reader of *being there* which cannot be captured in any other way, even by photographs. In the case of Chernobyl not many eyewitnesses were in the area outside the NPP at the time of the explosion in the very early hours of 26 April 1986 and there are relatively few records from the power plant workers who survived and the firemen. Other eyewitness accounts are given in chapter 5 from some of the physicians who worked as *liquidators* in the early days of May 1986.

The term *liquidator* is a special one, used to describe the emergency accident workers, EAWs, who were involved in the cleanup operations and the healthcare delivery during the period 1986–89. The estimated number varies according to the definition of a liquidator/EAW and the source used, but drawn from all parts of the USSR they may have numbered as many as 650 000[1]. This chapter also describes the work of the liquidators who were helicopter pilots and firemen who fought under extremely high radiation dose conditions to extinguish the fires in the central reactor hall and on the roof of the turbine hall.

3.1 Eyewitness accounts

3.1.1 A schoolgirl

Only two eyewitness accounts at the time of the explosion have been located apart from the general comments on page 38 relating to time *01:23:48* on 26 April. The first was from a 16-year-old schoolgirl, Natasha Timofeyeva, who, with her relatives, was returning home late from a visit to friends. Her small village of only 55 houses was Chamkov in the Gomel region of Belarus, and was only 6 km from the NPP, on the opposite bank of the river Pripyat. It was quite dark, and she recorded[2] that she saw 'a bright flash over the most distant chimney of the power plant'.

3.1.2 A Polish surgeon and radiation specialist

A more informative account is from a Polish surgeon, Edward Towpik of the Institute of Oncology in Warsaw and the editor of a memorial book for Marie Curie and her work with the discovery of radium[3]. On the night of 25 April he had been hunting black grouse on the Polish–Belorussian border, not too far from Chernobyl, where one has to lurk in the middle of the night, in a special ditch covered with branches, to be prepared for the shoot at daybreak.

'The dawn was surprisingly purple-red and not a single black grouse appeared at the shooting ground.' He began to 'feel sick with fever and an intensive sore throat, just like very acute laryngopharyngitis' and was so ill that he had to return to Warsaw. After his return, everything ceased quickly without any medication. Soon afterwards he learned what happened, from Western radio stations, of course, as the communist media remained silent. Immediately the most sought after medicine in Poland was iodine solution.

3.1.3 Firemen

The initial six firemen, who were on duty at the NPP and who fought the blaze right from the start, all died. The following two eyewitness accounts are from their colleagues Private Andrei Polovinkin and Sergeant Ivan Shavrei who were on backup duty and who were interviewed for a special memorial issue of *Izvestia*[4a].

From Polovinkin:

> We arrived at the scene of the accident in 3–5 minutes and started to turn the fire engine and to prepare for extinguishing ... I went onto the roof of the turbine generator twice to pass on the brigade leader's order: how to deal with it. I would personally like to place on record a favourable mention of Lieutenant Pravik who knowing that he had received severe radiation burns still went and found out everything down to the last detail.

From Shavrei:

> Alexsandr Petrovskii and I went up onto the roof of the machine room; on the way we met the kids from the Specialized Military Fire Brigade No. 6; they were in a bad way. We helped them to the fire ladder, then made our way towards the centre of the fire where we were to the end, until we had extinguished the fire on

> the roof. After finishing the job we went back down, where the ambulance picked us up. We too, were in a bad way.

In a 1990 interview[4b] in Moscow by Dr Fred Mettler of the University of New Mexico, with a 24-year-old fireman, Mr Irmolenko, it was quite clear when asked 'What were the circumstances of your exposure?' that the firemen were given no proper advice whatsoever on radiation protection procedures when they arrived at the NPP some two and a half hours after the explosion.

> My fire brigade of about 12–13 firemen was called to the nuclear station at 4am. We were positioned about 100 metres from the wall of the main reactor building and were told to be ready in case we were needed. We remained in that spot most of the morning without being asked to do anything. At noon we ate lunch and again waited. At about 3pm several of us began to experience nausea and vomiting but suspected this was due to food poisoning. At about 4pm we were allowed to go home and told to return the next morning.
>
> Our brigade returned next day to the same spot and again waited, but before noon several again developed nausea and vomiting. A physician came by (assumed by Dr Mettler to have probably been Academician Leonid Ilyin) and immediately evacuated them for medical care. I was subsequently diagnosed with first degree acute radiation syndrome and recovered with supportive care.

On being asked 'If you could tell firemen in other countries one thing about your experience, what would it be?'. The answer was 'If there was a radiation accident and they have nausea and vomiting they must leave immediately. Nobody even told me that in any training I ever had'.

3.1.4 A radiation monitoring technician

The number of deaths in the first three months were 31 but of these, one was a reactor operator Valery Khodemchuk whose body was never recovered and is entombed in the debris, and one was a NPP worker Vladimir Sashenok who died in Chernobyl Hospital from thermal burns within 12 hours of the accident. Sashenok's death has been described[5] to Yuri Scherbak (author[6], Ukranian Ambassador to the USA in 1996, and in 1988, founder of the Ukranian Green Movement) by Nikolai Gorbachenko, a radiation monitoring technician at the NPP whose shift began at midnight on 25 April.

Gorbachenko was in the duty room drinking tea at this time and not in Unit No. 4 as it was in the process of being shut down as part of the experiment which was being carried out. He heard

> two flat and powerful thuds, the lights went out including the lights on the control panel and it was just as in a horror film. The blast blew open the double doors and black-red dust starting coming out of the ventilation vent. The emergency lights then went on and we put on our gas masks. My boss sent me to Unit No. 4 to find out what was happening.
>
> Two workers entered and asked us to help find one of their comrades: Vladimir Sashenok who had been missing for 30 minutes and was supposed to be in the upper landing across from the turbine room. Everything was a shambles on this landing, steam was coming out in bursts and we were up to our ankles in water. Suddenly we saw him lying unconscious on his side, with bloody foam coming out of his mouth making bubbling sounds. We picked him up by the armpits and carried him down. At the spot on my back where his hand rested I received a radiation burn. Sashenok died without regaining consciousness at 6am.

3.1.5 A control room operator

Oleg Heinrich, a control room operator, related his experiences[7,8] when in Germany in 1990 visiting relatives and taking the opportunity to ask for a hospital check-up for cancer at the Kiel University Hospital, as cancer was a great worry to him. This is his story. Born in April 1960, and therefore aged 26 when the accident happened, he was working in the control room on a second eight-hour shift (because he needed the money) with another operator, an older man.

He was sleeping in a room next to the control room, which was a room with no windows, when the explosion occurred. His older colleague was crying, the window in the control room had broken, he had received a heat burn, the lights had gone out and he was looking for the stairs. Those on the right-hand side of the room were destroyed but on the left they were still usable. Oleg had recently attended a lecture on radiation protection and because of this he took a shower and a change of clothing. His colleague did not, and instead, went to see what had happened, and subsequently died.

Oleg ended up some days later in Moscow Hospital No. 6 where he received skin transplants for his burns, but no bone marrow transplant. Plate II includes a series of four previously unpublished photographs from the Kiel University Hospital case notes[8] showing the post-irradiation skin changes of Oleg Heinrich some four years after the accident.

3.1.6 An operating shift chief

This account[5] is from someone knowledgeable about nuclear physics.

> It seemed as if the world was coming to an end. I could not believe my eyes. I saw the reactor ruined by the explosion. I was the first man in the world to see this. As a nuclear engineer I realized all the consequences of what had happened. It was a nuclear hell. I was gripped by fear.

3.1.7 An air force colonel

Colonel Anatoli Kushnin, when interviewed by a journalist from *Literaturnaya Gazetta*[9], stated that there were 80 helicopters and airplanes of various types deployed in Chernobyl and that he was responsible for the radiation safety of the staff. One of his orders to the helicopter pilots was that they should cover the floors of their machines with lead.

> By 4 May the pilots had buried the reactor core in sand despite conditions that were difficult and dangerous. The dosimetric devices on these helicopters measured radiation levels up to 500 roentgens per hour. In the first days after the accident these dosimeters went off scale. The crews were exposed to enormous radiation doses during their flights over the reactor. The military test pilot Anatoly Grischenko died in 1995 in the United States. He was the one who tried to lift a huge dome over the exploded reactor with the biggest helicopter in the world, the MI-26. He didn't succeed, but he was exposed many times to huge doses of radiation. He wasn't even told about that for a while.

3.1.8 The scientific advisor to President Gorbachev

Evgenii Velikhov[10] (now Director of the Kurchatov Institute of Atomic Energy, Moscow, who in 1986 was one of the Deputy Directors) was told by Nikolai Ryzhkov, the Prime Minister of the USSR to go to Chernobyl to try and find out what had happened. He left the next day expecting to stay for three days but remained for one and a half months. On 6 May from a helicopter he had his first view of the damaged reactor through the holes in the shield and by the light of the burning parachutes which contained the materials (silicates, dolomite and lead) intended to put out the fire. 'I could see no reactor in sight, this was very embarrassing for me as nobody believed me. The problems were not only scientific and technical, but also political and psychological'.

Velikhov also related how he could not initially understand why, as the helicopter lost height flying from the top of the ventilation stack towards the bottom, the radiation dose remained constant. Surely, he thought, the inverse square law of radiation should apply. It was only later that he realized how highly contaminated this stack was and that the source of radiation was not limited to the area at the base of the stack.

3.2 Causes of the accident

The fatal accident sequence was initiated by the power station's management and specialists when they sought to conduct an overnight experiment to test the ability of the turbine generator to power certain of the cooling pumps whilst the generator was free-wheeling to a standstill after its steam supply had been cut off. The purpose of the experiment was to see if the power requirement of Unit No. 4 could be sustained for a short time during a power failure.

It has been admitted[11a] that these tests were not properly planned, had not received the required approval and that the written rules on safety measures said merely that

> All switching operations carried out during the experiments were to have the permission of the plant shift foreman, that in the event of an emergency the staff were to act in accordance with plant instructions and that before the experiments were started the officer in charge would advise the security officer on duty accordingly.

With regard to the *officer in charge*, the principal managers were electrical engineers from Moscow and the person in charge was an electrical engineer who was not a specialist in reactor plants[12] and as *Pravda* reported[13] there was noticeable confusion even in minor matters.

It was also admitted[11a] that

> Apart from the fact that the programme made essentially no provision for additional safety measures, it called for shutting off the reactor's emergency core cooling system. This meant that during the entire rest period, which was about four hours, the safety of the reactor would be substantially reduced.

In addition[11a], 'the question of safety in these experiments had not received the necessary attention, the staff were not adequately prepared for the tests and were not aware of possible dangers'.

The NPP staff conducting the experiment, incredible as it might seem, knowingly departed from the experimental programme which was already of a poor quality. This was in part due to the fact that the experiment was behind schedule and if not completed, could affect the bonuses of the power workers. This created the conditions for the emergency situation which finally led to the accident which no one believed could ever happen.

In summary, therefore, the main causes of the accident, which were technological followed by human activity, are given in table 3.1, and have been drawn from several sources and reviewed by Meshkati[14]. Table 3.2, which to a certain extent overlaps with table 3.1, is a summary from the second INSAG report[11c] and summarizes a number of broader problems, rather than specific problems, which also contributed to the accident.

Table 3.1. Main causes of the accident.

- Faults in the concept of the RBMK: inherent safety not built-in.
- Faults in the engineering implementation of that concept: insufficient safeguard systems.
- Failure to understand the man–machine interface¶.
- The shutdown system was, in the event of the accident, inadequate and might in fact have exacerbated the accident, rather than terminated it.
- There were no physical controls to prevent the staff from operating the reactor in its unstable regime or with safeguard systems seriously disabled or degraded.
- There were no fire drills, no adequate instrumentation and alarms to warn and alert the operators of the danger.
- Lack of proper training as well as deficiencies in the qualifications of the operating personnel.
- Management and organization errors: as distinct from operator's errors.

¶ The man–machine interface was of concern to Valery Legasov, the First Deputy Director of the Kurchatov Atomic Energy Institute in 1986 and also the leader of the Soviet delegation to the post-accident meeting in August 1986 at the IAEA in Vienna[11a]. He has been quoted[15] as saying

> I advocate respect for human engineering and sound man–machine interaction. This is a lesson that Chernobyl taught us. One of the defects of the system was that the designers did not foresee the awkward and silly actions of the operators. The cause was due to human error and problems with the man–machine interface: this was a colossal psychological mistake.

Legasov was one of the casualties of Chernobyl in that in spite of glasnost and perestroika he became too outspoken about the political, managerial and scientific organizational faults which led to the accident. He became increasingly sidelined in Soviet nuclear energy politics and in April 1988 he committed suicide, see Appendix, which the authorities blamed on a diagnosis of leukaemia: this was untrue.

3.3 Countdown by seconds and minutes

The events of the 24 hours leading up to the explosions at 01:24 hours on 26 April 1986 are given in chronological order[11a–b] in terms of the current state of knowledge in August 1986 from Soviet documents[11a] and from the INSAG 1986 report[11b] and commentary is made in the light of furthur studies reported in the INSAG 1992 report[11c].

Table 3.2. Broader problems which contributed to the accident[11c].

• A plant which fell well short of safety standards when it was designed, and even incorporated unsafe features.
• Inadequate safety analysis.
• Insufficient attention to independent safety review.
• Operating procedures not founded satisfactorily in safety analysis.
• Inadequate and ineffective exchange of important safety information both between operators and between operators and designers.
• Inadequate understanding by operators of the safety aspects of their plant.
• Insufficient respect on the part of the operators for the formal requirements of operational and test procedures.
• An insufficient effective regulatory regime that was unable to counter pressures for production.
• A general lack of safety culture in nuclear matters, at the national level as well as locally.

25 April 1986

01:06

Start of reactor power reduction in preparation for the experiments and the planned shutdown of Unit No. 4.

03:47

Reactor power reduced to 1600 MW of *thermal* power, which was 50% of the maximum thermal power of the reactor. (The 1000 in RBMK refers to the maximum *electrical* power of 1000 MW.)

13:05

Unit No. 4 has two turbine generators, numbers 7 and 8, and turbine generator number 7 was *tripped* (terminology for shutdown) from the electricity grid and all its working load, including four of the main circulating pumps, transferred to turbine generator number 8.

14:00

As part of the experimental programme, the reactor's emergency core cooling system was disconnected. However, at this point in time the experiment was subjected to an unplanned delay because of a request by the electricity grid controller in Kiev to continue supplying the grid till 23:10 hours. This was agreed to by the Chernobyl NPP staff, but the reactor's emergency core cooling system was not switched back on.

This as far as it was known in 1986[11a–b] represented a violation of written operating rules and was maintained for just over nine hours. However, recent Soviet information confirmed that isolation of the emergency core cooling system was in fact permissible at Chernobyl if authorized by the Chief Engineer. Although INSAG now believes that this point did not affect the initiation and development of the accident, it is of the opinion that operating the reactor for a prolonged period of 11 hours with a vital safety system unavailable was indicative of an absence of safety culture[11c].

23:10

The reduction of the reactor's thermal power was resumed, since in accordance with experimental procedure the test was to be performed at between 700 MW and 1000 MW thermal power[11a–b]. It became clear after the accident that sustained operation of the reactor at a power level below 700 MW(th) should have been proscribed[11c].

26 April 1986

00:05

Thermal reactor power 720 MW; steady unit power reduction continues.

00:28

Thermal reactor power at around 500 MW. On going to low power, the set of control rods used to control reactor power at high powers, and called local automatic control rods (LACs), were switched off and a set of control rods called the automatic control rods (ACs) were switched on. However, the operators had failed to reset the set point for the ACs and because of this they were unable to prevent the reactor's thermal power falling to only 30 MW, a power level far below the 700–1000 MW intended for the experiment. However, later investigations suggest that the system was not working properly, the cause was unknown and hence there was inability to control the power, and therefore, as such, there was no operator error[11c].

01:00

The operators succeeded in stabilizing the reactor at 200 MW thermal power, although this was made difficult due to xenon poisoning of the reactor. The 200 MW level was only achieved by removing control rods from the core of the nuclear reactor. Nevertheless, 200 MW was still well below the required power level and the experiment should not have proceeded, but it did[11a–b]. Later reports[11c] confirm that the minimum operating reactivity margin (ORM) was indeed violated by 01:00 and was also violated for several hours on 25 April. Also the safety significance of the ORM is much greater than was indicated in the INSAG-1 report[11b].

01:03 to 01:07

The two standby main circulating pumps were switched respectively into the left and right loops of the coolant circuit. Eight main pumps were now working and this procedure was adopted so that when, at the end of the experiment in which four pumps were linked to turbine generator number 8, four pumps would also remain to provide reliable cooling of the reactor core. However, due to the low power of 200 MW and the very high (115–120% of normal) coolant flow rate through the core due to all eight pumps functioning, some pumps were operating beyond their permitted regimes. The effect was a reduction in steam formation and a fall in pressure in the steam drums.

01:19:00

The operators tried to increase the pressure and water level by using the feedwater pumps. The reactor should have tripped because of the low water level in the steam drums, but they had overridden the trip signals and kept the reactor running. The water in the cooling circuit was now nearly at boiling point.

01:19:30

The water level required in the steam drums is reached, but the operator continues to feed water to the drum. The cold water passes into the reactor core and the steam generation falls further, leading to a small steam pressure decrease. To compensate for this, all 12 automatic control rods (ACs) are fully withdrawn from the core. In order to maintain 200 MW thermal power, the operators also withdrew from the core some manual control rods.

01:19:58

A turbine generator bypass valve was closed to slow down the rate of decrease of steam pressure. Steam is not dumped into the condenser. Steam pressure continues to fall.

01:21:50

The operator reduces the feed water flow rate to stop a further rise in the water level. This results in an increase in the temperature of the water passing to the reactor.

01:22:10

Automatic control rods (ACs) start to lower into the core to compensate for an increase in steam quality.

01:22:30

The operator looks at the printout of the parameters of the reactor system. These are such that the operator is required in the written rules to immediately shut down the reactor, since there is no automatic shutdown linked to this forbidden situation. The operator continues with the experiment.

Computer modelling has shown that the number of control rods in the reactor core were now only six, seven or eight, which represents less than one-half the design safety minimum of 15, and less than one-quarter the minimum number of 30 control rods in the operator's instruction manual.

01:23:04

The experiment is started with the reactor power at 200 MW, and the main line valves to the turbine generator number 8 were closed. The automatic safety protection system which trips the reactor when both turbine generators are tripped was deliberately disengaged by the operators, although this instruction was not included in the experimental schedule. After all, operation of the reactor was not required after the start of the experiment. What seemed to be going through the mind of the operator was that if the experiment at first failed, then a second attempt could be made if the reactor was still running. It is difficult to avoid the conclusion that the major priority of the Unit No. 4 operators was to ensure that they completed the experiment during the 1986 rundown to the annual maintenance in 1987. It is hard to imagine a situation where the pressure and stress exerted on experimentalists is such that they would ignore many vital safety procedures. Nevertheless this is just what happened[11a–b].

However, later analysis[11c] shows that although the second turbogenerator was tripped at 01:23:04 the first turbogenerator was tripped at 00:43:27. This trip was in accordance with operational procedures and therefore the operators were not at fault and the original INSAG-1[11b] statement that 'This trip would have saved the reactor' seems not to be valid[11c].

01:23:05

The reactor power begins to rise slowly from 200 MW.

01:23:10

The automatic control rods (ACs) are withdrawn.

01:23:31

The main coolant flow and the feedwater flow are reduced, causing an increase in the temperature of the water entering the reactor, and an increase in steam generation. The operators noted an increase in reactor power.

01:23:40

A reactor power steep rise (sometimes termed a *prompt critical excursion*) was experienced, and the Unit No. 4 shift foreman ordered a full emergency shutdown (an *emergency scram*). Unfortunately the order came too late. Not all the automatically operated control rods reached their lower depth limits in the core and an operator unlatched them in order to allow them to fall to their positional limits under gravity. However, since the rods had been nearly withdrawn, a delay of up to 20 s would have had to occur before the reactor power could have been reduced. This would have been at 01:24:.00.

01:23:43

Emergency alarms operate, but unfortunately the emergency protection is not sufficient to stop reactor runaway. The sharp growth of the fuel temperature produces a heat transfer crisis. Reactor power reaches 530 MW in 3 s and continues to increase exponentially, figure 3.1.

01:23:46

Intensive generation of steam.

01:23:47

Onset of fuel channel rupture.

01:23:48

According to observers outside Unit No. 4, two explosions (these were thermal) occurred about 01:24 one after the other. Burning debris and sparks shot into the air above the reactor, and outbreaks of fire occurred in over 30 places due to high temperature nuclear reactor core fragments falling onto the roofs of buildings adjacent to the now destroyed reactor hall. Diesel

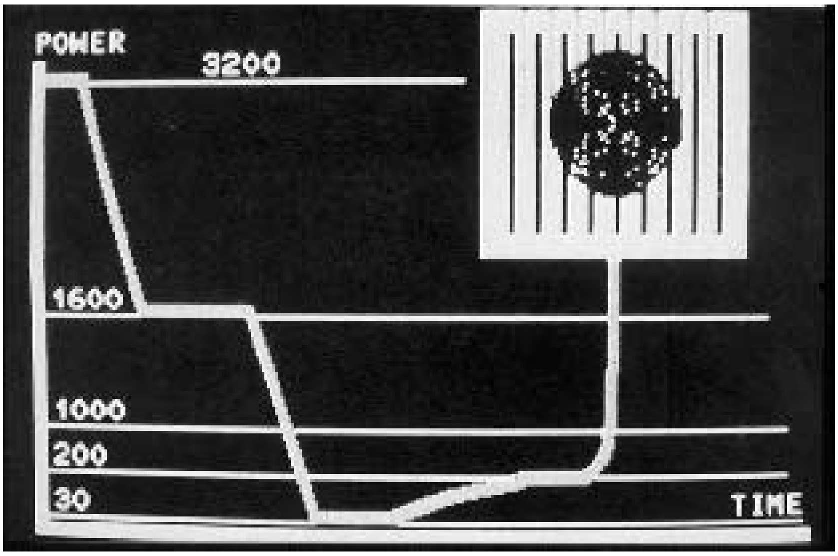

Figure 3.1. Variation of thermal power in MW with time, showing the final exponential rise of power[11a]. (Courtesy: USSR KGAE.)

fuel and hydrogen stores were also threatened and firefighting took precedence over radiation protection, since an even bigger disaster would have occurred if the fires had gone out of control.

There has been considerable further analysis[11c] of the events, including computer modelling, since the presentation[11a–b] by Soviet scientists at the August 1986 Post-Accident Review Meeting and these have led to new insights into the physical characteristics of the RBMK reactor. Most analyses now associate the severity of the accident with defects in the design of control and safety rods in conjunction with the physics design characteristics, which permitted the inadvertent setting up of large positive void coefficients. The scram just before the sharp rise in power that destroyed the reactor may well have been the decisive contributory factor[11c].

The features of the RBMK reactor have also resulted in other pitfalls for the operating staff and any of these, table 3.3, could just as well have caused the initiating event for this or an almost identical accident.

3.4 Damage to the power plant

One of the best descriptions of the damage to Unit No. 4 is given in part of the tender documentation[16] for the building of a second Sarcophagus to

Table 3.3. RBMK pitfalls other than defects in the design of control and safety rods and questions arising from the accident[11c].

Pitfalls
• Pump failure, disturbance of the function of coolant pumping or pump cavitation, combined with the effect of the positive void coefficient. Any of these causes could have led to sudden augmentation of the effect of the positive void coefficient.
• Failure of zirconium alloy fuel channels or of the welds between these and the stainless steel piping, most probably near the core inlet at the bottom of the reactor. Failure of a fuel channel would have been the cause of a sudden local increase in void fraction as the coolant flashed to steam. This would have led to a local reactivity increase which could have triggered a propagating reactivity effect.
Questions
• Which weakness ultimately caused the accident?
• Does it really matter which shortcoming was the actual cause, if any of them could potentially have been the determining factor?

protect the first one which is now crumbling with a likelihood of at least a partial collapse in the not too distant future. Part of this description is reproduced below.

After the explosion, part of the construction in the reactor unit, the ventilation stack, the turbine hall and other structures turned out to be destroyed, figures 3.2 and 3.3[11]. The reactor core was completely destroyed, walls and ceiling in the central reactor hall were demolished, Plate IV, figure 3.4, ceilings in the water separation drum premises were displaced and walls were destroyed. Premises housing the main circulation pumps (MCP) oriented to the north were destroyed completely and premises for the MCP lying to the south partially. Two upper stories of the ventilation stack were demolished and the columns of the building frame were shifted to the side of the turbine room.

The ceiling in the turbine room was destroyed in many places by fire and falling debris, several building girders were deformed and building frame columns were displaced along one axis by the explosion wave. The reactor emergency cooling system was completely destroyed from the north side of the reactor building and buried by debris.

The upper plate of the reactor's biological shield which weighed 2000 tonnes, was with the steam–water pipeline system and various ferroconcrete constructions were displaced so that the shield was inclined at 15° to the vertical and rested against the metal tank edge, figures 3.5 and 3.6[17]. The central reactor hall is filled with debris including materials thrown from

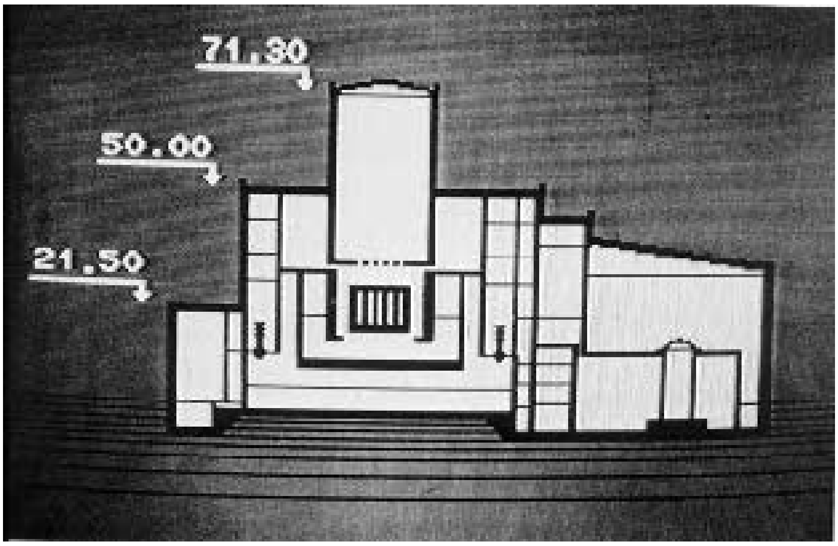

Figure 3.2. Cross-section through Unit No. 4 before the accident[11a]. (Courtesy: USSR KGAE.)

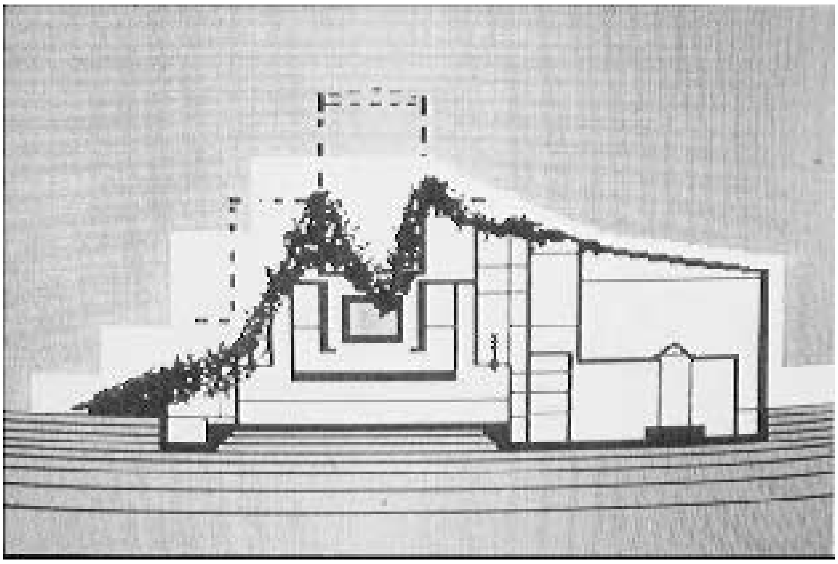

Figure 3.3. Cross-section through Unit No. 4 after the accident[11a]. (Courtesy: USSR KGAE.)

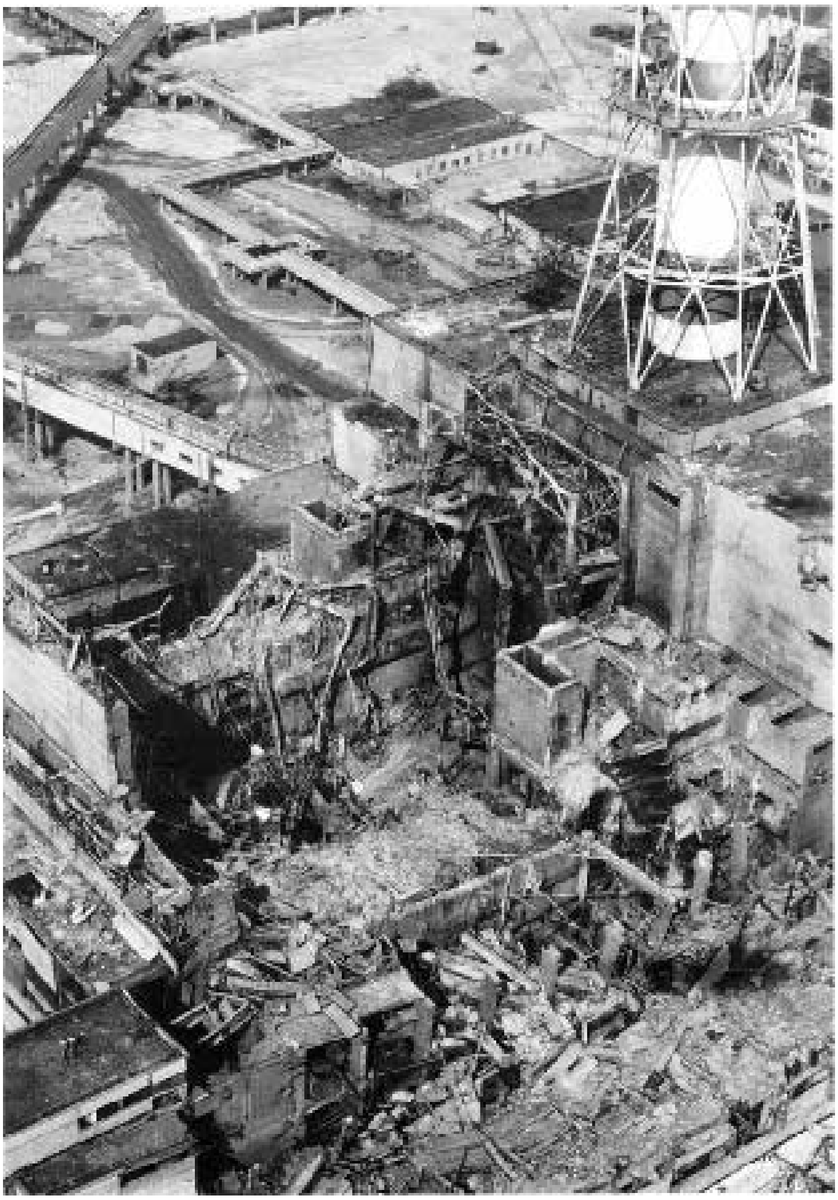

Figure 3.4. Close-up view of the damage to Unit No. 4. (Courtesy: Chernobylinterinform.)

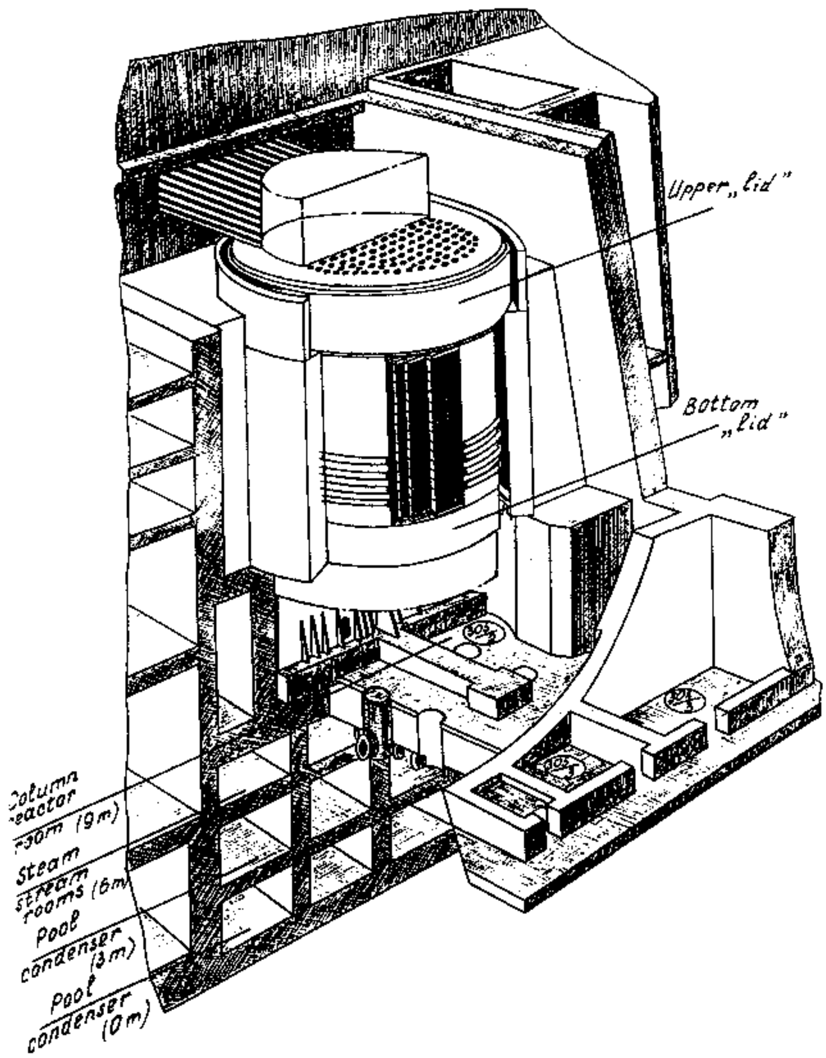

Figure 3.5. Cross-section through the central reactor hall before the accident[17]. (Courtesy: Chernobylinterinform.)

helicopters during the fire extinguishing phase. In some parts the debris is 15 m high.

Investigation of the south pool for spent fuel storage showed that fuel assemblies did not have any noticeable damage within the visible part of the pool. The north storage pool, which was empty, contains some elements

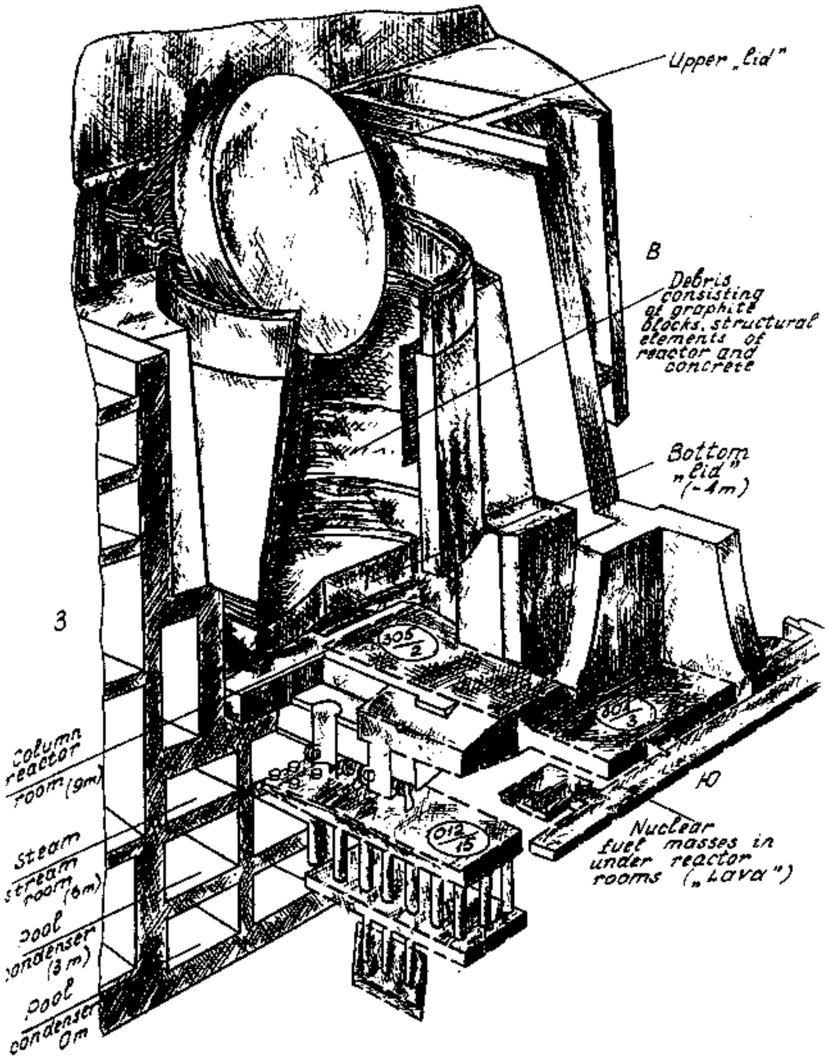

Figure 3.6. Cross-section through the central reactor hall after the accident. The upper lid is seen at an angle of 15° to the vertical[17]. (Courtesy: Chernobylinterinform.)

from the core and materials which were thrown from helicopters. No water was discovered in these pools. Such details of the accident[16] were not available for several years after 1986. Earlier, only exterior photographs of the damaged Unit No. 4 were published.

3.5 Extinguishing the fire

Extinguishing the fire was the first priority and this was achieved not only by the firemen, who worked mainly on the roof of the turbine hall, where the damage is clearly seen in Plate I, but also by helicopter pilots whose task was to put out the fire in what remained of the reactor central hall and to ensure that it did not break out again. This was attempted by dumping 5000 tonnes of boron compounds, sand, clay, dolomite and lead during the period 27 April to 10 May. On 27 April the helicopters flew 93 missions and on 28 April a total of 186 missions. The overflying speed was 140 km/hr.

Their missions continued throughout 1986 and by the end of June they had dumped 14 000 tonnes of solid materials, 140 tonnes of polymerizable liquids and 2500 tonnes of trisodium phosphate[18].

It was extremely hazardous for the helicopter pilots when flying near the electricity pylons, figure 3.7, and there was a fatal accident on 28 October 1986. This was captured on video[19], figure 3.8, and there is a memorial to those who died which incorporates one of the rotor blades. This is situated by the side of the road to Chernobyl and also includes a helicopter of the type which was used. The pilots were well aware of the dangers and an Afghan war veteran is on record[1] as saying 'When we heard that soldiers were being sent to Chernobyl as liquidators, we all felt we were better off fighting the war'. By 1991 it was reported that an unspecified number, *some*, of the helicopter pilots had died[18] and that in spite of their efforts no neutron absorbers reached the reactor core.

3.6 Initial reports of the accident

3.6.1 In the USSR

The Soviet authorities through TASS and the Novosti Press Agency informed the rest of the world about the accident before their own population. This was on 28 April 1986, two days after the accident had occurred. The first communication to reach the United Kingdom from Moscow TASS was terse:

> An accident has occurred at the Chernobyl Atomic Power Plant as one of the atomic reactors was damaged. Measures are being undertaken to eliminate the consequences of the accident. Aid

Figure 3.7. Helicopter flying near power lines and the ventilation stack[18]. (Courtesy: Chernobylinterinform.)

Figure 3.8. The fatal accident when the rotor blades crashed through a power line[19]. (Courtesy: Chernobylinterinform.)

> is being given to those affected. A Government Commission has been set up.

A second communication was later issued on 28 April which attempted, with anti-American rhetoric, to play down the effects of the Chernobyl accident.

> The accident at the Chernobyl Atomic Power Station is the first one in the Soviet Union. Similar accidents happened on several occasions in other countries. In the United States 2300 accidents, breakdowns and other faults were registered in 1979 alone. The atomic power station North Anna-1, Virginia, near Washington DC is topping the list of accident prone stations. A major accident occurred in 1979 at the atomic power station in Harrisburg, Pennsylvania, where radioactive substances leaked due to a reactor breakdown ... etc.

3.6.2 In the West

The USSR also, unsurprisingly, did not admit to any previous accidents, such as that at Kyshtym[20]. Forsmark nuclear power station in Sweden, 130 km north of Stockholm was the site at which the radioactive cloud was first detected outside the borders of the Soviet Union and the events have been related by a Swedish physicist[21].

> Radioactivity was measured on workers passing through the entrance gate to the power station at 7am on 28 April. High levels were measured outside the station and the Swedish authorities were informed at 9.30am. Evacuation of the station began at 11am. About 1pm the indications were that the activity did not come from the Forsmark station and that it was coming from the east, as that was the direction of the prevailing wind. Confirmation came from the Soviet authorities in the late evening of 28 April that an accident had taken place early in the morning of 26 April.

Several satellite photographs were published at this time and, for many years, it was generally assumed that the first of these was taken only after 28 April after the accident was noted at Forsmark. However, this was not correct. An American satellite had passed over the Chernobyl area only 28 s after the accident on Saturday 26 April 1986. This was pure chance. The reason for such a monitoring orbit was to take in a nuclear missile site. An early warning radar screen 132 m high by 96 m wide can still be seen on the road to Chernobyl NPP.

America's initial assessment was that a nuclear missile had been fired, then when the image remained stationary, opinion changed to a missile had blown up in its silo. It was only when a map of the area was consulted that it was realized that it was the Chernobyl NPP.

There are various confirmations of this story, one of the most interesting being that of an IAEA official in Vienna who was attending a British Embassy reception on the Sunday evening being asked about the nuclear accident which had just occurred. 'What nuclear accident?' 'You don't know, well go and check at the Agency'. This he did early on the Monday morning of 28 April to find that there was no knowledge of the accident. It was only later that day that the Forsmark radiation measurements were reported to the IAEA[22].

Once the accident had been confirmed in the West, the press ran riot with various exaggerated claims such as the following: 2000 dead in atom horror: reports in Russia danger zone tell of hospitals packed with radiation accident victims[23]; Please get me out Mummy: terror of trapped Britons as 2000 are feared dead in nuclear horror[24]; 15 000 dead in mass grave[25].

Many cartoons were also published and there were also some spurious photographs. One such series on American and Italian TV networks showed on their screens what purported to be the Chernobyl NPP burning. The truth was that these were pictures of a burning cement factory in Trieste[26,27]. The instigator, a Frenchman Thomas Garino collected a fee of US$20 000, and an ABC TV newscaster later told his audience that 'This is one mistake we will try not to make again'.

Another fraudulent photograph was published by *The Sunday Times*[28] in the United Kingdom on 11 May and in *Time* magazine[29] on 12 May, the former in black and white and the latter in colour. This photograph when in *The Sunday Times* was beneath the headline *Cloud over Kiev* with the quote: 'It was 3 pm on a sunny day when a tourist took this picture of the nuclear cloud, a cloud whose effects fill the residents of Kiev with fear'. The skyline is that of Kiev but it defies all credibility to believe that a black cloud of soot and smoke could travel the 146 km from the NPP and remain intact about a week after the explosion. The photograph eventually located[30] in the John Hillelson photographic agency was found to be only black and white. Journalistic license had added the orange tint to represent the sunset over Kiev.