Tape 3 Side B

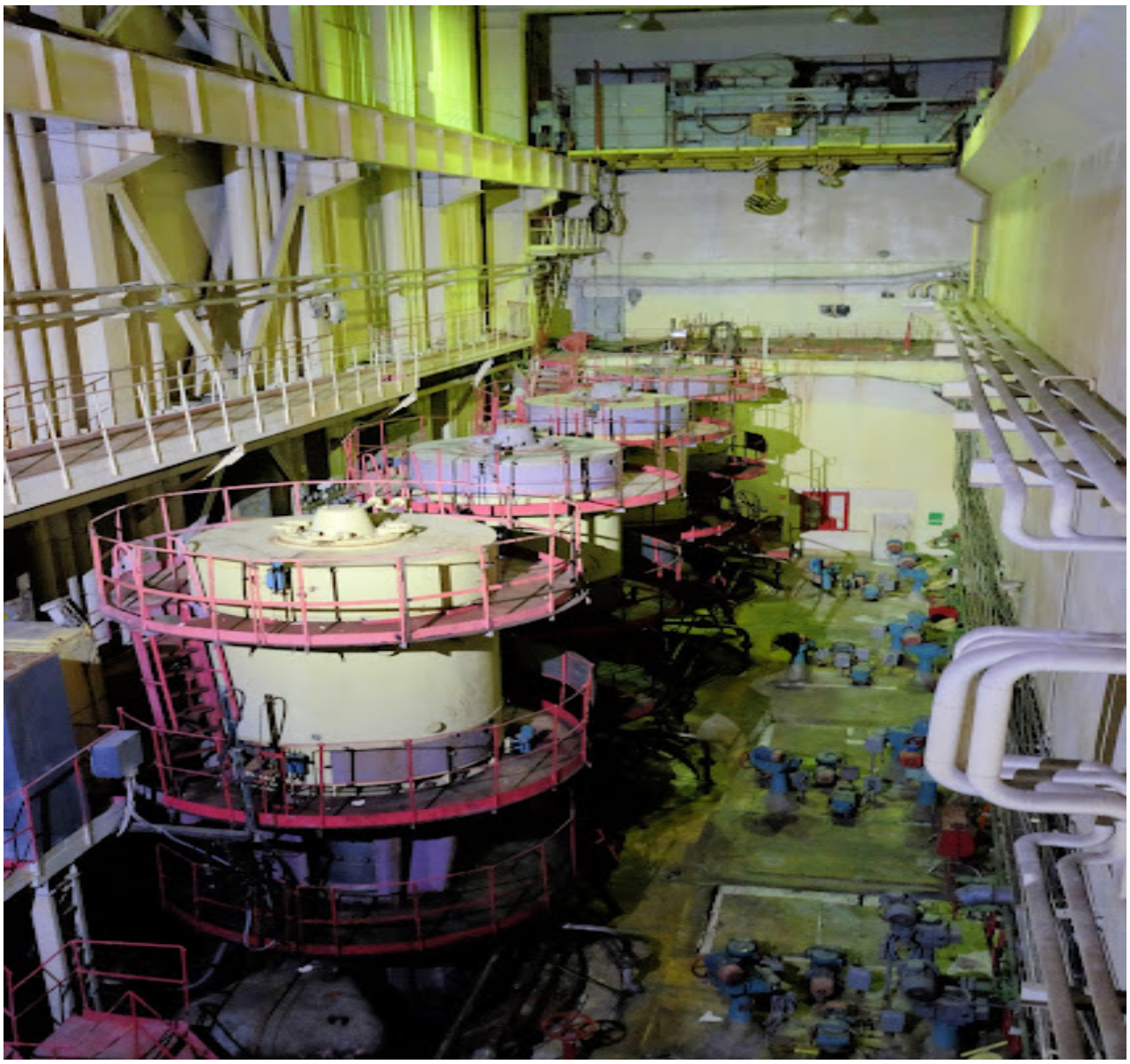
All of this had such an irregular, sudden quality. On the one hand, it could be explained by the young age of this branch of technology, and to some extent it is; but on the other hand, it was a reflection of an overall incorrect manner of working in general. When Nikolai Ivanovich spoke his words, and they, like a light, retrospectively illuminated all the previous events, I realised that these were the right words. But I also realised that this was not specific to the nuclear energy industry, but rather the consequence of the way work was organized in general, to create, very quickly create, a new branch of technology that the national economy needs.

Here's a way to organize work on construction sites: inconsistency in different types of production, say, the production of fuel elements; the machine-building equipment, the unpreparedness of builders to accept this equipment on time; garbage on construction sites; constant, incomprehensible changes in the number of construction staff (by construction I mean at nuclear power plants), at times too many, at others too few. Work, so to say, is progressing on the station, then abruptly stops because one or the other equipment is not there.

All this taken together was very unpleasant, and at the same time, hardly unique or specific to the nuclear energy industry alone. That is why the words of Nikolai Ivanovich Ryzhkov should be understood in a much wider context. And when I visited the Chernobyl station after the accident and saw what was happening there, I myself drew a precise and unequivocal conclusion, that the Chernobyl disaster is an apotheosis, the pinnacle of all the mismanagement that has been carried out for decades in our country.

Of course, what happened at Chernobyl has real, not abstract, culprits to blame. We already know now that the reactor's Protection Control System (PCS) had a defect in it, and many scientists knew this, and they proposed ways to fix this defect. The Chief Designer, not wanting to do, so to say, quick, additional work, was in no hurry to change the Protection Control System.

Also, there are, of course, specific culprits. What went on at the Chernobyl station itself for many years: conducting, so to say, experiments the plans for which were made very carelessly and sloppily. Before conducting the experiments, there were no simulations of possible situations, that is the situations were not walked through—what will happen if there is a protection malfunction; what will happen if the process does not execute as planned; how should the staff react in one situation or the other; can the reactor be left running when the steam supply to the turbine is stopped; and if this is done, what could happen; what will happen if the main circulation pumps are switched on.



Source: flickr/atomicallyspeaking

Common sense would suggest that all these cases had to be simulated before the experiment, be it this particular one or any other. But nothing of the kind, of course, was done. There was an absolute disregard of the viewpoint of the Chief Designer or the Science Supervisor. It needed a fight to…

[TAPE ERASED]

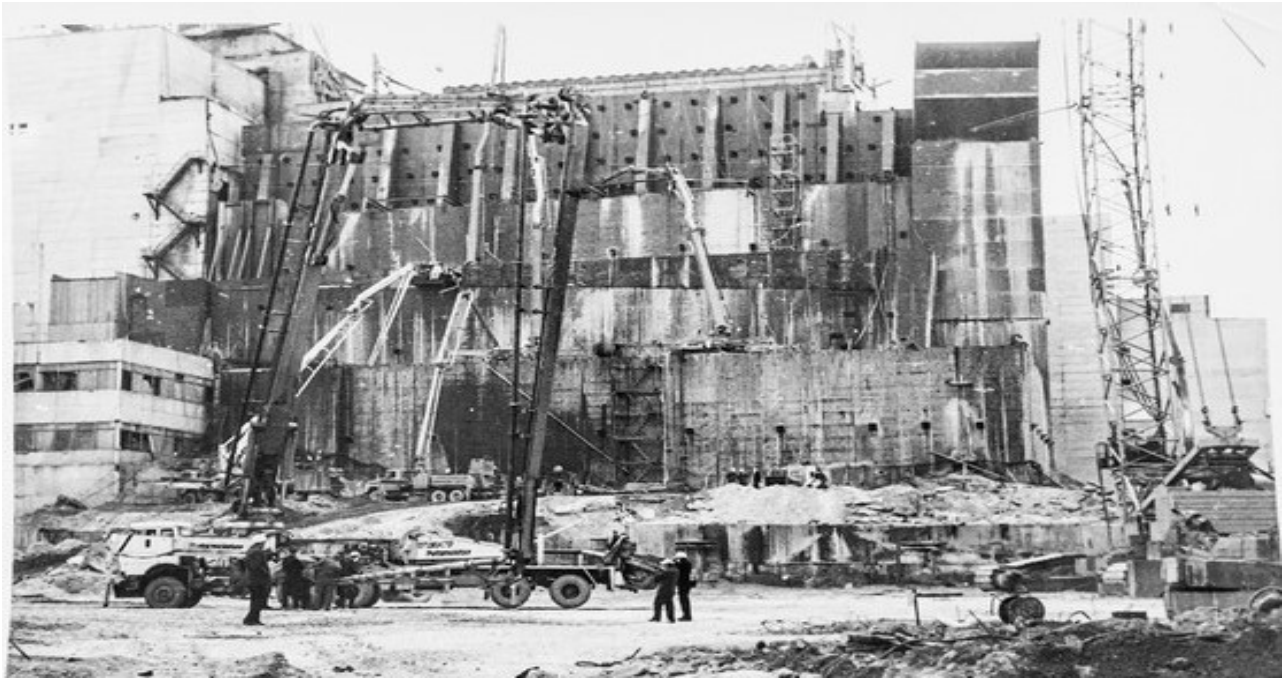
Speaking of the conversations with Mikhail Sergeyevich Gorbachev. While in Chernobyl, I spoke with him thrice on the phone. This was rather odd. He, of course, would call the Second Deputy of the Government Commission, comrade Silayev Ivan Stepanovich, or maybe he would call Shcherbina and talk to him, but this was not in my presence. But sometimes when we were at Silayev's, then Gorbachev would call. Ivan Stepanovich would tell him his point of view and then, when more detailed, specific, technical information was needed, he would ask, "To whom should I give the phone, Velikhov or Legasov?" And in the first call, he said, "Give the phone to Legasov."

So I started talking to him. He, Mikhail Sergeyevich, spoke for two or three minutes. "What is going on there? I am very concerned about this problem. Already the name of Gorbachev is being

tarnished all over the world because of this accident. Mass hysteria has begun. What is the real situation there?" In response to this, I outlined the situation for him; that basically—as it was after the 2nd of May; the call was around the 4th or 5th of May—the radiation emissions from the destroyed block have ceased, and the situation is currently under control. The scale of contamination in the areas adjacent to the Chernobyl station, as well as the scale of contamination around the world, is more or less known to us. It was already clear to us that people injured by radiation, except for those who worked at the Chernobyl station at the time of the accident, are expected to be unlikely; that the control of the population is thorough; that if the countries that came under the nuclear fallout from the accident took proper informational and sanitary measures, then there will be no real consequences to the health of the people.

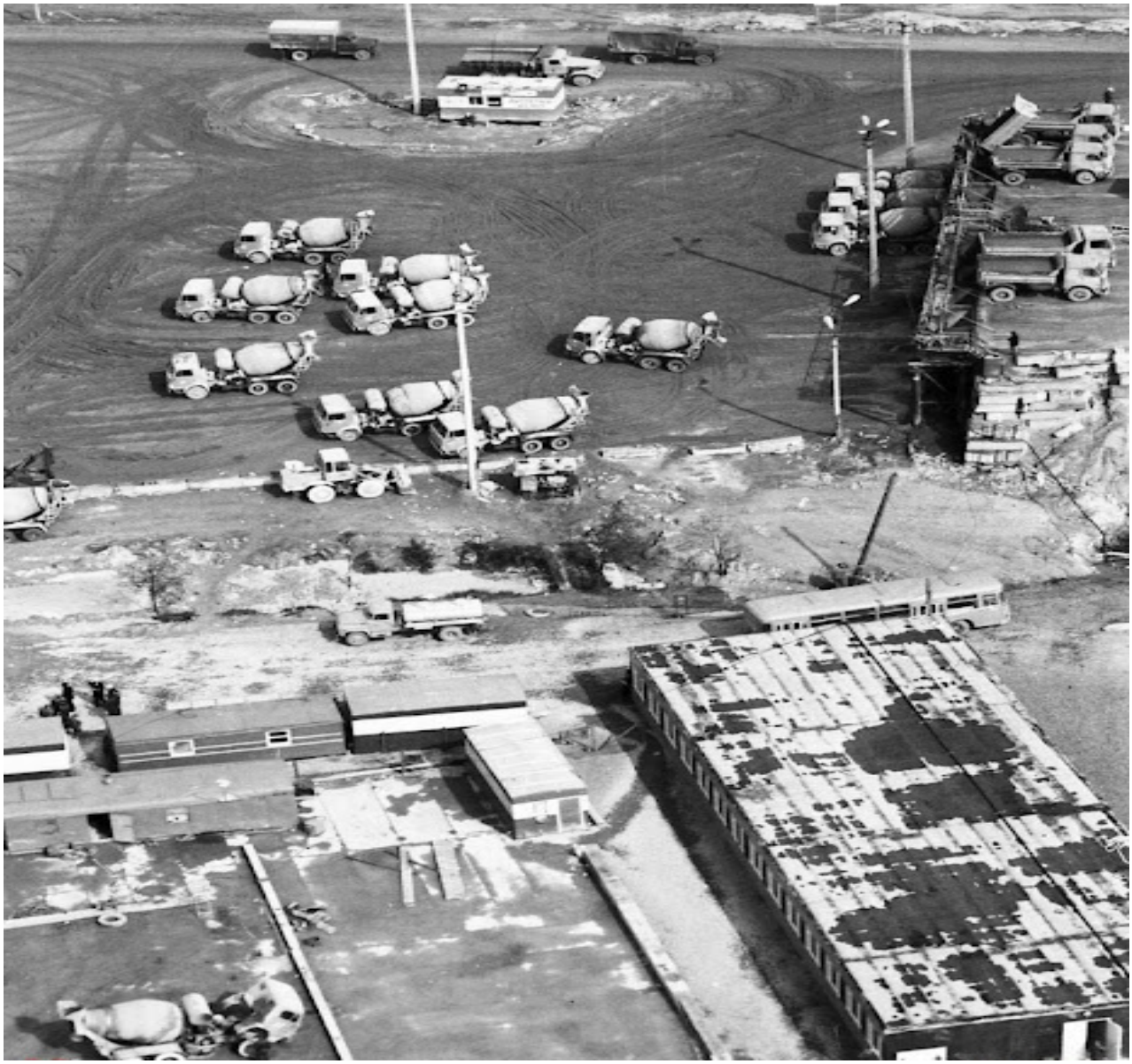
This is what I said to Mikhail Sergeyevich on the 6th of May, not knowing that on the same day a session of the World Health Organization, specially assembled about this issue, had come to the same conclusion. That the accident did not pose any threat to the people in Western Europe and other countries. I also talked about the specific situation, where the heavily contaminated areas were, where the situation was more or less favourable, and how the work was progressing. He was satisfied with this conversation.

The next day, when we were at Ivan Stepanovich Silayev's office again, the phone rang once more, and this time he asked for the phone to be given to Evgeny Pavlovich Velikhov. He began to ask him about the reasons for the accident, but Evgeny Pavlovich started giving very confusing explanations, and then quickly said that Valery Alekseyevich [Legasov] will explain this better, and handed the phone over to me. Perhaps I was too generous with the details, but I did explain why this accident had occurred. And at that moment, Mikhail Sergeyevich asked me to write a personal letter to him. And what surprised me was that I, specifically, had to send a letter about what had happened and what had to be reported. So I immediately sat down to write this letter, and after a few edits by Ivan Stepanovich Silayev, it was sent to Gorbachev that same night, signed by Silayev, Velikhov and me.



Ivan Stepanovich Silayev, during his term, paid the most attention to the construction work—arranging the concrete factories, arranging the shipment of concrete—because it was clear to him

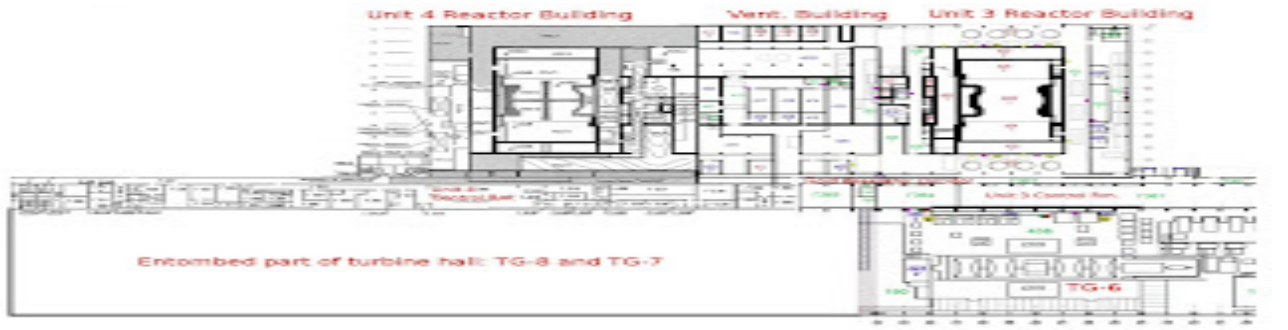
that the area around the 4th block had to be concreted as much as possible. He was very angry with, say, Makuhin, the First Deputy Minister of Energy and Electrification, who, it seemed to him, was working slowly; and he even made a quick decision to fire him. This decision was never implemented, but such words were said. It was Ivan Silayev who introduced the system of monetary rewards for doing the most dangerous tasks. And the most dangerous tasks during his term were to determine whether or not there was water inside the upper and lower bubblers, and in the rooms beneath the reactor hall because this was crucial. We were worried that some of the molten fuel would get there, and possibly lead to powerful vaporization which will carry out additional radioactivity. And we had to know whether those bubblers were empty or not. After that, we had to decide whether to leave them empty or to fill them with special concrete. So Ivan Stepanovich Silayev had to tackle all these issues



It was quite hard to get to these bubblers because the adjacent corridors were flooded with water from the time when they were trying to cool down the reactor with water. The levels of radioactivity in that water were quite high, up to a curie per litre in some places and at certain points in time. The pumping devices were turned on and this water was pumped out. And yet, the gate valve that needed to be opened to determine if there was water inside the bubblers, was opened by one of the station workers in very difficult conditions. So in the evening, Ivan Stepanovich solemnly thanked him and gave him a package with a thousand roubles. He had obtained the necessary permission for it. And I saw the face of that man who, on the one hand, was very proud that he had managed to do this difficult task in such difficult conditions. However, on the other hand, it was plain to see how he crumpled that package of money, not like a prize. Basically, it was uncomfortable for him to refuse this money, but at the same time, the cash form of the prize itself did not really please him. Probably because indeed, especially during that period, people who fought with this accident sought to do their best, to do everything they could, without thinking about any kind of encouragement, be it material or moral. Everyone worked as a single collective, attempting to find the best solution.

During this time, it was frightening to look at comrade Konviz—he was from Hydroproject and the chief engineer of the station—because he, I think, never slept, not for a minute. And naturally, to find out how to access various rooms, everyone turned to him, either to his drawings or simply to his memory, to his experience.

Here I recall many such annoying episodes. You would look at the drawings and see an open corridor. You would start moving along this corridor and suddenly run into a wall. The wall was obviously built there because of some engineering considerations after the project was completed. It was not in the design, but it was there and not shown in any of the drawings. There were reverse cases as well, when, say, where should have been a wall according to the drawings, in reality, was a doorway. We encountered such cases as well.



Source: reddit (r/chernobyl)

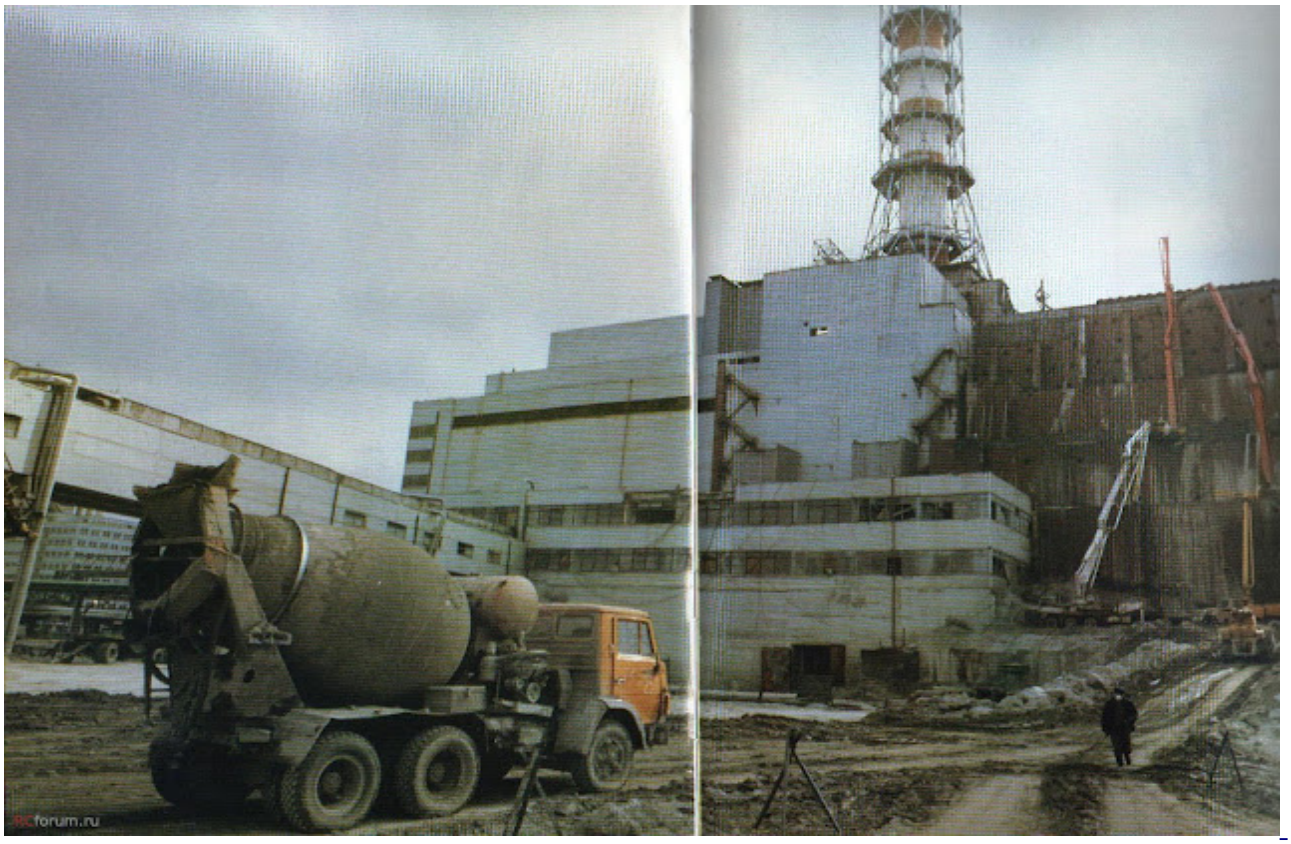
It was particularly hard for the miners because, beneath the station territory, a large number of pipes and plates were buried in the ground. And so when they worked using their or something similar, their way would appear to be clear when looking at the underground utility drawings. But when they began their work, they constantly ran into obstacles that were not shown in the drawings.

There were a lot of inconsistencies between the part of the documentation that was at the station and the reality in various places of the station and underground facilities. All this certainly gave an impression of gross neglect, of gross sloppiness towards maintaining documentation, which should be accurate and describe the state of building structures, and walkways, and electrical communications at every moment in time. Unfortunately, we came across this sloppiness quite often. At the same time, I want to highlight the fact that although these things are irritating when faced day after day, at that moment the people were so determined, they so wanted to complete their work, that all these past cases of sloppiness did not cause any fuss or outcry. All this receded into the background in front of the will to tackle the situation as quickly as possible.

The number of people staying at the site was increasing day by day because each group required new assistants, who came either with devices, or with documents, or with work tools that were needed to perform a task. This increase in the number of people required new ways of organizing work because it was no longer possible to personally give specific instructions and be done with it. That is why after the main problems had been solved (by main I mean protecting people from immediate danger and localizing the disaster itself), came the question of managing all these numerous groups of people who had gathered there at the suggestion of the Government Commission, according to the decisions of the Operative Group of the Politburo of the Central Committee, and stayed in ever-increasing numbers, along with their equipment, on the territory of the Chernobyl nuclear power plant.

It was necessary to simultaneously organize a number of tasks that were of completely different types. First of all, start the design of the covering that would later come to be called the ‘sarcophagus’. This design had to be done concurrently at the site and in the different design organizations located in cities across the Soviet Union, mainly in Moscow and Leningrad. It was necessary to immediately work on zone-wise decontamination, following the guideline of going from the most contaminated areas to the less contaminated ones. It was necessary to carry out a survey of the territory, to continue this reconnaissance, and to check how radioactivity was being spread by the wind, by the vehicles. It was necessary to tackle the issue of checking the equipment in the 1st and 2nd blocks, of checking the remaining structure and equipment in the 3rd block. It was necessary to assess the condition of all the rooms and areas on the entire Chernobyl station, its surrounding areas and roads. It was necessary to accommodate the army divisions as well as the various construction organizations that had arrived to help solve this situation. A proper

management system had to be established for scientific research, design and execution of projects across all these very diverse areas of work. The management system for this complex mechanism was established gradually.



The first two groups, led by Boris Yevdokimovich Shcherbina and Ivan Stepanovich Silayev, were occupied exclusively with the most important and urgent tasks. Thanks to the arrival of comrade Voronin, the overall scheme of work management had started to form. A procedure for ordering materials was established already; a procedure for work fulfilment. It became clear that one group of researchers had to work solely on the tasks related to the 4th block, while another would tackle its surrounding area. The third group—implementers, not researchers; these were mostly the army divisions— began decontaminating the rooms in the 1st and 2nd block, and also prepared for the construction of the sarcophagus, because the design was already in progress in Moscow.

Comrade Voronin was replaced by Yury Nikitich Maslyukov, and during his time a lot of work was done to build new premises, new villages for the evacuees. The treatment of roads had begun, and the initial preparations started in front of the 4th block for the construction of the sarcophagus. The sarcophagus itself had not yet been begun but the approaches to it had already been concreted. The most contaminated areas had either been cleared or concreted for the builders to begin their work on the sarcophagus construction.

When comrade Gusev came to the site with his team, the main design elements were being sketched out. It had already been decided to assign the construction of the sarcophagus to SU 605, a department in the Ministry of Medium Machine Building; and that a thorough assessment of the internal condition of the 4th block had to be carried out, of the structural soundness of its remaining building, so that the project could rely on some analysis, on some verified data.

And when comrade Vedernikov and his team replaced Gusev, the construction of the sarcophagus had already begun. Moreover, particularly under Vedernikov, with the participation of the group leader from the Institute of Nuclear Energy, comrade Tutnov, a decision was taken that made the construction of the sarcophagus easier and quicker. Because originally the plan was to build a dome made entirely of concrete over the wreckage. However, calculations showed that the time needed for the construction of the sarcophagus could be significantly reduced if the concrete dome—the reliability of which was being questioned, whether the design would hold its weight— is replaced by, so to speak, a pipe run. The pipe system of roof support would protect the sarcophagus against the possibility of radioactive dust being carried out. However, more radiation would escape through this top cover but it would be comparable to or even less than the total radiation on the site. The correct decision was made during the time of comrade Vedernikov.

And gradually, the following framework of work organization emerged. It came down to this that the research group from the Institute of Nuclear Energy together with experts (this group was successively led by experts such as Yury Vasilievich Svincev, Anatoly Mihailovich Polevoi, Tutnov as I have already said; next this group was led by comrade Kuharkin Nikolai Evgenievich. A lot of work was done when comrade Pologikh Boris Grigorievich led this group. Also, research groups under which particularly a lot of work was done were led by Kulakov, Borovoi, for example) had to —and this was their primary objective—thoroughly investigate the premises of the 4th block. Firstly, find the fuel; determine how was it distributed. Secondly, install the maximum number of sensors that would ascertain the condition of the 4th block.

Here I need to pay tribute to comrade Schekalov, the expert from the Institute of Nuclear Energy, and also to the experts from the Ukrainian (Kiev) Institute of Nuclear Research, who made great efforts to find the appropriate paths, put in the necessary sensors, and stretch cables to them. As for neutron sensors, they were the responsibility of CNIIP [Central Science Research and Project Institute] of the Ministry of Medium Machine Building. The experts from this institute were led by comrade Zhernov. Generally, one of their tasks was to put various sensors in the 4th block for measuring gamma fields, neutron fields, measuring temperature, measuring airflow, measuring the hydrogen concentration sensors should it suddenly appear in the system, etc. These sensors were placed in various spots. This was dangerous and hard work because they had to go inside the block every time and search for the most suitable spots that would reliably diagnose the condition of the 4th block. This was one set of tasks.

At the same time, videos and photos of the rooms of the 4th block were taken continuously which allowed the engineers to select the proper solutions for the construction of the sarcophagus itself. During this, the project team from NIPIET - Leningrad Design Institute of the Ministry of Medium Machine Building, was working on-site in Chernobyl, and an array of design decisions, though the general design had been developed at the Institute, an array of design decisions were made there on the spot. An absolutely enormous amount of work was done by comrade Kurnosov, the chief engineer of this project and the chief engineer of the institute itself. He regularly found proper solutions when one or the other difficult situation arose.

And there were difficult situations. An attempt to pour concrete in an area was unsuccessful because there were rather large gaps through which the concrete flowed to the levels below. Methods to hold the concrete in place had to be thought of. Some supports were not strong enough and reinforcement was necessary. This harmonious work of the researchers and the designers, in the end, led to a reliable construction. That was one group of tasks.

Another set of tasks was performed by the construction experts from the Ministry of Energy who were building a temporary village called Green Cape (Zelyoniy Mis). Many prefabricated houses were ordered, made both in Finland and in the Soviet Union. And for the shift workers that had to work in the 1st and 2nd blocks, a very nice village was constructed with all the needed amenities: with houses, with shops, with cultural facilities. This village had been constructed literally in a few months. Boris Yevdokimovich Shcherbina was personally following the construction of this village, paying attention not only to the places to sleep after work, but also that there should be flowers, that the canteen worked as well as in any other part of the Soviet Union, and that the people felt comfortable there. These divisions of the Ministry of Energy had taken part in the construction of the village at Green Cape, and also in the construction of many stations for the decontamination of vehicles, quite a lot of which had gathered on the site by then.

The Government Commission itself had already been relocated by this time. The work was, as before, done in Chernobyl in the former regional Party Committee building, but the living accommodations were moved approximately 50 kilometres away from Chernobyl. The leaders of the Government Commission, as well as the various experts that were arriving to perform certain tasks, lived there.

A large group of researchers from various organizations of the Soviet Union, from the Academy of Sciences , from the Kurchatov Institute of Nuclear Energy(when I say Academy of Sciences , for example, I mean of course the GeoChem [ГЕОХИ] and the entire Ukrainian Academy of Sciences), this whole group of researchers was working on a detailed assessment of the radioactive contamination of the area. For this, they used both statistically reliable samples that were gathered on the site—followed by analysis in the radiochemical laboratories that had been deployed in Chernobyl, and some samples were sent to the institutes, the Radio Institute or the Institute of Nuclear Energy—and measurements of gamma fields made using helicopters. These surveys were done for both the total amount of gamma radiation and the isotope spectrum of gamma radiation. And were found between the contents of individual isotopes, by using relative contents of which we could predict the concentration of, say, Plutonium that was released into the environment. Of course, samples of Plutonium, as well as other heavy alpha-active elements, were collected continuously to compare the data gathered by the helicopters and through the direct collection.

The responsibilities were distributed in such a way that everything that was outside of the 30-kilometre zone was controlled both from the air and from the ground by the Goskomgidromet [State Committee on Hydrometeorology] led by Yury Antonovich Izrael. I cannot exactly tell how much time he spent in Chernobyl, and took the most thorough part in data collection, their correct estimation, researching the history of the appearance of contamination spots. An enormous amount of work had been done and as a result, outside the 30-kilometre zone, we were receiving more and more precise maps that showed the degree of contamination of various areas.

And within that 30-kilometre zone, the talk was mostly about Caesium contamination, because several Caesium spots had appeared (these will be shown on the maps) and the creation of Caesium maps began in the period from the date of the accident until the 20th of May, after which the creation of such maps was stopped.

According to existing sanitary norms, decisions were taken that set the maximum limits [of radiation exposure] that allowed people to live in areas contaminated by certain isotopes. The local authorities acted according to these rules, either relocating people or letting them stay, switching to

imported food, or declaring the area safe enough to live in and to use the land. At the same time, the Gosagroprom [State Agro-Industrial Committee] and the experts from the Ministry of Medium Machine Building were also carrying out analysis of various agricultural crops, determining the degree of their contamination, observing the forests and fields around the Chernobyl station, both within the 30-kilometre zone and around it.

As for the 30-kilometre zone itself, it was under the charge of the experts from the Ministry of Nuclear Energy, the experts from the Kurchatov Institute, experts from the Radium Institute and the experts from the Ukrainian Academy of Sciences.

In September, the work of the substitute Government Commission had ended. All the work was transferred to the revised composition of the first Government Commission (the one led by Boris Yevdokimovich Shcherbina) that had been approved. And subsequently, from September onwards, all the work on the site of the Chernobyl station and within the contaminated zone was the responsibility of the Government Commission. It made all the decisions, reviewed all the projects, all the comments, and led all the work.

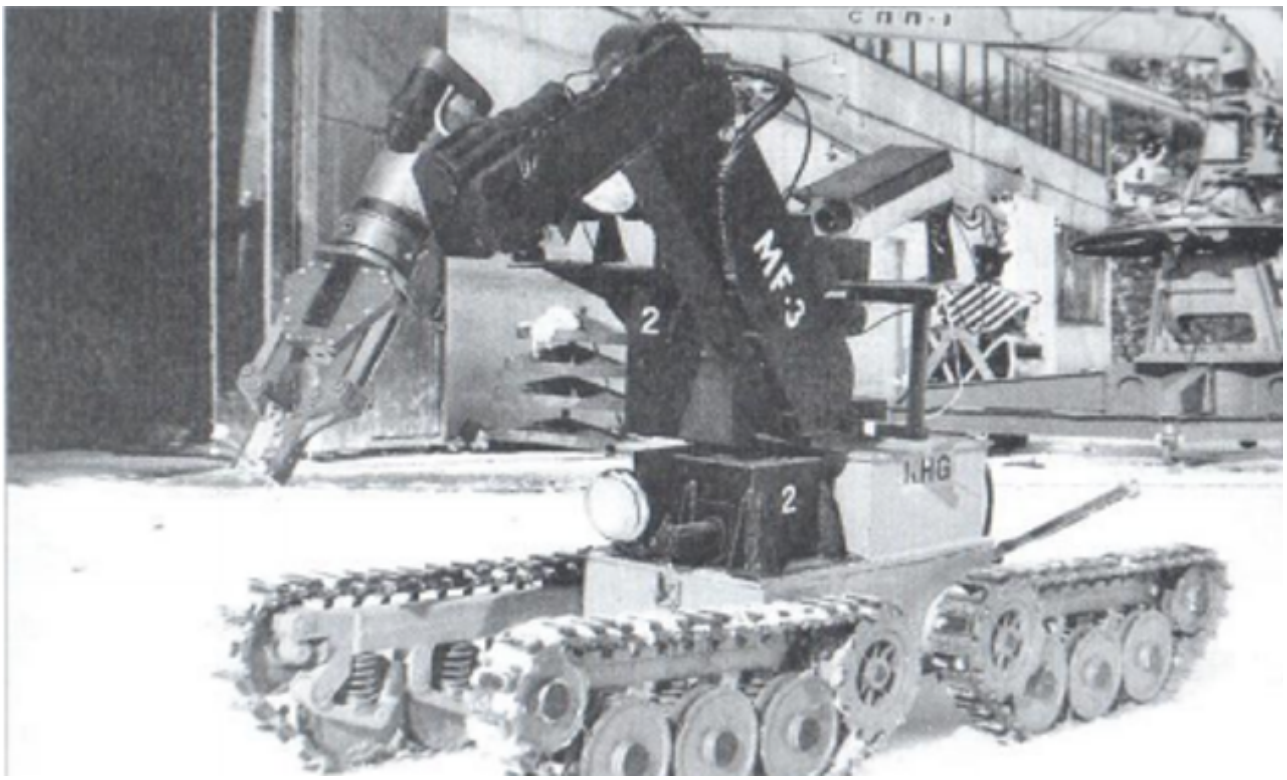
The order of operations was approximately as follows. Around the beginning of September, the evacuation efforts had been generally completed and the evacuees were placed in the newly-constructed villages. Some of the station personnel got in Kiev city and some in Chernigov. All in all, the accommodation issues had been solved. A decision was made to build the city of Slavutych because it was clear from the beginning that the shift work method could only be used temporarily at the nuclear power plant. And so the design of the new city of Slavutych began; the city that would replace Pripyat as the permanent residence for the power engineers.

The period of August and September was a period of active preparation to launch the 1st and 2nd blocks of ChNPP. This launch was carried out successfully. Moreover, before launching these blocks, an entire complex of measures, developed by experts to further increase the safety of such type of stations, was implemented and tested; partially on the 1st block and fully on the 2nd block. This was sort of the main task in that period.

Concurrently with the preparation for the launch of the 1st and 2nd blocks, and with performing the launch operations, work was underway on the construction of the sarcophagus. The original deadline for this construction was at the end of September, but various issues that naturally come up prevented this work from being completed in time. But, I will repeat, this was because unforeseen circumstances cropped up constantly. There were very large gaps that could not hold the concrete, preventing it from hardening, and making it impossible to set up the base for the subsequent construction elements. There were problems with selecting the appropriate material (this, by the way, was the task given to the experts from Kiev, they were also employed at the end) that would close the gaps between the components of the pipe cover. It was necessary to design a forced ventilation system for the sarcophagus so that if there was not enough natural ventilation, it would be possible to remove heat by switching on the forced one.

All these issues were gradually solved during the design phase and were refined during the construction of the sarcophagus of the 4th block. This construction was a separate saga in itself.

I will repeat that the project teams were working on the spot. The work was done with the help of two cranes made in the German Federal Republic by the firm Demag. The primary work was being done using these cranes, but still many finishing tasks, that would increase the reliability of the sarcophagus, had to be done by hand or by using various robotic devices. However, as I have already said, the robotic devices we had, be it our own or acquired from abroad, turned out to be practically useless in those conditions. Say, even if a robot had sufficiently reliable electronics, it could not overcome obstacles, that were the result of a large amount of wreckage of the 4th block, and stopped. This was the reason they were unusable. If, however, the researchers received robots that had good all-terrain travel capability in the most difficult conditions, then their electronics would fail because of the high gamma radiation and they also stopped.



So there we were, trying to use robots to clean the contaminated roofs of buildings where the 3rd and 4th blocks were, and also the roof of the reactor, of the radioactive contamination. We tried to use robots but this generally was not very successful. The best technical devices were created by experts from NIKIMT. Yurchenko Yury Fedorovich was the director of this organization. He himself spent a lot of time on the site and under his leadership, the robots were created, tested and used. But, well, what kind of robots? Ordinary. Ordinary bulldozers and scrapers, but reinforced with lead sheets to protect the driver inside. And such vehicles were used to do the majority of decontamination work in the most difficult places. The army divisions were primarily used to decontaminate large areas of the station territory and the insides of the station buildings. They worked very diligently, with great speed and efficiency.

Of course, many things changed as time passed, our views and ways of working. I remember an episode well when we, with General Kuncevich, arrived at Pripyat. It seemed that it would be impossible to decontaminate this city because everywhere one went, there were very high levels of radiation, say, 700-800 milliroentgens per hour. This was the magnitude of doses that we measured with our devices. But then we did one thing. We broke off pieces of facing from one of the buildings and took them from Pripyat to Chernobyl. And it turned out that this facing was radiating 800 milliroentgens per hour but here [in Chernobyl], it radiated less than 10 milliroentgens per hour. So it became clear that the contamination sources were not widely spread, but rather there were local sources of contamination in Pripyat that created a general environment that made it seem like that decontamination was not possible.

After we figured this out, and after the most active isotopes had already decayed, then mainly around August-September, very active work began, carried out by the military organizations, to decontaminate Pripyat. And the city of Pripyat was considerably decontaminated by about the same time when the sarcophagus construction was ending.

While constructing the sarcophagus (it is still under construction), we solved the problem of how to close the gaps. The following decisions were taken. Dip asbestos sacks filled with polyethylene chips into appropriate solutions—this would produce foam—and then use these sacks to close the gaps on the roof of the sarcophagus. But even before the work on the sarcophagus ended, work began on checking the condition of the equipment in the 3rd block. The question arose about what to do with the 5th and 6th blocks. These were the questions we had.

Around October 1986, the situation regarding work distribution was very clear. US 605 of the Ministry of Medium Machine Building was completing the construction of the sarcophagus, which was later named ‘Shelter’. The builders from the Ministry of Energy were occupied with the construction of the shift village at Green Cape and some tasks related to the creation of a decontamination station inside the 30-kilometre zone and some work on the territory of the station itself. Minatomenergo led the work on the preparations to launch the 1st and 2nd blocks and had

already started to gradually make their way into the 3rd block to assess its condition. The army divisions, together with the organizations of Ministry of Medium Machine Building, were cleaning the roofs of the building where the 3rd and 4th blocks of the Chernobyl NPP were. The military divisions were also continuing with the decontamination of the villages that were within the 30-kilometre zone. The research group, as I have already said, had divided its tasks as follows: researching the wreckage of the 4th block; finding the fuel; and surrounding it with the maximum number of diagnostic devices.

T-25 tractor model.

The diagnostic devices were inserted from under the 4th block. For the bubbler rooms, the diagnostic elements were inserted through holes drilled into the sidewalls that led to the reactor hall. And the bulk of the diagnostic devices were inserted from above, hung on special ropes inside the reactor hall.

At the same time, another group of researchers was occupied with another task, specifically, studying the migration of radionuclides inside the 30-kilometre zone and around it. We were concerned by the question: how deep do the radionuclides penetrate after they are deposited on the surface; how are they absorbed. Different techniques for the artificial absorption of radionuclides on

surfaces were tested. The problems of preventing the radionuclides from getting into the Pripyat river were solved. Measures were taken to prevent the radionuclides from getting into the groundwater.

Within the last field, the actions were quite simple. Around 150 wells were constructed, both diagnostic and service wells. The diagnostic wells worked continuously and measured the radioactivity of the groundwater, and if required, the service wells could be turned on to pump out the contaminated water. But fortunately, during the entire period of work, and to this day, all the diagnostic wells have shown that the groundwater has always been clean, and the service wells have never been used.

Complex research was done in the cooling pond near the Chernobyl NPP, where the radioactivity of the water, as well as silt, was measured. and a lot of attention was paid to the condition of the Pripyat river itself, the Kiev reservoir. But it was very quickly discovered that the water itself did not have much contamination, but the silt was affected. And the concentration of radioactive elements in the silt under the cooling pond was up to 10-5 curie, [END OF TAPE 3] while the concentration of radioactivity in the water was no more than 10-8 or 10-9 curie per litre.