

CONCEPTUAL PROBLEMS OF DECOMMISSIONING OF THE REACTOR PLANT BN-350

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The reactor plant BN-350 located on the seaside of Caspian Sea is a part of the industrial complex of the Mangyshlak Nuclear Power Plant with a fast breeder loop reactor with three-circuit cooling system. The coolant of first two circuits is a liquid metal sodium, of the third circuit - is water-steam. The Reactor Plant was intended to supply steam to turbogenerators (about 150 Mwatt) and sea water desalination (about 120000t/day) and accumulation of auxilary nuclear fuel (plutonium) for atomic energy. BN-350 reactor plant has been in operation since 1973. The reactor operation was stopped in 1998 after 25 years service.

The BN-350 Reactor Facility includes:

- BN-350 Reactor with a spent fuel pool;
- special water treatment complex;
- storage facilities for liquid and solid radioactive wastes;
- fresh nuclear fuel storage facilities.

Justification for Decommissioning Activities

- Decree of the Government of the Republic of Kazakhstan of April 22, 1999 No 456 On Decommissioning of BN-350 Reactor
- The Law of the Republic of Kazakhstan “On Use of Atomic Energy”
- General provisions for radioactive wastes disposal in the Republic of Kazakhstan
- Plan of Priority Actions for Decommissioning of BN-350 RF in the Aktau City of the Mangistau Oblast approved by the Ministry of Energy, Industry and Trade of the Republic of Kazakhstan.

Main reasons of Decommissioning Activities

- economical inexpediency for the further operation
- uselessness of plutonium accumulation
- termination of serviceable lifetime
- problem of radioactive waste processing and disposal.

Purpose of Decommissioning Activities: ensuring the nuclear, radiation and ecological safety during spent fuel and radioactive waste management, dismantling of the equipment and passing the reactor site to the further use.

Funding sources:

- Budget accounts, funds earmarked for a special purpose
- assistance of donor-countries
- ISTC and TESIS projects etc.

Strategy of BN-350 decommissioning:

- transfer the reactor BN-350 to the safe storage including nuclear fuel unloading,
- conservation and safe storage over 50 years-period for the further dismantling or disposal,
- partial or complete dismantling of the equipment and its disposal.

The absence of decommissioning experience in our country has resulted in the need to create a project and assessment of its primary stages.

Basic stages of BN-350 decommissioning and realization terms

- develop technology, packing equipment.
- Packing, allocation and safe storage of BN-350 spent fuel
1999 -2006
- Elaboration of the decommissioning project
1999- 2001
- Transfer the BN-350 reactor to the safe storage and its conservation
2000- 2006
- Safe storage of the BN-350 under supervision
2007-2057

The main directions of the BN-350 decommissioning are:

- ensuring the reactor safety during transition period
- elaboration of the decommissioning project
- nuclear fuel unloading from the reactor and draining of the coolant from the circuits
- packing, transportation and storage of the spent fuel that is present at the reactor BN-350
- utilization and storage of radioactive waste formed at operation and decommissioning of the BN-350 reactor.
- deactivation and conservation of the equipment.

The large part of all the expenses is allocated to the radioactive waste handling, especially with liquid metal coolant (sodium), to the radiation, fire and explosion protection.

The priority tasks are the following:

- fuel unloading in the reactor pool,
- cleaning of sodium from cesium radionuclides and sodium draining from reactor systems.

The elaboration of the BN-350 Decommissioning plan is provided by cooperation of international experts from Kazakhstan, Russia, USA, European countries and Japan.

The Decommissioning Plan consists of the following parts:

- Purpose of Decommissioning Activities
- Justification and Basis for Activities
- Statement on the Burdens to Future Generations (Reduce Exposures, Lower Final Costs, Reduce Environmental Impacts)
- Structure of the Body of the Report (work organization scheme, measures for preparation of the reactor to the safe storage, work schedule, radiation and physical protection program, Costs and Funding by major tasks, final radiation survey and license termination, facility and site restoration)
- The Report's Regulatory Basis.

The general guide and plan of transfer the reactor BN-350 to the safe storage developed by the international group of experts should be submitted for the international review.

Jointly with the specialists from the USA the following works have been providing: selection of technology of the spent fuel storage, develop project of cleaning the first circuit sodium at the reactor BN-350 from cesium radionuclides as well as draining of sodium from the reactor systems, review of accident situations at fuel transportation, legal and economic aspects of fuel transportation and safe storage. The problems of physical protection of nuclear materials, the environment, personnel and population protection have been considering too. One was planned to use an international experience for example the decommissioning of the reactor EBR-II (Idaho State, USA) or evaluation energy reactor in Tokyo (Japan).

For the elaboration of the BN-350 decommissioning project two fields of activity are the most essential:

- determination of cost and optimization of material and financial expenses;
- ensuring the radiation safety of the personnel and population.

The information on financial and material expenses, dose rates on the personnel and radiation impacts on the population during decommissioning works must be collected, processed, analyzed, systematized and submitted in a form possible to be used in the future decommissioning projects.

The structure provided available information form can be found by dividing of works: planning, radioactive waste management, radiation protection, dismantling, public relation.

The work for D&D project care out with international cooperation :

1. USA - Department of Energy, Nuclear Regulation Commission, ANL, BNL.

Justification for Decommissioning Activities: Executive agreement on the BN-350 decommissioning signed in Washington, USA, December 21, 1999 between Department of Energy USA and Ministry of Energy, Industry and Trade of the Republic of Kazakhstan.

- Upgrade of BN-350 fire-safe protection (equipment assembling, full analysis of risks during the transfer the reactor to the radiation-safe mode, determination of actions for personnel and equipment safety)
- Calculation and theoretical studies of safe spent fuel management
- Works on selection of spent fuel storage
- Making of BN-350 decommissioning plan, ISTC project
- Development of the project for the first circuit sodium cleaning from cesium radionuclides, ISRC project
- Sodium draining from reactor plant systems (it is planned to use experience of fast breeder reactor EBR-II decommissioning, Idaho (Argonne National Laboratory). The Project focuses on development, installation and maintenance of special equipment, development and production of installation for sodium transformation into applicable waste form.
- Study of physical and mechanical properties of the BN-350 irradiated materials to forecast the behavior of materials during the long-term irradiation and elaboration of recommendations for life extension of light-water reactors. (ISTC)
- The problems of physical protection of nuclear materials, protection of the environment, population and the personnel are considered.

2. KEC-EDF/CLI, SOGIN financing of works on TESIS projects.

- Removing the leak of fuel pool
- Upgrade of BN-350 fire-safe protection including equipment purchase and supply
- Radiological description of the reactor plant and upgrades of protection
- Development of the BN-350 decommissioning international plan
- Study of physical and mechanical properties of the BN-350 irradiated materials to forecast the behavior of materials during long-term irradiation and elaboration recommendations for life extension of light-water reactors. (ISTC)
- KEC participation is planned in the processing of liquid radioactive waste

3. Japan - JNC, PESCO, MARUBENI, HITACHI

- Providing of the BN-350 physical protection (equipment supply).

One of the important result of the whole activity should be a general database contained the following information:

- stages of decommissioning works;
- radioactive waste management;
- possible expenses;
- possible irradiation of the personnel, population and the environment;
- properties of irradiated construction materials and welded joining;

assessment of volume and ways of accumulation, storage and processing of data to be used for the future nuclear power plants decommissioning.