Message on the functioning of the “Shelter” facility at the Chernobyl NPP

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Secret

Regarding the Shelter Facility at the Chernobyl Nuclear Power Plant

The KGB Directorate of the Ukrainian SSR for the city of Kiev and Kiev Region, taking into account the insufficient study of the Shelter Facility as a source of increased danger and the serious impact of this circumstance on the moral and psychological situation among the population of the city and the region, is taking the necessary measures to ensure effective operational control over the development of the situation and the timely assessment of the effectiveness of ongoing scientific programs.

As a result of work carried out under high-risk conditions by employees of several enterprises and institutions of the Ministry of Medium Machine Building, the Ministry of Energy, the Ministry of Atomic Energy, and the USSR Ministry of Defence, construction of the facility was completed in a very short time, and in December 1986, it was transferred to permanent operation of the Chernobyl Nuclear Power Plant.

During the development of design documentation for the Shelter, the All-Union Scientific Research and Design Institute of Power Technology (VNIPIET, Leningrad) envisaged that it would perform the following primary functions:
- protection of personnel working at the plant and the surrounding area, as well as the environment, from external radiation, and limiting the release of radioactive fission products into the atmosphere;
- monitoring for possible changes in the state of the fuel mass during reactor breakdown, as well as the removal of residual heat;
- prevention of the occurrence of a self-sustaining chain reaction (SSCR) and other nuclear-hazardous conditions.

As a result of an in-depth study of the situation, with the participation of operational and official sources from among leading specialists from the Combine Production Association, the Chernobyl Nuclear Power Plant, the I.V. Kurchatov Integrated Expedition, and the Institute for Nuclear Research of the Academy of Sciences of the Ukrainian SSR, the following was established.

The facility's structural elements, erected throughout 1986, provide protection for personnel and the surrounding environment from external radiation. The most vulnerable part of the Shelter is the roof. Since the support points for the roof pipes (the so-called "mammoths") were placed using television cameras due to high radiation levels, additional studies are needed to ensure the reliability of the fastenings, and based on these studies, appropriate technical solutions can be implemented.

To ensure continuous monitoring of the structure's walls and foundation, a joint integrated expedition of the All-Union Production Association "Inzhgeodeziya" (Novosibirsk) developed and implemented a system of specialised measurements using benchmarks. It was established

that, since the structure began operating, the northwest-facing walls have subsided by 12–13 mm. Experts believe that additional research is needed to study the impact of groundwater on these processes in order to objectively assess the situation.

Some employees are seriously concerned about the condition of the pre-accident building structures, a significant portion of which, especially the load-bearing columns, are severely damaged. In this regard, in December 1987, a commission headed by the deputy chief engineer of VNIPIET conducted a detailed inspection of the site, to the extent possible. Based on the results of this investigation, the development of technical documentation has begun for reinforcing work, primarily on the supporting columns, beams, and the most damaged areas.

According to a number of experts, including operational sources, the implementation of the planned engineering solutions will lead to a further increase in the weight of the Shelter, and consequently, the load on the foundation, as well as additional radioactive contamination of the environment due to the release of dust and aerosols. Therefore, further study of these issues is necessary, involving all relevant organisations.

The condition of structural materials, primarily steel, from the standpoint of exposure to neutron and gamma fields, is not being studied at the facility, as, according to leading national institutes, the current levels for metal embrittlement are insufficient.
However, according to plant specialists, such studies are necessary to determine the reliability of the steel structures of the reactor core, the cross (the lower base of the reactor), the steam distribution corridor, and the sparger pool, which are subject to significant mechanical loads and are in direct contact with highly radioactive fuel residue. Their possible collapse and the subsequent release of radioactive aerosols and dust from the sub-reactor space, which is currently almost hermetically sealed, could lead to negative consequences.

Although the Shelter protects the environment from neutron and gamma fields, due to the incomplete isolation of the wreckage of Reactor No. 4, radioactive material continues to escape from its surface, reaching its maximum levels during north-westerly winds. The absolute values of the total activity discharged have not yet been determined.

Remediation of these deficiencies is currently hampered by the leaky roof of the facility, which cannot be ensured due to the insufficient mechanical strength of the supporting structures.

To monitor potential changes in the fuel mass condition, the Kurchatov Institute of Nuclear Power has developed a comprehensive research program, which includes three main areas:
– "Condition" – providing scientific support for routine maintenance, diagnostics of the current condition, and forecasting;
– "Subcriticality" – preparing and conducting special studies, the ultimate goal of which will be the development of recommendations for a set of measures to prevent the possible occurrence of a criticality event;
- "Reliability" is a definition of the facility's long-term stability.

Currently, the facility's condition is monitored using a specially developed and implemented information and diagnostic system, "Shater." Improvements to the software, carried out at the

end of last year, as well as the replacement of 100 of the 150 sensors with more advanced ones, have allowed us to somewhat increase the reliability of monitoring and ensure its continuity.

The system measures the following parameters of the "Shelter":
– neutron flux density above the collapsed area and in the rooms adjacent to the apparatus shaft;
– exposure dose rate at various points (gamma radiation);
– gas-aerosol emission activity and its isotopic composition;
– temperature-heat flux near the heat-generating masses;
– vibrations, displacements, and subsidence.
The sensors are read automatically every 3–4 seconds; the resulting data, after processing on a computer, is printed out and displayed on a monitor. In the event of a threatening situation, alarms are generated.

However, according to some experts, the Shater system currently does not allow for objective monitoring of the reactor's state of disintegration, primarily of the fuel masses. This deficiency is due to the limited information provided by the sensors, which were installed only where possible, not in all necessary locations, as well as the lack of detailed information on the distribution locations and quantity of residual fuel, and the complexity of the physical processes within the reactor itself.

Specialists from the Institute of Nuclear Research of the Ukrainian Academy of Sciences conducted calculations to assess the state of the nuclear fuel, based on averaged data from standard neutron flux density sensors.

Neutrons from the most stable isotope, plutonium-240, which accumulates during reactor operation, were isolated from the energy spectrum. Using a mathematical model, it was concluded that approximately 6% of the fuel was ejected from the core. However, researchers at several institutes within the USSR Ministry of Medium Machine Building (Ministry of Medium Machine Building) believe that the fuel loss during the accident was more significant, amounting to 30 to 50% of the original volume. According to existing estimates, the remaining fuel is in the form of a melt consisting of 90% silicon, with the remainder consisting of radioactive material.
The bulk of its mass is concentrated beneath the apparatus and in the steam distribution corridor, the so-called "elephant's foot."

To verify these findings, determine the precise location of the fuel, its qualitative and quantitative characteristics, and improve the efficiency of the Shater complex, a program has been developed to drill 60 mm diameter boreholes into the debris field. This program is being carried out by a comprehensive expedition from the I.V. Kurchatov Institute of Nuclear Election.
Five boreholes are being drilled from room 207 adjacent to the apparatus, two of which have already entered the sub-reactor space.
As a result of observations through a periscope installed in one of the wells, it was discovered that the space beneath the apparatus was littered with debris from building structures, pipelines, and partially filled with concrete. Work on the second well was suspended due to

the gamma radiation level at its bottom suddenly reaching 10,000,000 µSv/hr. For safety reasons, drilling is stopped when the level reaches 1,000,000 µSv/hr.
A total of 20 wells are planned to be drilled from room No. 207. Simultaneously, decontamination work has begun on room No. 502, where drilling equipment will also be installed.

The planned program must be completed by the end of this year. This will improve the reliability of monitoring the facility's condition and allow for the feasibility of debris removal.

Drilling has currently been suspended due to the fact that the integrated expedition, assigned as an independent organisation, does not have permission to conduct work at facilities controlled by the USSR State Atomic Energy Supervision Authority.
At the same time, according to leading Chernobyl Nuclear Power Plant specialists, it is necessary to conduct special studies of the entire decay chain, as at certain stages substances emerge release of which into the environment, not only due to radioactivity but also due to their high chemical toxicity, could harm human health, primarily that of plant personnel.

During the design of the Shelter, VNIPIET developed and subsequently installed a special system for suppressing the spontaneous combustion cycle by spraying areas where fuel residues are concentrated with potassium metaborate.
The facility consists of two 3-meter tanks, a piping system, and control units. Although the occurrence of a self-sustaining chain reaction is considered unlikely, due to the fact that the reactor was doused with boron-containing substances during the initial phase of the accident clean-up, the installed facility is considered ineffective. This is because the exact location of the remaining nuclear fuel has not been determined.

Measures to improve the reliability and effectiveness of the facility for suppressing self-sustaining chain reactions are planned to be implemented after the completion of the Subcriticality program. According to operational sources, the measured parameters characterise the stable state of the Shelter, show a constant downward trend, and correspond to calculated data.

As of March 12 of this year, the following data were recorded:
– neutron flux density averaged 0.2 neutrons/cm^2/sec;
– gamma radiation level above the collapse surface of 29,170,000 µSv/hr;
– temperature 35.5°C.
However, despite this, experts unanimously agree on the need for detailed studies to determine the amount of remaining fuel, its location, and the identification of possible local critical masses and subcritical clusters, as well as their physical, mechanical, chemical, and thermal stability.

Taking this into account, we have taken additional measures to ensure reliable monitoring of the situation at the facility and in the taskforces conducting work there.

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