

Expansion of storage capacity of interim spent fuel storage (MSVP) Bohunice

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Abstract

This article describes modifications of Interim spent fuel storage, performed with aim of storage capacity expansion, seismic stability enhancement, and overall increase of service life as well as assuring of MSVP safe operation. Uniqueness of adopted technical solutions is based upon the fact that mentioned innovations and modifications were performed without any changes, neither in ground plan nor architecture of MSVP structure. It also important to mention that all modifications were performed during continual operation of MSVP without any breaks of limits or operational regulations. Reconstruction and innovation of existing construction and technological systems of MSVP has assured required quality standard comparable with actual trends.

Introduction

Present Interim spent fuel storage (MSVP) SE - VYZ was built in location of EBO Bohunice NPP during period of 1983 - 1987, and later on commissioned in February of 1988 as "wet storage" of spent fuel. In consequence with creation of new social relations in early 90's of the last century, new investment project: "Increase of seismic resistance and expansion of MSVP storage capacity" (REKO MSVP) has been launched. Aim of this project was expansion of stored amount of spent fuel elements in MSVP, increase of seismic resistance of the building constructions, technological systems and elongation of MSVP's service period for next 50 years, minimum.

Expansion of MSVP's storage capacity is performed by the way of sequential compaction utilizing new type of spent fuel storage cask (type KZ 48). Such an operation will provide storage for complete production of two Bohunice NPP blocks V1 and V2 during their service period, without any enlargement of present MSVP. Consequently, this basic requirement was followed by performance of necessary reconstruction work on MSVP equipment, to be able expand amount of safely stored spent fuel.

Seismic resistance of MSVP

With reasonable changes in opinions and experience with problem of seismic effects on industrial buildings based on new scientific and technical observations and creation of database containing earthquake effects and impacts, complete reevaluation of seismic risks on already built nuclear-energetic equipment had to be done.

Original soviet project documentation of MSVP EBO, according which the interim storage has been built, included constructional and technological solutions designed for seismic resistance of building construction and technological systems up to 6^o MSK 64 in free landscape. Interim storage of spent fuel SE - VYZ Jaslovske Bohunice is geographically located in region of Male Karpaty where seismic activity of earthquake can possibly reach up to IO = 7^o ÷ 8^o MSK 64. Original soviet project documentation of MSVP does not take into account seismic situation in this location, and that was main reason why decision for increase of seismic resistance up to 8^o MSK 64 has been taken for selected building constructions and technological equipment. This increase of seismic resistance follows methods of IAAE 50 - SG - S1 (Rev. 1) 1991. In course of interim spent fuel storage safety increase, MSVP SE - VYZ has been classified as an object of 1st category of seismic resistance.

Expansion of storage capacity

Storage capacity expansion of Bohunice MSVP is necessary for further service of two WWER - 440 blocks. In 1997 original capacity of MSVP was completely filled with production of two blocks V1 and V2 of Bohunice NPP. Due to the fact that final storage of spent fuel will not be commissioned in Slovak

republic earlier than in 30 - 40 years, whole production of spent fuel during this period must be stored in MSVP Bohunice.

Required expansion of MSVP storage capacity results from amount of already stored fuel elements and from amount of spent fuel elements production during further service of V1 and V2 blocks of Bohunice NPP. Expansion of MSVP storage capacity is not realized by ground plan enlargement of the storage area, but by way of utilization of new cask type - compact storage cask KZ 48 and its denser placing into existing pool and consequent modifications of original technological and safety equipment of MSVP. Initially utilized cask T 12 enables placement of 30 pieces of fuel elements, and into one pool can be placed only 56 of these casks. New design of compact cask enables placement of 48 pieces of fuel elements, and new shape of cask gives possibility to place 98 compact casks KZ 48 into one pool. This new technology expanded storage capacity of MSVP 2.8 times and will guarantee enough capacity for whole production of spent fuel during service period of blocks V1 and V2 Bohunice NPP.

In process of storage capacity expansion of MSVP plays an important role manipulator for relocation of spent fuel MAPP 440. Since March 1999 this manipulator performs safe and reliable relocation of spent fuel from original casks T 12 into new type of casks KZ 48. This operation is fully automatic and controlled on distance.

It is obvious that increased amount of fuel elements in the storage, from initial 5040 pieces up to 14 112 pieces, will cause heat rise from initial maximal rate of 516 kW up to 1990 kW. Heat increase will be proportional to the rising amount of stored fuel elements. Maximal heat rate, 1990 kW, of stored fuel elements will be reached in year 2024. After reaching maximal rate the heat will gradually decline. It was necessary to take this fact into account and provide increase of cooling power of the pool water-cooling unit and other technological modifications of the systems including replacement of electro cables with new fireproof cables according to IEC 332-3A standard. Following, replacement and modernization of electrical equipment has been provided, establishment of new power back-up unit - diesel generator, as well as replacement of original MSVP control system with system SIMATIC S5. All signalization and control cables were replaced with fireproof cables according to IEC 332-3A standard.

Other performed modifications during reconstruction work

Except modifications made on the original construction solution and technological equipment of MSVP, which were conditioned by requirement of seismic resistance increase and expansion of storage capacity as a main goal of reconstruction with aim of MSVP's technical standard increase, some other changes were also performed. Changes mostly connected with modifications of building and technological part of MSVP. In building part dispositional modifications of sanitary loop were performed, as well as built up of new sanitary loop for women and visitors. Built up of new storeroom on floor level + 3.60 m, rebuilt of MSVP entrance for personnel, built up of garage on the floor level 0.00 m and erection of new steel construction for intermediate floor on the level of + 3.60 m. Modification of technological part contains changes in placement of compressed air and nitrogen reduction units including modification of pipelines, duplication of selected ventilation systems, improvement of air-conditioning systems in the operator's rooms and ventilation of MSVP entrance, modification of ventilation system in sanitary loop due to dispositional changes. In the system of decontamination, pool water filtration unit has been completed with German BALDUF filtration unit for collecting microorganisms in the pool water, including liquidation of filters-beds by the filtration unit. Following the plan, decontamination bath has been replaced with more suitable type; system for inspection of fuel elements (Sipping in Pool) and monitoring of pool facing's corrosion was completed. Modernization of transportation system included design of new movable cover platform above the shaft No.2. For needs of radiation control, enters into the ventilation tunnel were built up as well as modernization of whole system and instrumentation of the radiation control system was performed. Work on increase of MSVP's seismic resistance was completed in the end of 1999. This reconstruction was important contribution to accomplish all requirements either qualitative nor quantities for further safe storing of spent fuel produced by blocks V1 and V2 of Bohunice NPP.

MSVP monitoring

As mentioned above, elongation of MSVP's service life was invocated by taken steps while developing the process of last spent fuel cycle in Slovak republic

Supervisory body UJD of Slovak republic defined conditions, which had to be fulfilled for receiving the license on further service period of MSVP. These conditions are implemented by completing MSVP

with new operational unit PSM9-R: Long-term monitoring of building constructions and technological systems service life.

This unit is designated to perform monitoring and evaluation of selected components and parts, as follows:

- monitoring of the pressure vessels
- monitoring of equipment applying nondestructive inspection methods (visual inspection, capillary method, magnetic powder method, ultrasonic inspection, leakage and pressure testing)
- monitoring of corrosion deterioration of building constructions, machine and transport equipment applying method of acoustic emissions and method using gouging specimens:
 - for determination of mass losses
 - CCB type (for determination of crack occurrence and non-uniform corrosion distribution on external surface of the arc)
 - circular cladding (determination of crack on the specimen surface)
 - U-bend (determination of transversal cracks on external surface of the bend)
 - for metallographic evaluation (surface treatment analysis)
 - made of ATABOR steel
- monitoring of stability and observation of building construction service life:
 - sub-soil and a ground constructions
 - pool site and concrete supporting constructions
 - supporting metallic elements and constructions
 - external coating and internal filling
- monitoring of rotating machinery (diagnostics of vibrations, ultrasonic field method)
- monitoring of electro technical equipment:
 - detection of insulation resistance of cables
 - detection of loss coefficient
 - cables tensibility (gauging specimens)
 - detection of voltage
 - detection of impedance
 - wiring transmission
 - detection of winding resistance
 - testing of protection and blocking systems
- inspection stand for monitoring of spent fuel, stand is designed to carry exchangeable modules, it is transportable with possibility of decontamination. Stand performs following operations:
 - dismantling and assembly of the shroud tube
 - removal of selected fuel elements from assembly and its entry to the container
 - visual inspection of shroud tubes and fuel elements by TV system
 - ultrasonic inspection of fuel elements after dismantling of shroud tube
 - eddy current inspection of the individual fuel elements
 - gamma spectroscopy of individual spent fuel elements
 - gamma spectroscopy measurement of the individual fuel elements length
 - pellet-clad gap measurement
 - eddy current of oxide layers thickness measurement
 - taking of the samples of oxide layers fuel elements
 - detection of the pressure of fission products measurement by thermo method
 - measurement of position spacer grid without dismantling the shroud tube
 - measurement of diameter and a ovality of individual fuel element

Supervisory body UJD SR has released positive evaluation of realized modifications on MSVP and submitted approval for further service of reconstructed MSVP by reissuing the license.