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Chapter 1 : The Lepse project - theinnatdunvilla.com

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The boat is The construction of Lepse was started in at Nikolaev shipbuilding yard, but suspended in In the boat was transferred to Kherson yard for completion. Instead of being completed, the boat was scuttled. In the vessel was salvaged and stayed in Black Sea port Poti till , when it was towed to Admiralty Shipyard in St. Petersburg and rebuilt to service refuelling operations on nuclear-powered ice-breaker Lenin, a service it entered in The Lepse serviced Lenin till Later, the storage compartments of Lepse were rebuilt to take the fuel from the new generation of ice-breakers, and from till the ship was used for defuelling operations at the new reactor installations of Lenin as well as Arktika and Sibir nuclear-powered ice-breakers. In Lepse stopped performance of defuelling operations, and in it was officially transferred to the rank of laid-up vessels. Storage compartments for spent nuclear fuel There are two storage tanks on-board the Lepse, both are 3. Each tank has sealed penals 67 mm in diameter and 4 caissons mm in diameter. As a result of the reactor accident on-board the Lenin in , 54 damaged fuel assemblies were put into the storage facility of Lepse. During its 30 years of operation Lepse has been receiving spent fuel from nuclear-powered ice-breakers and submarines, most of which was in unsatisfactory condition. Today, Lepse stores some spent fuel assemblies. The activity of the spent nuclear fuel stored on Lepse is estimated as 28, TBq , Ci. The work was completed in According to Russian calculations, unless remotely operated equipment is used, removal of the spent nuclear fuel from Lepse will expose workers to the maximum permissible doses of radiation. Earlier plans to decommission In , the spent fuel onboard Lepse was officially defined as solid radioactive waste, which meant that the fuel was not to be reprocessed at Mayak in Siberia. Following plans considered the possibility of disposing of the Lepse in the permafrost on Novaya Zemlya. The storage facility with the spent fuel was to be filled with concrete, the superstructure removed and the boat towed to Novaya Zemlya and placed into a repository in the permafrost. At that time Novaya Zemlya was considered to be the most viable location for a long term nuclear and radioactive waste repository. Early on, it was important to learn as much as possible about the materials stored and the condition of the storage ship. The findings are presented in Bellona Report No. Prior to the release of the report, Bellona and MSCo had begun to discuss various ways to solve the Lepse problem. As an alternative to the Novaya Zemlya plans, Bellona suggested removal of the fuel using remotely controlled equipment and robots. While being more expensive, this approach would dramatically reduce radiation exposure of the workers. One of the main topics of discussion was the matter of safely securing Lepse. Subsequently, in TACIS earmarked ECU , for a preliminary study on how to remove and safely dispose of the spent nuclear fuel stored on board the vessel. Requests for bids were circulated within the European nuclear industry, and Bellona translated the bidding forms into Russian for MSCo. This marked the formal launch of the international efforts to solve the Lepse problem. Taking place in August , this meeting was important both in getting the project underway quickly, and in clarifying a few points at an early stage. The feasibility study The purpose of the TACIS-funded feasibility study was to determine how to remove and safely dispose of the spent nuclear fuel stored on board Lepse. The study provided a concept for safe removal of the spent nuclear fuel from the Lepse. The budget estimation is 8. The estimated duration from inception to retrieval of all the fuel from the ship is 3. By now the advisory Committee has obtained commitment from main donors to fund the project. Egorov, the Lepse Project was included in the State Federal program for remediation of hazardous nuclear objects. Although the currently available funding covers only the first segment of the project â€” fuel retrieval, the Lepse remediation activity has been broken down into four segments: Fuel retrieval operation Segment 2: Fuel transportation and storage operations Segment 3: Other Lepse ship radioactive waste management Segment 4: Conversion of the ship to an environmentally safe condition. The latter three segments were apparently put into the project description under pressure from the Russian counterpart, since, according to Russian safety regulations, the plan for remediation of an object should comprise all the necessary steps from the very beginning and up to the final stage of securing the object. At present the first and most environmentally sensitive segment has been developed in details. The safety features and the technical feasibility was developed under the frame of the EU-funded study. Then the Advisory Committee members have funded the development of a "Project Manual", describing the detailed breakdown of the project into work packages, structuring the organisation, the management, the contractual and legal issues. Mayak â€” or not The other segments of the Lepse project are being addressed in parallel. The most sensitive segment here is "Fuel transportation and storage operations". At the outset, the damaged fuel was to be sent to Mayak for reprocessing. But now a number of Russian experts claim that Mayak is unable to reprocess the damaged fuel. The situation is aggravated by the fact that operation of Mayak reprocessing plant is currently suspended for an uncertain period of time, pending replacement of shut down equipment. Consequently, stocks of the spent fuel in the storage facilities at Mayak are increasing, leaving minor hope that Mayak will be eager to complicate its current situation by accepting the damaged Lepse fuel. This point may slow the project down, as fuel transportation and storage planning is at a rather preliminary stage. This step is justified by the fact that the Lepse project lacks suitable containers for safe transport and interim storage of retrieved fuel elements. Currently Norway, Russia and the US are working to modify an existing Russian cask originally designed for transport and storage of spent nuclear fuel from nuclear power plants using RBMK reactors, to make the container suitable for transport and storage of damaged and undamaged fuel from nuclear powered subs and ice-breakers. According to preliminary talks with MSCo, there is room at the nuclear powered ice-breaker base Atomflot for these casks. Thus, it may be possible to avoid shipment of the fuel to Mayak, instead storing it for up to 50 years onsite before a better solution is found. Further steps The main contractual documents have been prepared, and are expected to be signed by autumn According to Minatom official Victor Okhunov, his ministry is working with the Ministry of Finance and the Federal Customs Committee on reducing taxation of equipment to be delivered to Murmansk Shipping Company for the spent fuel retrieval. Okhunov, a partial tax reduction is possible, but "it is very complicated". The question of liability in case of an accident, has to be solved before the Western companies can deliver equipment to the project. A solution to this problem is being sought by the Norwegian Ministry of Foreign Affairs. So far, there has been little progress on this problem. Although both Western and Russian participants of the project admits that the progress is a bit too slow, the parties are optimistic when assessing its impact on further Russian-Western co-operative efforts to solve the environmental and nuclear safety problems in the North West of Russia.

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Chapter 2 : Chernobyl disaster - Wikipedia

The NATO Advanced Research Workshop on "Radiation and Envir- mental Safety in North-West Russia â€" Use of Impact Assessments and Risk Estimation" was held in Moscow, Russia on December 8 - 10,

The Nuclear Window complements Russian and bilateral funded programmes aimed at the decommissioning of nuclear-powered vessels, provision of safe and secure infrastructure for nuclear materials and the safe removal of spent nuclear fuel from the region. The Andreeva Bay Coastal Technical Base was built in the s to service nuclear submarines of the former Soviet Northern Fleet and closed down in When leaks developed in the ponds in the s, the fuel was urgently transported to three dry storage units DSUs nearby and has been kept there since. Water has entered the storage units and many of the storage cells are flooded. Water analysis has shown that the storage units are leaking radioactivity into the ground. Six spent fuel assemblies SFAs remain in one of the small pools which are responsible for the high gamma-radiation levels at the top of the pool. The submarine NPS was a Papa-class nuclear powered submarine of the Soviet Union, built in and decommissioned in It was the only submarine of this class built in the Soviet Union and had a unique reactor design. As such it had not been able to defuel the reactors and this posed a nuclear and non-proliferation hazard in the region Archangelsk. The dry cargo ship Lepse was built in and re-equipped in for use as a nuclear service ship, i. In , Lepse was taken out of service and in it was classified as a berthing ship, with the port of Atomflot near Murmansk as its anchorage place. The specialised storage facilities on board Lepse contain spent spent nuclear fuel assemblies SFA. Unloading of the SFA from Lepse is a complicated task which requires a specially developed process using non-standard tools and equipment. Over 20, spent nuclear fuel assemblies will be removed over a period of several years. Decommissioning of a derelict and heavily contaminated former spent fuel storage facility Building No. The building represents a significant radiological and environmental risk. The installation and commissioning of the equipment will take place to enable the recovery and removal of the SFAs in Decommissioning of the service ship Lepse which contains a large amount of spent fuel from icebreaker defueling operations was safely towed from Murmansk to Nerpa shipyard where it was dismantled to leave two large storage packages LSPs. The aft LSP containing radioactive waste has been removed to the nearby Sayda Bay facility for long-term storage. Infrastructure and equipment required for the safe removal of the spent nuclear fuel from Lepse was completed in and the start of the SNF removal operations is planned for late It will take some 18 months for all of the SNF to be removed from the storage tanks and transported to Atomflot Murmansk and then to Mayak.

Chapter 3 : NDEP Nuclear Window

Proceedings of the NATO Advanced Research Workshop on Radiation and Environmental Safety in North-West Russia - Use of Impact Assessments and Risk Estimation, Moscow, Russia, December

Location of Chernobyl nuclear power plant The abandoned city of Pripyat with the Chernobyl facility visible in the distance The disaster began during a systems test on 26 April at reactor 4 of the Chernobyl plant near Pripyat and in proximity to the administrative border with Belarus and the Dnieper River. There was a sudden and unexpected power surge. When operators attempted an emergency shutdown, a much larger spike in power output occurred. This second spike led to a reactor vessel rupture and a series of steam explosions. These events exposed the graphite moderator of the reactor to air, causing it to ignite. The plumes drifted over large parts of the western Soviet Union and Europe. Thirty-six hours after the accident, Soviet officials enacted a kilometre exclusion zone , which resulted in the rapid evacuation of 49, people primarily from Pripyat, the nearest large population centre. Initially, the town itself was comparatively safe due to the favourable wind direction. Until the winds began to change direction, shelter in place was considered the best safety measure for the town. A further 68, persons were evacuated, including from the town of Chernobyl itself. Although certain initiatives are legitimate, as Kalman Mizsei , the director of the UN Development Program , noted, "an industry has been built on this unfortunate event," with a "vast interest in creating a false picture. The rate of new construction builds for civilian fission-electric reactors dropped in the late s, with the effects of accidents having a chilling effect. The World Association of Nuclear Operators was formed as a direct result of the accident, with the aim of creating a greater exchange of information on safety and on techniques to increase the capacity of energy production. The accident raised the already heightened concerns about fission reactors worldwide, and while most concern was focused on those of the same unusual design, hundreds of disparate electric-power reactor proposals, including those under construction at Chernobyl, reactor No. As the reactor had not been encased by any kind of hard containment vessel , this dispersed large quantities of radioactive isotopes into the atmosphere [33]: The accident occurred during an experiment scheduled to test the viability of a potential safety emergency core cooling feature, which required a normal reactor shutdown procedure. This heat continues for some time after the chain reaction is stopped e. Analysis indicated that this residual momentum and steam pressure might be sufficient to run the coolant pumps for 45 seconds, [33]: An initial test carried out in indicated that the excitation voltage of the turbine-generator was insufficient; it did not maintain the desired magnetic field after the turbine trip. The system was modified, and the test was repeated in but again proved unsuccessful. In , the tests were attempted a third time but also yielded negative results. The test procedure would be repeated in , and it was scheduled to take place during the maintenance shutdown of Reactor Four. The test procedure was expected to begin with an automatic emergency shutdown. No detrimental effect on the safety of the reactor was anticipated, so the test programme was not formally coordinated with either the chief designer of the reactor NIKIET or the scientific manager. Instead, it was approved only by the director of the plant and even this approval was not consistent with established procedures. If test conditions had been as planned, the procedure would almost certainly have been carried out safely; the eventual disaster resulted from attempts to boost the reactor output once the experiment had been started, which was inconsistent with approved procedure. The station managers presumably wished to correct this at the first opportunity, which may explain why they continued the test even when serious problems arose, and why the requisite approval for the test had not been sought from the Soviet nuclear oversight regulator even though there was a representative at the complex of four reactors. The reactor was to be running at a low power level, between MW and MW. The steam-turbine generator was to be run up to full speed. When these conditions were achieved, the steam supply for the turbine generator was to be closed off. Turbine generator performance was to be recorded to determine whether it could provide the bridging power for coolant pumps until the emergency diesel generators were sequenced to start and provide power to the cooling pumps automatically. After the emergency generators reached normal operating speed and voltage, the turbine generator would be allowed to continue to freewheel down. Conditions before the accident The conditions to run the test were established before the day shift of 25 April The day-shift workers had been instructed in advance and were familiar with the established procedures. A special team of electrical engineers was present to test the new voltage regulating system. The Chernobyl plant director agreed, and postponed the test. Given the other events that unfolded, the system would have been of limited use, but its disabling as a "routine" step of the test is an illustration of the inherent lack of attention to safety for this test. This delay had some serious consequences: According to plan, the test should have been finished during the day shift, and the night shift would only have had to maintain decay heat cooling systems in an otherwise shut-down plant. Toptunov was a young engineer who had worked independently as a senior engineer for approximately three months. This continuing decrease in power occurred because in steady state operation, xenon is "burned off" as quickly as it is created from decaying iodine by absorbing neutrons from the ongoing chain reaction to become highly stable xenon When the reactor power was lowered, previously produced high quantities of iodine decayed into the neutron-absorbing xenon faster than the reduced neutron flux could burn it off. The operation of the reactor at the low power level and high poisoning level was accompanied by unstable core temperature and coolant flow, and possibly by instability of neutron flux, which triggered alarms. As part of the test plan, extra water pumps were activated at The increased coolant flow rate through the reactor produced an increase in the inlet coolant temperature of the reactor core the coolant no longer having sufficient time to release its heat in the turbine and cooling towers , which now more closely approached the nucleate boiling temperature of water, reducing the safety margin. The flow exceeded the allowed limit at At the same time, the extra water flow lowered the overall core temperature and reduced the existing steam voids in the core and the steam separators. The crew responded by turning off two of the circulation pumps to reduce feedwater flow, in an effort to increase steam pressure, and by removing more manual control rods to maintain power. Nearly all of the control rods were removed manually, including all but 18 of the "fail-safe" manually operated rods of the minimal 28 which were intended to remain fully inserted to control the reactor even in the event of a loss of coolant, out of a total control rods. Further, the reactor coolant pumping had been reduced, which had limited margin so any power excursion would produce boiling, thereby reducing neutron absorption by the water. The reactor was in an unstable configuration that was outside the safe operating envelope established by the designers. If anything pushed it into supercriticality, it was unable to recover automatically. Experiment and explosion This section needs additional citations for verification. Please help improve this article by adding citations to reliable sources. Unsourced material may be challenged and removed. April Learn how and when to remove this template message Radioactive steam plumes continued to be generated days after the initial explosion, as evidenced here on 3 May due to decay heat. The roof of the turbine hall is damaged image centre. Roof of the adjacent reactor 3 image lower left shows minor fire damage. Igor Kostin would take some of the clearer pictures of the roof of the buildings when he was physically present on the roof of reactor 3, in June of that year. Four of the main circulating pumps MCP were active; of the eight total, six are normally active during regular operation. The steam to the turbines was shut off, beginning a run-down of the turbine generator. In the interim, the power for the MCPs was to be supplied by the turbine generator as it coasted down. As the momentum of the turbine generator decreased, so did the power it produced for the pumps. The water flow rate decreased, leading to increased formation of steam voids bubbles in the core. Unlike western Light Water Reactors , the RBMK had a positive void coefficient of reactivity, meaning when water began to boil and produce voids in the coolant, the nuclear chain reaction increases instead of decreasing. With this feature at low reactor power levels, the no. This caused yet more water to flash into steam, giving a further power increase. During almost the entire period of the experiment the automatic control system successfully counteracted this positive feedback, inserting control rods into the reactor core to limit the power rise. This system had control of only 12 rods, and nearly all others had been manually retracted. The reason why the EPS-5 button was pressed is not known, whether it was done as an emergency measure in response to rising temperatures, or simply as a routine method of shutting down the reactor upon completion of the experiment. There is a view that the SCRAM may have been ordered as a response to the unexpected rapid power increase, although there is no recorded data proving this. Despite this, the question as to when or even whether the EPS-5 button was pressed has been the subject of debate. There have been assertions that the manual SCRAM was initiated due to the initial rapid power acceleration. Others have suggested that the button was not pressed until the reactor began to self-destruct, while others believe that it happened earlier and in calm conditions. The control rod insertion mechanism moved the rods at 0. A bigger problem was the design of the RBMK control rods , each of which had a graphite neutron moderator rod attached to the end to boost reactor output by displacing water when the control rod section had been fully withdrawn from the reactor. Thus, when a control rod was at maximum extraction, a neutron-moderating graphite extension was centered in the core with a 1. Therefore, injecting a control rod downward into the reactor during a SCRAM initially displaced neutron-absorbing water in the lower portion of the reactor with neutron-moderating graphite on its way out of the core. As a result, an emergency SCRAM initially increased the reaction rate in the lower part of the core as the graphite section of rods moving out of the reactor displaced water coolant. This behaviour was revealed when the initial insertion of control rods in another RBMK reactor at Ignalina Nuclear Power Plant in induced a power spike, but since the subsequent SCRAM of that reactor was successful, the information was disseminated but deemed of little importance. A few seconds into the SCRAM, a power spike occurred, and the core overheated, causing some of the fuel rods to fracture, blocking the control rod columns and jamming the control rods at one-third insertion, with the graphite displacers still in the lower part of the core. Apparently, the power spike caused an increase in fuel temperature and steam buildup, leading to a rapid increase in steam pressure. This caused the fuel cladding to fail, releasing the fuel elements into the coolant, and rupturing the channels in which these elements were located. It was not possible to reconstruct the precise sequence of the processes that led to the destruction of the reactor and the power unit building, but a steam explosion , like the explosion of a steam boiler from excess vapour pressure, appears to have been the next event. This is believed to be the first explosion that many heard. A second, more powerful explosion occurred about two or three seconds after the first; this explosion dispersed the damaged core and effectively terminated the nuclear chain reaction. This explosion also compromised more of the reactor containment vessel and ejected hot lumps of graphite moderator. The ejected graphite and the demolished channels still in the remains of the reactor vessel caught fire on exposure to air, greatly contributing to the spread of radioactive fallout and the contamination of outlying areas. Some of them fell onto the roof of the machine hall and started a fire. About 25 percent of the red-hot graphite blocks and overheated material from the fuel channels was ejected. Parts of the graphite blocks and fuel channels were out of the reactor building. As a result of the damage to the building an airflow through the core was established by the high temperature of the core. The air ignited the hot graphite and started a graphite fire. One such survivor, Alexander Yuvchenko , recounts that once he stepped outside and looked up towards the reactor hall, he saw a "very beautiful" LASER -like beam of light bluish light caused by the ionization of air that appeared to "flood up into infinity ". One view was that the second explosion was caused by hydrogen , which had been produced either by the overheated steam- zirconium reaction or by the reaction of red-hot graphite with steam that produced hydrogen and carbon monoxide. Another hypothesis, by Checherov, published in , was that the second explosion was a thermal explosion of the reactor as a result of the uncontrollable escape of fast neutrons caused by the complete water loss in the reactor core. According to this version, the first explosion was a more minor steam explosion in the circulating loop, causing a loss of coolant flow and pressure that in turn caused the water still in the core to flash to steam. This second explosion then did the majority of the damage to the reactor and containment building. The force of the second explosion and the ratio of xenon radioisotopes released after the accident a vital tool in nuclear forensics indicated to Yuri V.