
Safety Review for the Chernobyl Spent Fuel Storage Facility ISF-1

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Abstract:

In the present paper the work of western European TSOs in order to support licensing authorities of eastern European countries and to ensure further implementation of international accepted safety standards is explained at the example of the performed review of the safety assessment report (SAR) of the wet interim nuclear spent fuel storage facility SFSF-1 at the Chernobyl NPP site.

1 INTRODUCTION

The German and French Technical Support Organizations (TSO) GRS and IRSN have co-operations in the frame of TACIS projects among others for evaluation of interim storage of spent fuel in several eastern European countries. As an example some aspects of a recently performed evaluation of the wet storage facility SFSF-1 at the Chernobyl site is presented in this paper.

Accompanying to the activities of decommissioning and dismantling of the reactor units 1, 2 and 3 at Chernobyl NPP-site, which is supported financially by the Nuclear Safety Account (NSA), the European Community provides technical support to the State Nuclear Regulatory Committee of Ukraine (SNRCU) and its TSOs in licensing activities related to decommissioning facilities of Chernobyl NPP site in the frame of TACIS projects. This work in general comprises review and evaluation of safety related documents, which have been sent to the Ukrainian authority SNRCU by the applicant within the licensing procedure.

The EC financed projects in this context are usually assigned on the base of a tender. GRS and IRSN participate in such tenders by their common daughter company RISKAUDIT International located in Châtillon, France, with offices in Moscow and Kiev. Contracts with the EC are signed by RISKAUDIT, while the technical expert organizations IRSN, GRS and if appropriate additional western TSOs are engaged in the projects via separate sub-contracts with RISKAUDIT. The main objectives of the technical support in this fields are

- to develop capabilities of the eastern authorities and their TSOs on the basis of transferred Western European safety principles and practices,
- to ensure, that in the implementation of the financially supported decommissioning activities the internationally accepted safety criteria and standards are met.

2 THE ROLE OF SFSF-1 IN CHERNOBYL DECOMMISSIONING ACTIVITIES

Construction of an effective and lasting shelter for the destroyed unit 4 of Chernobyl is one of the biggest technical challenges of our time and a concern which is supported by many countries world-wide. Tightly connected to this task is the unloading and decommissioning of the reactor units 1, 2 and 3 of which the last one, unit 3 has been shut down by the end of 2000. The concept for spent fuel (SF) management envisages on site interim storage of the fuel assemblies from these reactors for up to 100 years. Therefore it is planned to build a dry concrete module storage system based on the US NUHOMS concept [1]. This concept has been developed and applied so far in USA and has to be adapted for RBMK-1000 fuel assemblies (FA). Due to problems, in particular with SF drying and treatment of damaged fuel assemblies the project for construction of the dry Interim Storage Facility ISF-2 has been delayed for several years with regard to the original time line. An international consortium conducted by Holtec International is currently working out an improved concept. As a consequence of this delay in construction of a new storage facility the existing wet storage facility SFSF-1 will be needed in operation at least until 2016 or beyond. This could exceed the originally planned life time of the facility. Construction of the SFSF-1 started in 1983 and the facility went in operation in 1986. In the light of this scenario the Ukrainian Authority SCNRCU and in particular its consulting safety experts have to deal with and give answers on the following questions:

- How is the current safety status of the SFSF-1 to be characterized?
- If necessary, which measures for backfitting, improvement of safety functions and monitoring are to be recommended?
- What could additionally be done to enable safe operation of the facility if necessary beyond the design life time of the facility?

In order to provide technical assistance to SNRCU in this task the western TSOs IRSN and GRS together with the local experts of SSTC were mandated for reviewing a safety assessment report, which has been prepared by ChNPP for the SFSF-1. This work was performed between December 2007 and February 2008.

3 REVIEW OF THE ISF-1 SAFETY ASSESSMENT REPORT

3.1 Main Characteristics of ISF-1

The ISF-1 has been constructed between 1983 and 1986 at the Chernobyl NPP site as an independent wet storage facility for spent fuel of RBMK-1000 type. It is located at about three hundred meters distance from the shelter of unit 4. Operation started in September 1986. The ISF-1 building consists of the "Transport technological part" where the spent fuel is handled and stored, the "Chemical part" for cooling water treatment and the administration building. The storage pool section consists of 5 equally sized storage compartments of the dimensions 26.4 m x 5.6 m x 10.5 m (length x width x depth). The total capacity is 21,900 fuel assemblies (Figure 1). The fuel assemblies are stored separately in cartridges, consisting of a tube of about 10.8 m length, 0.1 m in diameter and 2 mm wall thickness, which is open on the upper side and closed on the bottom side. The cartridges carrying the fuel assemblies are filled with water and placed in a vertically hanging position in the storage racks of the cooling pond (Figure 2). There is no direct connection between the water inside the cartridges and the pool water. Control of the water level in the cartridges is performed

manually by operators. The minimum required water level in the cartridges to cover the fuel rods is 7 m, the water level in the cooling pond is 10.5 m. In the storage pool the FAs are positioned in a rectangular pitch of 230 x 110 mm.

The RBMK type fuel assembly consists of two fuel rod bundles each of 18 fuel rods and about 3.6 m length, connected in axial direction by a central rod. An extension rod of 3 m length is connected on the top. The total length of the FA is 10 m, the outer diameter is 79 mm. As the ISF-1 has no equipment for cutting the extension rod and the central rod to separate the upper and lower fuel bundle, the FAs must be handled and stored at their full length. On-site transportation between the NPPs and the ISF-1 is performed by a transport cask TK-8, accommodating 9 FAs, which can be transported on a special rail waggon. The total number of FAs which have to be stored in the ISF-1 intermediately is 21 284 and additionally 1 700 spent absorbers, which have the same dimensions as the FAs. Initial enrichments of the FAs are 1.8 %, 2.0 % and 2.4 % ^{235}U , the maximum burn-up e.g. for 2.4 % enriched fuel is 23.5 MWd/kg.



Figure 1: View of the ISF-1 from outside and the storage area (left) and details of the storage racks and cartridges (right)

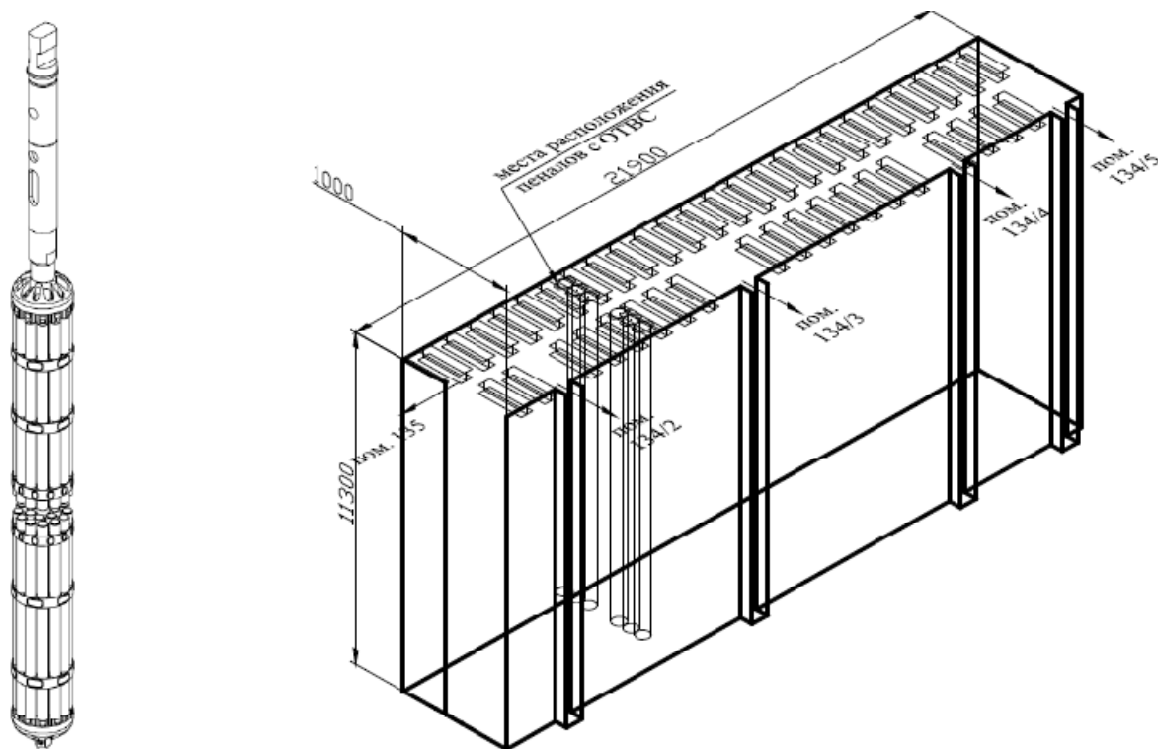


Figure 2: Schematic view of RBMK fuel assembly (left) and Storage racks and cartridges for SF storage

3.2 Expertise on the Safety Status of ISF-1

A Safety Assessment Report had been prepared by the operator of the ISF-1 and submitted to SNRCU and subsequently to the TSOs for review. The SAR consists of 17 chapters where all relevant safety issues of the facility are addressed. Among these the main important issues are: Site characteristics, strength analysis and civil structures, decay heat removal, radiation protection and monitoring, criticality safety, operation limits and conditions, accident analysis, radioactive waste management, quality assurance, decommissioning.

The expertise of the western TSOs was based on a review and evaluation of the SAR. At first the involved experts reviewed the SAR independently from each other and wrote their draft review reports. After this the results were exchanged for information and a meeting was held to discuss the results and conclusions and to write a common conclusion report. This meeting was held end of January 2008 in Kiev. In connection with this meeting a visit of the ISF-1 took place. During the meeting in Kiev the findings and conclusions of the involved experts were discussed intensely in detail and a draft common review report was written on the base of the previous separate reports. The reviewing experts were aware of the specific situation of the ISF-1 in connection with the decommissioning and remediation works at the Chernobyl site, nevertheless they addressed serious deficits according to their opinion and made recommendations to improve the safety assessment report, which finally shall reflect the safety status of the facility. In particular the reviewing experts identified and addressed deficits of the SAR with regard to the following items:

- Lack of information on the actual technical state of the facility
- Compliance with requirements of normative documents in force in Ukraine
- Quality assurance during construction

- Design deficits such as back-up power supply, technical means of appropriate dealing with defected or damaged FA
- Demonstration of implementation of a defence in depth concept for radiation protection
- Documentation of operational feedback for 20 years of operation
- Demonstration of sub-criticality for certain design-base events
- Demonstration of stability of the storage building and the storage pools in case of special external loads, such as earthquake or external explosion.

Therefore, the reviewing experts of RISKAUDIT/SSTC concluded among others, that the continuation of operation requires a significant safety upgrade implementing more extensive measures than those, which have been proposed so far by the operator and in accordance an update of the SAR. Further, it was addressed as an urgent task to accelerate the construction and commissioning work on the ISF-2 in order to limit the lifetime of the ISF-1 facility.

The common assessment report of the SAR has been issued end of January 2008 as the final results of the TACIS project terminating at that time. It was recommended to update the SAR significantly. The RISKAUDIT/SSTC comments were accepted by ChNPP. On 26 June 2008 SNRCU issued a license for ISF-1 operation under the condition that a safety reassessment will be presented by the operator until 31 December 2012.

4 SUMMARY

The wet storage facility ISF-1 is needed for temporary interim storage of the spent fuel assemblies on site in the frame of the decommissioning activities of Chernobyl NPP. As the remaining fuel assemblies have to be unloaded from the reactor units under decommission, and construction of the planned long term dry storage on site is delayed due to technical and other problems, the ISF-1 will for a certain time period be the only available storage facility on site and has to be operated at its full storage capacity.

A recently by western and Ukrainian experts performed review of the safety assessment report of the ISF-1 yielded deficits regarding important safety issues. The comments and recommendations for upgrading the SAR and improving the safety of the facility were accepted by the operator. The Ukrainian authority SNRCU issued a license for ISF-1 operation under the condition of providing a reassessment of the safety of the facility until 31 December 2012.

REFERENCES

- [1] A. S. Hanson, P. Chollet, International experience of storing spent fuel in NUHOMS systems, International Conference on Storage of Spent Fuel from Power Reactors, IAEA CN-102, 2 - 6 June 2003, Vienna, Austria