УКРАЇНА
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"КИЇВСЬКИЙ НАУКОВО-ДОСЛІДНИЙ ТА
ПРОЕКТНО-КОНСТРУКТОРСЬКИЙ ІНСТИТУТ
"ЕНЕРГОПРОЕКТ"

UKRAINE
JOINT-STOCK COMPANY
"KYIV RESEARCH AND DESIGN INSTITUTE
"ENERGOPROJECT"

New construction.
Fuel fabrication facility

BRIEF DESCRIPTION OF THE PLANNED ACTIVITY AND ASSESSMENT OF IMPACTS OF CONSTRUCTION, OPERATION AND ACCIDENTS ON THE TERRITORY OF NEIGHBORING STATES

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INTRODUCTION

Joint Stock Company «National Nuclear Energy Generating Company «Energoatom» (JSC «NNEGC «Energoatom») plans to implement the following activity «***New construction. Fuel fabrication facility***».

1 OVERVIEW

Operating nuclear power plants (NPPs) in Ukraine are currently supplied with foreign nuclear fuel. Ukraine, having a developed nuclear power industry, is almost completely dependent on foreign nuclear fuel supplies.

To diversify the supply of new fuel to NPPs in Ukraine, a decision was adopted on the FA (fuel assemblies) mechanical assembly line in Ukraine using the US Westinghouse nuclear power company (Westinghouse) technology.

In 2021, the current affiliate «Separate Subdivision «Atomenergomash» of the Joint Stock Company «NNEGC «Energoatom» (affiliate «SS «Atomenergomash»), started activities on establishing the FA fabrication using Westinghouse technology to completely replace fuel of russian origin.

On January 17, 2022, SE «NNEGC «Energoatom» (currently JSC «NNEGC «Energoatom») and Westinghouse signed an agreement on the assessment and qualification of the FA fabrication lines.

SE «NNEGC «Energoatom» and Westinghouse announced (https://suspilne.media/246322-energoatom-ta-westinghouse-ogolosili-pro-rozsirenna-spivrobitnictva/) the expansion of cooperation in the nuclear fuel supply and construction of new nuclear power units in Ukraine.

This is to provide FAs for both existing power units and those that the companies jointly plan to construct in Ukraine.

Enriched nuclear material in the form of complete fuel rods will be supplied from Westinghouse's manufacturing site in Sweden. At the same time, the fabrication of the FA individual components will be implemented in Ukraine on the basis of one of the JSC «NNEGC «Energoatom» separate divisions.

2 PURPOSE

The purpose of the planned activity is to create a FA assembling facility from complete components to supply domestic reactors and ensure foreign nuclear fuel supply diversification to Ukrainian NPPs.

3 CHARACTERISTICS

Fuel Fabrication Facility (FFF) is a facility that assembles FAs from complete components and fuel rods (fuel rods and gadolinium fuel rods).

The FFF products are fuel assemblies that are completely assembled for transporting to NPPs.

The process of FA assembling from complete components is provided for in Ukraine only.

Enrichment, conversion, fuel pellets, fuel rods, and gadolinium fuel rods fabrication are not envisaged in Ukraine.

The FFF includes a complex of buildings and structures ensuring compliance with international and national requirements for radioactive materials transportation, including nuclear materials, and the performance of technological operations with due regard for nuclear and radiation safety requirements at all FA assembling stages.

The FFF includes a complex of buildings and structures, namely:

- fabrication building;
- accommodation building with a gallery;
- administrative building (civil defense facility);
- electrical building;
- garage;
- FA skeleton components warehouse;
- diesel generator station;
- security facilities:
  - guardhouse (civil defense facility);
  - checkpoint-1;
  - checkpoint-2;
- water supply and sewage facilities:
  - fire water supply facilities;
  - storm water drainage facilities;
  - domestic sewage treatment facilities.

The following operations are planned to perform at FFF:

- receiving and temporary storage of FA skeleton components;
- receiving and temporary storage of fuel rods and gadolinium fuel rods;
- skeleton assembling from components;
- FAs assembling, control, preparation for transporting, temporary storage and transporting of completely assembled products to NPPs.

4 CONSTRUCTION, OPERATION AND ACCIDENT IMPACTS ASSESSMENT ON THE NEIGHBORING COUNTRIES

4.1 General provisions

Pursuant to the Convention on Environmental Impact Assessment in a Transboundary Context, ratified by Ukraine on March 19, 1999, the planned activity listed in paragraph 3 of Annex I «List» is among the activities that may have significant adverse transboundary effects on the environment.

The purpose of this section is to preliminary prove that there will be no transboundary impacts during the FFF construction, operation, accidents and decommissioning in Ukraine.

4.2 Impact characteristics

According to the fabrication technology implemented at FFF, the formation of gaseous and volatile radioactive sources and liquid radioactive media during normal operation is not possible.

The dose level from FAs, fuel rods/gadolinium fuel rods and unirradiated nuclear fuel excludes the possibility of radiation exposure outside the building (i.e. to the public).

4.3 Construction impact assessment

Due to the fact that the construction is planned in a clean area, it was determined that there is no additional radiation impact on the population and the environment during construction compared to the natural background.

4.4 Impact assessment under normal operating conditions

The fabrication technology implemented at FFF based on Westinghouse technology excludes the formation of gaseous and volatile radioactive substances and liquid radioactive media.

Gaseous emissions and water discharges of radioactive substances are not envisaged during FFF normal operation.

4.5 Decommissioning impact assessment

The FFF decommissioning will be carried out with the aim to achieve conditions that will allow for the reuse of the territory on which it is located. The complete release from regulatory control shall be achieved during FFF decommissioning .

The FFF decommissioning will be performed after complete nuclear materials removal (FAs and fuel rods) from the territory and removal of all radioactive materials and waste, if available. The residual contamination before FFF decommissioning is not expected. It is assumed that there will be no radiation impact on personnel and the public during FFF decommissioning.

4.6.2 Impact assessment under beyond design basis accident (BDBA)

The doses obtained for the considered BDBA are as follows – the maximum effective dose for two weeks after the accident is 7.65 E-05 Sv (7.65 E-02 mSv), namely:

- dose due to inhalation and exposure from the cloud 2.24 E-05 Sv (2.24 E-02 mSv);
- dose due to local food consumption and exposure from the ground surface 5.41 E-05 Sv (5.41 E-02 mSv).

All the doses received under the considered BDBA are insignificant and do not require any countermeasures.

In the event of an accident, an emergency plan shall be implemented, local food consumption shall be prohibited, radiation survey of the territory shall be conducted, and decontamination with the removal of contaminated soil shall be performed.

When the emergency plan is implemented, namely, when local food consumption is prohibited, the doses received will be less than 22.5 μSv (2.25 E-02 mSv) for accident.

To determine the distance at which the value of 10 μSv (1.00 E-02 mSv) for accident will not exceed, under the considered BDBA, additional dose calculations were performed at distances of 100 and 300 meters from the release point.

For a distance of 100 meters from the release point, under the considered BDBA, the following dispersion parameters were obtained:

- the meteorological dilution factor for uranium isotopes 234, 235, 238 short-term release is 1.755 E-02 s/m^3;
- the sum of the dry deposition and precipitation scavenging factors on the SPA border is 1.68 E-04 m^{-2}.

For the considered BDBA at a distance of 100 meters from the release point, the maximum effective dose for two weeks after the accident is 2.25 E-05 Sv (2.25 E-02 mSv), namely:

- dose due to inhalation and exposure from the cloud 6.59 E-06 Sv (6.59 E-03 mSv);
- dose due to local food consumption and exposure from the ground surface 1.59 E-05 Sv (1.59 E-02 mSv).

For the considered BDBA at a distance of 100 meters from the release point, all received doses are insignificant and do not require any countermeasures. In the event of an accident, an emergency plan shall be implemented, local food consumption shall be prohibited, radiation survey of the territory shall be conducted, and decontamination with the removal of contaminated soil shall be performed. When the emergency plan is implemented, namely local food consumption is prohibited, the doses received will be less than 10 μSv (1.00 E-02 mSv) for accident.

For a distance of 300 meters from the release point, under the considered BDBA, the following dispersion parameters were obtained:

- the meteorological dilution factor for uranium isotopes 234, 235, 238 short-term release is 2.58 E-03 s/m^3;
- the sum of the dry deposition and precipitation scavenging factors on the SPA border is 2.28 E-05 m^{-2}.

For the considered BDBA at a distance of 300 meters from the release point, the maximum effective dose for two weeks after the accident is 3.12 E-06 Sv (3.12 E-03 mSv), namely:

- dose due to inhalation and exposure from the cloud 9.64 E-07 Sv (9.64 E-04 mSv);
- dose due to local food consumption and exposure from the ground surface 2.16 E-06 Sv (2.16 E-03 mSv).

4.6 Accident impact assessment

The radiation consequences of two events were considered for the planned activity, namely:

- design basis accident with maximum radiation consequences (MDBA);
- hypothetical beyond design basis accident (BDBA).

A single FA drop with damage was considered as MDBA in the final assembly area or in the FA loading area, or FA damage caused by heavy equipment or building structures falling on this FA, or other initial events.

Damage to the maximum FAs number in the storage area, i.e. the number that can be concentrated in one place, as a result of a beyond design basis event, for example, an aircraft crash, was considered as a BDBA.

When calculating emergency doses to the public, the most conservative data and approaches to the conditions of release dissemination and exposure were selected, namely:

- sanitary and protection area (SPA) boundary at a distance of 50 m from the release point;
- the release height 0 m, weather category F, wind speed 2 m/s, weather conditions do not change;
- without release cloud depletion on the way to the SPA boundary, maximum radionuclide deposition on the surface as a result of wet and dry deposition in accordance with the document approaches;
- exposure parameters (respiration volume, local food consumption, radionuclide intake class, exposure time) and activity-to-dose conversion factors.

The dissemination parameters obtained are as follows:

- the meteorological dilution factor for the uranium isotopes 234, 235, 238 short-term release is 5.97 E-02 s/m^3;
- the sum of the dry deposition and precipitation scavenging factors on the SPA border is 5.71 E-04 m^{-2}.

4.6.1 Impact assessment under maximum design basis accident (MDBA)

The doses obtained for the MDBA are as follows – the maximum effective dose for two weeks after the accident is 4.25 E-07 Sv (4.25 E-04 mSv), namely:

- dose due to inhalation and exposure from the cloud 1.25 E-07 Sv (1.25 E-04 mSv);
- dose due to local food consumption and exposure from the ground surface 3.00 E-07 Sv (3.00 E-04 mSv).

For the MDBA under consideration, all doses received are extremely low, much less than 10 μSv (1.00 E-02 mSv) for accident, and do not require any countermeasures.

In the event of an accident, an emergency plan shall be implemented, local food consumption shall be prohibited, radiation survey of the territory shall be conducted, and decontamination with the removal of contaminated soil shall be performed.

When the emergency plan is implemented, the possible doses to the public will be further reduced.

For the considered BDBA at a distance of 300 meters from the release point, the doses received are extremely low, significantly less than 10 μSv (1.00 E-02 mSv) for accident, and do not require any countermeasures. In the event of an accident, an emergency plan shall be implemented, local food consumption shall be prohibited, radiation survey of the territory shall be conducted, and decontamination with the removal of contaminated soil shall be performed. When the emergency plan is implemented, the possible doses to the public will be further reduced.

Therefore, for the considered BDBA:

- at a distance of 50 m from the release point (industrial site boundary), the doses received are insignificant, but exceed the value of 10 μSv (1.00 E-02 mSv) for accident;
- at a distance of 100 m from the release point, the values received do not exceed the value of 10 μSv (1.00 E-02 mSv) for accident, provided that local food consumption is prohibited;
- at a distance of 300 m from the release point and further, the value of 10 μSv (1.00 E-02 mSv) for accident will not be exceeded even if the emergency plan is not implemented and local food consumption is not prohibited.

4.7 Transboundary impacts conclusions

With respect to the extremely low doses and soil contamination under the considered accidents, there is no transboundary impact of the planned activity.

There is no transboundary impact under normal construction and operation conditions, abnormal operation and accidents.