Tape 4 Side B

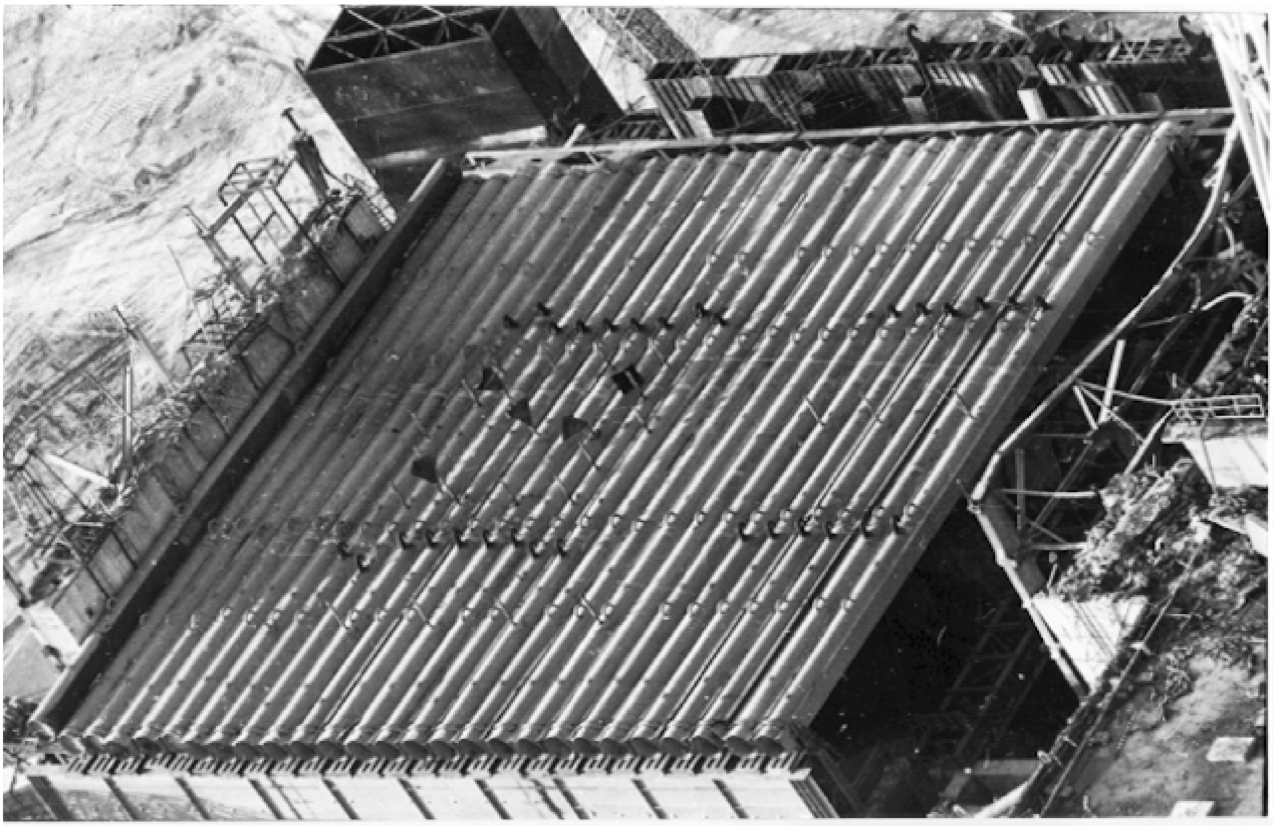
Secondly, once there was sand, it meant that there was thermal insulation, bringing additional trouble from possible heating of the area. Hence, elements like dolomite and lead were introduced. Lead is difficult to oxidise; dolomite decays. Endothermically, lead takes heat to melt; dolomite also takes heat to melt; SiO_2, sand itself, also takes heat to melt. This is how a lot of the heat was absorbed by endothermic processes.

And finally, elements such as clay, for example, served as filtering elements meant to prevent part of the radioactive isotopes from getting into the external environment. All this reasoning should be correlated with actual graphs: when what was emitted and when it stopped. In particular, it must be said that not all measures were prudent. For example, the injection of liquid nitrogen that was done per my proposal made around the 2nd of May and implemented around the 4th or 5th of May. This measure turned out to be pointless because when I had proposed it, the extent of the destruction of the reactor was not yet known and neither was known the natural air circulation, its natural flow. But after some time, we calculated that the airflow is so high that injecting and diluting it with liquid nitrogen would not have any effect. First of all, it leaked through the side gaps and practically passed by the reactor area that had the fuel; and secondly, its quantity was calculated entirely incorrectly. This is why we discontinued injecting liquid nitrogen. This measure did not prove to be useful in practice.

About lead, it must be noted that our initial plan was, of course, to put metal, iron shot there. The shot was on station territory but it was in a room that was heavily contaminated, making it impossible to load it into the helicopters. Also, we didn't know the exact temperatures at various points of the destroyed Chernobyl reactor. Say, for the uppermost points, we found that the temperature range was around 300-350 degrees [Celsius]. For this temperature range, lead would be the most suitable element which would additionally act as a shield against radiation. For areas with higher temperatures that were located lower, we needed to deliver the metal, but then it would generate additional energy because of overoxidation. That is why we chose SiO_2, sand, which would perform the same function, that is, melting, flowing in the same way as dolomite; because magnesium oxide [sic] is a relatively good conductor of heat, the most conductive among all ceramics. This is why all these measures were quite sensible.

Now, with the introduction of all these elements, such as lead, for example, we assessed if there would be lead contamination in the area. We calculated simply. 2400 tons of lead was dropped. The assumption was that all this lead will get into the hot zone and evaporate, which is impossible because most of it condensed at the upper levels. Then we assumed that even if all the lead evaporates, we took the 30-kilometre zone and derived that everything [contamination in this zone] would turn out to be less than the permissible concentrations. At least later, comrade Izrael, with his associates, measured lead concentration both in the air and on the ground. And it turned out that it was determined solely by the lead that comes from automobile exhaust pipes from leaded gasoline. And against this background, against the background of lead contamination, to detect lead contamination caused by the 2400 tons scattered around was almost impossible. And there was a lot of talk about lead poisoning. That is why the calculations had to be very precise accounting for all the measures that were taken.

Then a few words need to be said about the concepts for the sarcophagus construction. There were 17 projects but only two or three need be described. The first concept, the embanked mound, and why we rejected that. Then the second option, a sarcophagus but with a concrete dome; why we rejected that—because the structure wouldn't withstand it. Why the concrete dome, which would certainly have been better, was replaced with a pipe run and a suitable metal roof. These circumstances need to be explained.



Source Chernobyl album

It is necessary to explain the following facts in this order. This is very important. No country in the world... and quite a few countries responded to our trouble, sent telegrams, proposals, etc. We became convinced that no country in the world had a proven, experimentally verified action plan for such a situation. This is the first circumstance.

The second one. There were no dosimeters with proper scales for minimum to maximum doses. There were no unmanned aircraft that could be fitted with the necessary measuring equipment at the time of the accident, in the beginning, to be precise. This forced us to use manned helicopters, which in turn caused additional radiation exposure for the people and made these flights dangerous because the helicopters could collide with some structure and lead to the destruction of, say, a neighbouring block.

Going back a bit, it has to be highlighted that the actions of the firemen were logical. Because many journalists, and in plays, write that the firemen needlessly stayed there for several hours and got exposed to high radiation doses as a result, etc. Their actions were rational. Because there was hydrogen in the generators in the engine room; there was engine oil. And they expected that the fire could spread to the 3rd block and cause damage there as well as in the 4th block. This is why their actions were truly selfless and, most importantly, rational; and not just some pointless actions arising out of ignorance.

Further still, we must return to the fact that neither work nor reconnaissance robots were available in any country in the world. We bought and tried robots from other countries but they failed either because they could not overcome the obstacles in the destroyed block, or because they could not be controlled when electronics failed due to the high gamma fields. And only recently—this must also be described—have our own reconnaissance robots been developed at the Institute of Nuclear Energy.

It is necessary to talk about the management scheme for the process of liquidation, that is, about the separation of functions. There was a group that investigated the causes of the accident; a group that was occupied with decontamination and preparation for the launch of the first and second block; a group that worked on analysing what is being done in the 4th block, the wreckage, diagnostics, research and other necessary things; a group that worked on the design for the sarcophagus itself; a group that worked on the construction of the sarcophagus; the army group that carried out the decontamination of the territory; a group that built new living spaces for the evacuated population; a group that worked on establishing decontamination posts to control transport and to wash and clean it. All this must be described in the most thorough and detailed manner.

After that, as I see it, there should be a section named "Current status" where it should be stated that there is a Coordination Council in the Academy of Sciences, that includes heads of departments responsible for the relevant type of work—Gosagroprom, Minsredmash, Minatomenergo, etc.—as well as leading scientists-experts from the fields of medicine, radiology, agriculture and so on. And that this Coordination Council systematically analyzes the situation related to all the circumstances around this Chernobyl accident. This organizational aspect should also be described.

Then, have a section by Vladimir Fyodorovich Dyomin wherein simply describe the following clearly. How many areas, and people, were affected and to what degree; what has already been restored and what hasn't. All that is related to the consequences, from the injured people to the damage to the Red Forest, must be accurately and clearly described. The psychological factors arising out of the liquidation process must, under no circumstances, be forgotten. Because a whole array of illnesses found in people, a whole array of phenomena related to the personnel who survived this tragedy, were not related to radiation sickness. This was unambiguously established by the doctors. But nevertheless, the psychological shock and, say, because of that psychological shock, cardiovascular dystonia was found in a large number of experts and continues to be found up until now. The shift mode of work, all that was experienced, etc.—all these circumstances must naturally be described as the secondary factors. Here, the doctors have a lot of information and, I think, Vladimir Fyodorovich knows it well. If not, I can suggest all that is needed.

In the next section, after the consequences of the accident have been described, the current research and agricultural measures that are being carried out right now must be outlined. What has already been discovered, what is encouraging for us, that is, I mean, the accumulation of radioactive elements inside fish and animals that are inside the 30-kilometre zone, what is not frightening, what is useful, what is useless, the behaviour of the various tree species, all the Gosagroprom findings, only those that are currently very obvious—these should be described. And conclude this section about the consequences with such normal words—that this is a long-term program, that the consequences of this accident will manifest themselves for many, many years, and describe how they will manifest, and that the research front is a broad, so to say, rough plan. It is possible to safely talk about the programs that are led by Ruteny Mikhailovich Polevoy who established several of them. They can be regarded as the directions work should take. All this has to be done.

Talk about the various organizations that are involved both on the site and in their offices; about the medical radiology centre that has been created there. All of this, in my opinion, has to be described in this section as obvious and clear.

This section cannot be concluded with only the obvious and clear things. A whole variety of questions must be posed. For instance, we are not clear why there was not complete conformity in the decline of radioactivity in the 4th block. In some areas, it reduced faster than predicted by the laws of radioactive decay. There are various theories but those are only theories. Therefore, we still cannot fully explain this phenomenon but there are such theories.

There are unsolved issues. For example, those remarkable photographs that are on my table, brought by Nikolai Nikolaevich Kuznetsov, where spruce has transitioned into pine form, that is, when spruce twigs start to branch in the same way as pines. And that we are starting to research the cause of this phenomenon which, it needs to be said, is not clear to us. And all this should be collected into a group of unanswered questions, where we have the facts but no full explanations for those facts. This, as it seems to me, should be recorded because it would be foolish to say that everything is already fully apparent to us, fully clear.

By the way, looking back, I want to say once again that the question of how positive reactivity was added is a matter of discussion. Because there are various ways that could lead to the addition of positive reactivity in such an uncontrollable reactor. None of them unequivocally corresponds to all the experimental facts; that is why discussions are ongoing. But actually, that doesn’t have particular significance. Because the main thing is that, in principle, it was possible to add positive reactivity with such a strong acceleration. This is the main thing while the specific details are not so important. Because the discussion itself shows that there were several ways to get the reactor to the state it was in.

After the section by Vladimir Fyodorovich, I see that Vladimir Konstantinovich must be involved in two ways. The first way is to briefly, clearly and plainly explain that, from the very beginning, the Soviet Union did not conceal anything. There are questions like why was it announced so late? Well, . No one wanted to start a panic or give out wrong information. And what international measures have been taken, what conventions have been adopted, what was the Soviet position on international cooperation. This part has to be stated as the completed part.

And further, to develop a philosophy that, as the experience of the Chernobyl accident shown, any device can cause trouble not only in the country where it is located but also in the neighbouring countries; and cause not only radiation damage but also economic and psychological losses in those countries. The questions of international inspections, quality checks of constructed facilities, etc, to create this international procedure ... it is necessary to express this desire and this, in my opinion, would be right.

Broadly, the international tasks section should be split into two parts. The first part should be about what the Soviet Union has done in the international arena—what material it has presented, whom it invited, who hosted, whose help it accepted and whose help it refused. And the second part should be about how it will be necessary to inspect, control and mutually verify the level of safety in nuclear energy in the international plan. I think that Vladimir Konstantinovich should develop these points.

And finally, the last but, from my perspective, the most important section. It should begin with the measures that are planned in the Soviet Union to increase the safety of nuclear energy. Well, they are listed in the reports presented at Vienna. They must be included. Such and such things are planned. Such and such things have been implemented. And then, from the position of Vladimir Mikhailovich Novikov, state that the level of device that we currently have is probably sufficient to ensure that Chernobyl does not happen again. Although, I must say that for those devices that do not have containments, these measures will probably not be enough. We need to think about some special measures to localize accidents for those 28 devices that don't have containments.

It is clear that these localisation measures must be dynamic because it is economically and technically impossible to build containments over them. And these non-traditional dynamic localisation methods for possible accidents at such facilities need to be thought about by us today, well, mainly by the Soviet community because it is our problem; although we would happily cooperate internationally for this task. This is the problem. So this is what it is. Today, our measures are planned; such and such have been implemented and such and such issues worry us.

Next comes the philosophy. Can the Soviet Union, for example, limit the number of devices that are there, gradually put those that have no cover out of service, and hence, switch to fossil fuel. Kuzmin and my work can be used here that considers this particular question—whether it is possible to do without nuclear sources in our country which is so rich in fossil fuel—and shows that it is impossible. That we will need nuclear sources in an ever-increasing amount, firstly due to economic considerations, resources and secondly, environmental. And most importantly, emphasize that nuclear sources, as any previous sources, are not only the bearer of energy but also the bearer of new technology. It can be taken from my older works that we mostly use heat, radiation, today; but actually, it is possible to produce synthetic materials, to alloy, modify, remove impurities in nuclear sources more simply and more economically than is done today in, for example, chemical or metallurgical industry. This is one more proof that we cannot do without them.

And thereafter would be the concept, developed by Vladimir Mikhailovich, about what safe nuclear energy should look like. I will not talk about safe reactors because the requirements formulated by Novikov are very accurate. But the full cycle of nuclear fuel safety must be added to those requirements. And quantitative estimates must be made for the processing and enrichment plants, similar to those that were made for the reactor. Considering the latest accident in Brazil, it is even worthwhile to mention the use of radiopharmaceuticals and the forms of their use. It seems impossible to stop using them but how can their use be made safe.

The question should be thought through in such a way that the understanding of safe nuclear energy is as wide as possible and not limited only to the question of creating a safe reactor. And I would very much like to ask to make such a statement that, as of today, we do not have safe nuclear energy, or a concept of safe nuclear energy, or even a concept of a safe nuclear reactor that is completely ready. And since the number of such [nuclear] devices must increase, the problem becomes urgent. The time available to solve it is not too small but not too much either. It is about 15-20 years within which all the questions we are discussing here must be resolved. This, roughly, is the structure according to which all the material should be prepared. And I repeat that it should be based on the work we have previously done so that we refer to our own sources and not someone else's.

[PAUSE, NEW RECORD]

[THE INTERVIEW TO A.ADAMOVICH, JUDGING BY THE INSCRIPTION ON THE CASSETTE'S 'B' SIDE]

Legasov: First of all, you would imagine that I have some special place in this whole story because I've been in the field of nuclear energy for 15 years. However, my position is somewhat distinctive. I am a radiochemist, that is, in the designing of reactors, for example, I am involved only from a position of being present at the board meetings to listen to the discussions, debates, etc. that happen there, from which I, of course, gain a perspective. But as you can understand from the talk, I am the director of my own department that supports the nuclear fuel cycle, that is, separating the isotopes, disposal of radioactivity… My position is of an external observer, as it were, and also of a participant.

But my participation in the events at Chernobyl was certainly justified because there was no reactor anymore, just its remnants which is my direct speciality. This is nuclear and non-nuclear chemistry. One must understand which processes are happening with the radioactive elements, how they differ from other processes, what can be introduced and what that will lead to. This may have been a truly random coincidence but this is really my direct speciality.

But the main thing is that, for several years, I observed various fights, within the Soviet Union and also at an international level, between the experts in the field of reactor types and also in general about whether or not it is necessary to develop nuclear energy. At the same time, under my leadership, work developed in the field of safety of chemical production, which also poses a great danger. So, from a strictly professional perspective, I understand the safety issues, and how to manage them, very well. This is why I am such a confusing figure; because, on the one hand, I know the questions of safety in their overall philosophical form, how they should be posed and solved, I know the nuclear fuel cycle and its external parts, and [on the other hand] I was an observer of the reactor saga.

Chernobyl began, in my opinion, conditionally of course, in 1961; that is, in the very year when Gagarin flew into space or at the time of the last highest achievement of Soviet science and technology. Although I generally believe that our science and technology has developed very successfully, , surprising the whole world with colossal achievements in almost all fields. And the pinnacle of these achievements was Gagarin's flight into space. After that, we began to give way sharply in all fields, give way and just started to decline. This general downfall of Soviet technology, the reasons for which can be discussed extensively and for a long time, it was simultaneously the beginning of Chernobyl. This is not an abstract statement and not in the sense that we had begun to lower the general technical culture. Rather, it is a concrete statement.

The fact is that, as you know, the Soviet Union was the founder of nuclear energy. We built the first power plant in Obninsk near Moscow. Then we built the Beloyarsk Nuclear Power Station and the Novovoronezh Nuclear Power Station. And then stopped the development of nuclear energy. This was in the late 50s. Because such a belief prevailed that we have enough Donbass coal and that we don't need to develop nuclear energy. So we, after pioneering its development, stopped its development for 10 years. And the three nuclear power plants, Novovoronezh, Beloyarsk and Obninsk were like playgrounds for scientists, where researchers solved their problems. These are three different types of reactors. They had their peculiarities that they [scientists] were researching. But nobody thought of nuclear energy as a large-scale phenomenon.

And at the same time, England first and then the United States of America began to develop their energy sector, not as separate nuclear power plants but as a nuclear power industry. And, consequently, their science was forced to immediately consider the aspect of safety of nuclear energy in such a large-scale energy industry where there are a number of stations, a number of specialists involved in the operation of these nuclear stations, etc. Whereas our Gosplan made a potent miscalculation, based on an assumption that we have enough fossil fuel that will last for a long time and that we would practically not need nuclear energy. But sometime around the 60s—61, 62, 63, around that time—it became evident that a miscalculation had been made. That the European part of the Soviet Union, where 80 per cent of the population and industry is concentrated, will not survive on shipped fuel; and Donetsk coal became too expensive and too little. And shipped fuel is quite expensive; economically, transportation-wise and environmentally expensive. It became clear that it is impossible not to develop nuclear energy. The European industry will not survive without it.

In fact, because of ecological reasons, and many people do not understand this, it is impossible not to develop [nuclear energy]. Supposing, for a moment, that we take a Politburo decision to shut down nuclear energy; we stop the presently-operating nuclear power stations and do not build new ones; then immediately, straightaway, as a result of this, the level of radioactive contamination of our territory and our people would increase incredibly. Just radioactivity; I'm not even talking about carcinogens and other things. Why? Well, because many radioactive elements have accumulated inside coal and oil seams over the centuries. Moreover, these are specifically the long-living isotopes and the most dangerous: alpha-active. For example, the Kansk-Achinsk coal basin, just in its upper layers, contains 2 million curies of alpha-active, long-living isotopes. As soon as we start to actively use the Kansk-Achinsk basin, we will start to saturate our own lungs with radioactive dust along the roads on which this coal is shipped and also when we burn it. Therefore, the fewer nuclear power plants and the more coal and oil ones we have, the higher the radioactive pollution will be under normal circumstances. This is a very obvious scenario.

Of course, it would be best to use what we all eagerly wish for, the alternative sources: thermonuclear, solar, НГД(sic), and the others. But, here, we must be honest with ourselves; that within the next 40-50 years, there will be nothing. Because even the best figures today show that, in solar energy, the cost of human labour will be a 100 times more for a unit of power, and the cost of materials a 150 times more, than coal and nuclear power plants. Undoubtedly, science will address this and things will improve but not by 100 or 150 times. Because of this, the share of alternative sources in the foreseeable period of 45-50 years will be . This share must be maintained in order to develop these energy sources but it cannot be the basis of energy [planning]. Thus, in this way, the inevitability of nuclear energy became apparent in the 60s but the pace was lost. And then, it became a scramble across Europe. But, money being limited, no investments were made for 10 years.

And here the fateful mistake was made, from which, specifically, Chernobyl began. What was this fateful mistake? The world accepts the normal standard of safety for any dangerous industry including nuclear power stations. This standard consists of three elements. One, make the reactor maximally reliable. Two, make the operation maximally reliable; trained staff, good discipline, easy-to-operate equipment, etc. And strive for maximum reliability everywhere. But, since the world understands that "maximally" does not mean 100 per cent and that there is always a chance of a technical component failing, even the most reliable one, or of a person doing something, by malice or ignorance or by accident, the third element is introduced. Three, all this dangerous industry with a maximally safe reactor, maximally safe operation, must compulsorily be encapsulated; enclosed in a containment as it is called in the West, placed under a cupola as we call it. So, if something, having a low probability but still, suddenly happens, it will remain limited to the area of the reactor itself. All the troubles will be restricted to the area.

And the main criminals... Of course. those who have already been convicted at Chernobyl are criminals because they committed unthinkable actions and they were convicted absolutely legally. Now the investigation, additional investigation is underway and, I think, will probably judge the designers of the RBMK reactor—at least they should be judged in my opinion—who made at least three grave mistakes in the design of this reactor. Grave mistakes. And perhaps they should bear criminal responsibility for it. This is my point of view but I don’t know how this will turn out.

But the main criminals are those leaders of energy in the 60s who despite the opinion of experts, and Soviet experts … Say, at our institute, there is corresponding member Sidorenko Viktor Alekseyevich; he is now the Deputy Chairman of Gosatomenergonadzor. He wrote a doctoral dissertation and later published a book at approximately that time, in which he proved the impossibility of having nuclear stations without containments, no matter the type, VVER or RBMK; that it was dangerous and criminal. But, as they say, they spat on him from the big bell tower [a Russian proverb that means to not care] because this made each station approximately 25-30 per cent more expensive. And since Gosplan strictly specified the funding for nuclear energy, this would mean 20-30 per cent fewer nuclear power plants would be built in a given time.

Adamovich: [HARD TO HEAR THE QUESTION]

Legasov: No, as far as I know, Petrosyants was not specifically involved in these matters. It was the leadership of Gosplan at the time: comrade Baybakov, comrade Voloyants were involved, and comrade Slavsky was among the ones mainly responsible, and comrade Neporozhny. So this was the team: Neporozhny, Slavsky, Voloyants, Baybakov. However, Baybakov’s role was that he consulted Slavsky and Neporozhny as energy experts. And this wasn’t because there was no such knowledge. The knowledge existed; the experts, however, were not unanimous. Because in our Kurchatov Institute itself, the author of the development, Professor Feinberg Savely Moiseevich, now deceased, was advocating the possibility of a reactor without containment, particularly RBMK.

It is very important for me that you understand that had the international philosophy been adopted, had each reactor been inside a containment, then the RBMK reactor would simply not exist. Since it is a high power channel-type reactor and is assembled from many blocks, it would not fit inside any containment. And there wouldn’t be a designer's error because there wouldn’t be such a reactor. Now, about how it came to be and why. Since we were late by 10 years in the development of nuclear energy…

Adamovich: [CLARIFICATION ON FEINBERG'S LAST NAME]

Legasov: Feinberg S.M. was a good physicist, of course, but he also got into this story. It was all tangled up.

Adamovich: [HARD-TO-HEAR QUESTION ABOUT ALEXANDROV A.P. AS A GUARDIAN]

Legasov: Anatoly Petrovich had nothing to do with the design of the RBMK reactor at all. But I will tell you about the role of Anatoly Petrovich Alexandrov later as objectively as I can. From my point of view, he bears some degree of guilt, of course, small. But he is too meritorious, has done too much for the country to talk about it in this way, but…

Adamovich: [QUESTION ABOUT ALEXANDROV SAYING THAT THE RBMK REACTOR CAN BE PUT IN RED SQUARE]

Legasov: No, that is just a mistake. He did say that about one of the reactors, the AST, a nuclear power plant of an entirely different type, which really is the safest of all that exist in the world today; about that he said that it can be put even in Red Square. I will talk about Aleksandrov's role later but it is important for me that you understand that the main issue was the 10-year delay. Because once we were 10-years late, then before anything, the question arose ...

A line of cased reactors was developed in the world, similar to our water-water energy reactors VVER; like the one that had to be built near Minsk but will not be built now. But they required considerable machine-building capacities to build the case that the Soviet Union did not have. Building one case takes 2-3 years. And then the Atommash factory was specially built to make cases for such reactors.

The question arose that there are no cases, nuclear energy has to be developed, and then comrade Slavsky, the Minister of Medium Machine Building comes up with a proposal, in parallel with the VVER reactors…

Adamovich: [QUESTION INTERRUPTS THE NARRATION ASKING TO EXPLAIN THE VVER ABBREVIATION AND DIFFERENCES FROM RBMK]

Legasov: The VVER reactor is a large metal vessel in which the active zone is immersed in water. The water overheats; the pressure is 170 atm. The two-circuit system heats the water in the second circuit, and the water in the second circuit, turning into steam, drives the turbine. And the RBMK reactor is a single-circuit reactor. It has many zirconium channels in which water is heated using the fuel pellets and this water immediately enters the turbine and drives it. For this reason, in VVER reactors, power is limited by the size of the reactor vessel but in RBMK reactors, power is not limited by anything. Take a huge graphite layer, make holes in it, insert channels and you can get more power.

So, when it became clear that there is not enough of Soviet energy, then Efim Pavlovich Slavsky, the Minister of Medium Machine Building said, "There is a way to help the country." Do you understand? This type of device came from the Ministry of Medium Machine Building where several such devices were built for special purposes and operated in the most unique way. There was military acceptance of each piece of equipment, specially trained personnel, the highest requirements, etc. These are the same industrial reactors that the Americans have. They also don't have containments because they are large. But there are only four of them, the American ones. And the tracking and monitoring for each one of them are very high-class.

So, for the Ministry of Medium Machine Building and, in this sense, also for Anatoly Petrovich Aleksandrov, there was an impression that this reactor, if operated properly and with reliability, is very good and normal. But as soon as the first such reactor, the first one they plugged in near Leningrad, a 100 kilometres from Leningrad, the first such RBMK reactor... As soon as it began to run, right away it was discovered that the reactor was bad, that it was difficult to control, that its neutron fields started to "float". The operators were all sweating; they could not control it because of its large size and the peculiarities of the nuclear processes. The level of fuel enrichment had to be changed, every time something… Well, altogether, from the moment it was launched, there were constant changes and alterations.

And yet, because 10 years had been lost and because the international philosophy that every device had to be inside a containment was not necessarily adopted, these devices were introduced into the national infrastructure. And they were built not by the Ministry of Medium Machine Building but by the Ministry of Energy. Kursk, Chernobyl, Smolensk NPPs, all use these RBMK reactors. However, in whispers, all the operators, all the engineers and experts were saying that this reactor is very difficult to control.

In economy, in cost per kilowatt-hour of energy, in fuel consumption, it was about the same as VVER, better in some ways, worse in others. But that it was more difficult to control became clear. But the main thing, and I keep coming back to this, the main crime committed was allowing a criminal philosophy into the Soviet nuclear energy, allowing stations, of any type, VVER or RBMK, to be built without containments. If there were containments, then RBMK would simply not exist; as it didn't anywhere in the world, this type of reactor.

Another mistake was that with such technology, it is dangerous to not go the way the world is going. Because, after all, this is a dangerous technology. And when we are dealing with VVER-type reactors, we can use the entire world's experience. Just think about it; we have a dozen such reactors, the Americans have 90 of them, the British have 40 and the French have 60. And each one accumulates experience and mistakes, and all of it belongs to all humankind. But RBMK, there was only the Leningrad station initially and, yes, Chernobyl and that's all. This was all the experience and but we thought we knew enough; and there was no more information available to seek. And later it turned out that we knew very little about them. This was the so-called "road to development". Firstly, it was domestic, which meant that it was not supported by any international experience. Secondly, SEV countries could not be consulted because they didn't have such a device. The philosophy itself contradicted what we had at hand. And the design itself had, I'd say, at least three fundamental flaws. I find them monstrous, and have always found them monstrous. So don't look at me as a person who… The fact is that our institute was divided about this reactor. And here I will speak about Anatoly Petrovich.

What is the monstrosity of his design mistakes apart from the containment philosophy? The monstrosity of the mistakes lies in the philosophy of safety. Why do I say this? Because the philosophy of safety does not depend on what you are dealing with, be it a nuclear reactor, a biological facility where viruses propagate, a chemical plant or something else. The specific technical decisions do depend but the philosophy does not vary. Because it has three elements: a maximally reliable device, a maximally reliable staff, and putting all this underground with maximum reliability, in a rock, under a containment. This is the philosophy that applies to any entity which makes the system reliable. But also with some reliable design… It requires that if you have some kind of emergency protection system which stops, say, a car, a train or something else, then you must have at least two protection systems. And they should be based on independent physical principles and one of the two systems should not depend on the operator. This is the law of the theory of safety.

Because, say, the operator suddenly becomes ill and he cannot press the button, or something else, then because of an overrun in parameters, because of anomalies, the second protection system should activate automatically.

The RBMK reactor has only one protection [system], unlike the VVER reactor, which is a flagrant violation of principles, the first mistake. Moreover, the designer to this day… If the designers of the

RBMK reactor or my colleagues from my own institute heard me now, they would tear me to pieces because they think that I don't understand the philosophy of safety. Since the emergency protection system consists of 211 rods that are lowered, they say that they have 211 [protection] systems, not two; because when they remove these 211 rods, each of which can absorb neutrons when lowered into the reactor, they say that there are 211 [safety systems]. But this is rubbish because all these rods are lowered by the operator; by the automatic system; by pressing a button, etc. And if the operator is killed, falls ill or dies, then all these 211 rods will remain in place. They still cannot understand this, or maybe this is just a self-defensive reaction. That is why they are after me with such terrible force in this aspect.

Moreover, when the Chernobyl accident happened, when it was necessary to make modifications, I immediately proposed an independent gas-based protection system, that is, injecting into the device sort of a gas capsule. I will not describe the whole thing in detail here. They accepted it very reluctantly, put it somewhere in their implementation plans for the 90s at the last moment, and began to correct the second mistake.

And the second mistake in the design, apart from there not being two protection systems but one, was that….

[END OF TAPE 4]