TECHICAL SURVEY OF ETRR-1 REACTOR'S TANK AND SPENT FUEL STORAGE

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A reactor ETRR-1 belongs to the WWR-S type [1] and was put into operation at a power 2 MW in 1961 in Nuclear Research Center of ARE near Cairo. In 1992 a team of Russian specialists working in the B.P.Konstantinov Nuclear Physics Institute carried out a technical examination of the reactors mechanical equipment to ascertain that the reactor can be operated in a case of upgrading power up to 8 Mw. Basically, the cost of reactor reconstruction is determined by possible further operation of the reactor tank and the spent fuel storage,therefore attention is mainly paid to these parts of mechanical equipment. The reactor ETRR-1 tank has almost the same construction, as the tank WWR-M [1], except intratank, named separator, dividing water of the first circuit flowing down through the active corefrom motionless water of the shield. Spent fuel storage is of the same construction as in WWR-M. Constructional material for both reactors is the same aluminium alloy SAW-1. Taking into account low value of fast neutron flux ($3.7 \cdot 10^{23}$ n/m^2) for the tank ETRR-1 it is possible to confirm that the mechanical properties are the same as those of the initial nonirradiated material [1]. It means, that the constructional material of the tank ETRR-1 will be analogous to that of WWR-M 1993 y only after 50 years of exploitation at a power 8 Mw. The mechanical properties will begin to change due to irradiation practically in 5 years and only in 30 years it will become necessery to take into account the alloys embrittlement in connection with strength calculations. The closeness of constructional decisions for both tanks ETRR-1 and WWR-M determines analogous type of stress state, i.e. the tank ETRR-1 will have more than double safety margin during half a century of the following operation time but... this optimistic prediction is correct under the condition that the alloys gomogenity structure remains stable and does not change the construction shape and the quality of its surface. A stable structure is preserved because of low temperature (less than 70°C). The same factor in combination with low stresses enables to remain the shape. Unfortunately presented for the inspection data of waterchemical regime in the tank and the spent fuel storage showed, that water quality did not meet the requirements placed upon the use of aluminium alloys in nuclear reactors. For this reason it was naturally to wait for appearance some defects on the metal surface accordingly it was chosen methods of survey. Underwater television camera was used for visual examinations inside the reactor tank. The television head includes telecamera, swivelling gear and luminaries. It is fixed on a rod which allows an operator to submerge the head at a certain depth and scan in a horizontal direction. The television system allows to find the pits with a diameter of no less than 2.0 mm and the cracks with a width of no less than 0.5 mm. The results of examination can be recorded on video tape. Optical rod is used as an extension of the television system enabling it to examine surface in places inaccessible to the television head. The optical rod is a tube at the lower end of which a turning mirror made of a stainless steel is fixed. 12X magnification optical device is set on the upper end of the rod. The ultrasound thickness gauge "KVARZ-15" is used for walls thickness measurements. The measurement of defects depth was carried out by means of imprints method on plastic material.

The technical survey showed that total corrosion does not exceed 0.01 mm/year, it means

that real value of pH was close to 5, i.e. normal. Enough low value of total corrosion is confirmed by thickness measurements. But the pits were determined practically on all the surfaces. The cause of pitting was high concentration of the chlorine-ions. Particularly, the walls of the storage were damaged by pitting, where high concentration of cooper was determined in addition to clorine-ion. Maximum pits surface size amounts to about 0.5 sq.cm., the pit depth does not exceed 1.5 to 2 mm. Examined weld seams do not have visible defects. Cracks were not detected.

The technical inspection of the ETRR-1 reactor revealed that metal surface is mainly exposed to pitting. At the moment of the inspection the size of pits and their number do not limit possible operation of the equipment under the normal water and chemical conditions, except for the spent fuel storage. The final decision of possible operation of the storage can be made only after additional survey with the fuel removed. The results of examination revealed that the state of the reactor tank and intratank constructions provides to perform a reconstruction without substantial dismantling.

REFERENCES

1. *Bat G.A., Kochenov A.S., Kabanov L.P.* Issledovatelskie Jadernye Reactory. M.: Atomizdat, 1972.