1. Basic information

1.1. CRIS number 5812.05.01

1.2. **Title:** Upgrading of the heat exchangers and ion-exchangers at the MARIA research reactor to reduce the possible radioactive release into the environment.

1.3. Sector: 23064

1.4. Location: POLAND

2. Objectives:

2.1. **Overall objective:**

The objective of the project is to constrain the radiological hazard resulting from the transfer of radioactive isotopes due to the leakage of water from the fuel channel cooling circuit and reactor pool cooling circuit into the water at the secondary side at the reactor heat exchangers as well as to improve the chemical quality of water at the secondary circuit.

2.2. **Project purpose/immediate objective**

The project is aimed in improving the radiological situation by sealing the reactor primary cooling circuits from contacting with water of the secondary side flowing in an open cooling circuit having a direct contact with ambient atmosphere.

2.3. **Accession Partnership and NPAA Priority:**

This project implements the recommendations contained in the Council report on “Nuclear Safety in the Context of Enlargement” with due regard to remarks to be found in the report.

3. Description of the project

3.1. **Background and justification:**

The MARIA research reactor has been operating since 1974. It is equipped with two primary cooling circuits: the fuel channel pressurised cooling circuit and an atmospheric pool cooling circuit. Heat generated in the reactor core is transferred into the water of the secondary circuit in vertical U-tube heat exchangers. Due to aging and quality of water in the secondary circuit we face exploitation troubles associated with corrosion and jamming of the tubes in heat exchangers.

The heat exchangers aren’t equipped with an on line cleaning system e.g. as the “TAPPROGE” one so we are accomplishing the cleaning operation after reactor shutdown during the operational cyclic break. Water at the secondary circuit is cooled at
the wet dripping cooling tower so it has a direct contact with ambient atmosphere. Despite filtration and chemical treatment that water contains impurities and corrosion generating chemical elements that cause sedimentation of sludge at the inner tube surface as well as pitting and cracking corrosion of the heat transfer U-tubes. To make cleaning process of the tubes more effective we have changed the water flow organization inside the heat exchangers namely the coolant of the first circuits flows outside the U-tubes and the cooling water of the secondary side flows inside the U-tubes. This procedure improved substantially the operational regime of heat exchanger and the operation of reactor but it didn’t eliminated completely by the corrosion and sedimentation processes. In recent years we have discovered a number of leaking tubes (3 ÷ 7 per year) so we had to plug them. The trouble is that even if we notice a ruptured or leaking tube and due to activity increase at the secondary circuit the reactor is scrammed, still because of large pressure difference between the primary and secondary side at heat exchanger (0,8MPa) the radioactive isotopes are transmitted into the secondary open type cooling circuit and the radioactive releases to the environment are noticeable. To be in compliance with the ALARA principle we are due to upgrade the heat exchangers. The available area in the pumping room imposes limitation on the lay-out of the upgraded heat exchangers. On performing assessment and analysis we have come to the conclusion that the best estimate is to retain the vertical type of the heat exchangers and only replace their internals i.e. the tube bundles with perforated slabs. The same concerns the filtration system in which ionite beds will be changed.

3.2. Linked activities:

The Institute of Atomic Energy has already elaborated a conceptual design of the lay-out of the upgraded heat exchangers filter units and their pippins together with linking fittings.

3.3. Results:

The upgrading of the heat exchangers at the fuel channels and reactor pool circuits as well as ion-exchange beds will:

• Help the IAE to meet the standards and requirements regarding the quantities of the radioactive releases into the environment imposed by the National Regulatory Body, the recommendation of the International Atomic Energy Agency as well as the obligations determined by the EU regulations (Chapter III of the European Treaty and the derived Directives);
• Limit to the minimum possible radioactive releases into the environment to be achievable when using the open secondary cooling circuit having direct contact with ambient atmosphere.

3.4. Activities:

The project will comprise the following activities:
• Technical assistance activities (expertise) on checking and verifying the technical documentation for upgrading the heat exchangers and refurbishing the ion-exchange filtration system as well as the identification of technology and assembly of pieces of equipment.

This would include:
• Development of technical documentation for constructing the new heat exchangers internals;
• Elaboration of the thermal and hydraulic calculation of the heat exchangers;
• Dismantling of the old internals at the heat exchangers;
• Removal of the used ionite beds and transmittance then to the Central Waste Storage in Rózan;
• Decontamination of the dismantled equipment;
• Adaptation of the new heat exchangers internals to the vessels and connector pipes;
• Displacement of the old fittings and piping at the filtration system and installing the new ones;
• The supply of equipment and other components requires, as follows:
  ➢ to purchase the necessary heat exchanger internals (9 pieces);
  ➢ to purchase ion-exchangers beds;
  ➢ to purchase the necessary component cooling to the technical documentation.
• Assembling and fitting the new heat exchangers internals.

4. Institutional framework

The main beneficiary of project is the Ministry of Economy, Labour and Social Policy, which is the main funding authority for the Institute of Atomic Energy. The institute and in particulars its Reactor Analyses and Technology Department along with the Reactor Operation Department will assure the co-ordination of the project and will be responsible for the organisation linked with the implementation of the project. The final owner of installation after its completion will be the Reactor Operation Department. The project will be authorised by the National Regulatory Body, an organisation independent from the IAE.
5. Detailed budget: (cost of the project expressed in EUR)

<table>
<thead>
<tr>
<th>Project components</th>
<th>PHARE support</th>
<th>Total</th>
<th>National Co-financing</th>
<th>IFIs</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Investment</td>
<td>PHARE</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Support</td>
<td>Building IB IB</td>
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<td></td>
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<tr>
<td>Service</td>
<td>0.075</td>
<td>0.075</td>
<td>0.025</td>
<td>0.100</td>
</tr>
<tr>
<td>Supply of materials, equipment, components.</td>
<td>0.648</td>
<td>-</td>
<td>0.648</td>
<td>0.216</td>
</tr>
<tr>
<td>TOTAL</td>
<td>0.648</td>
<td>0.075</td>
<td>0.723</td>
<td>0.241</td>
</tr>
</tbody>
</table>

6. Implementing arrangements

PAO for this project will be the Office of the Committee for European Integration:
Office of the Committee for European Integration
Tadeusz Kozek
Bagetela 14
PL-00-585 Warszawa
tel: +48 (22) 455 52 40
fax: +48 (22) 455 52 43
e-mail: tadeusz_kozek@mail.ukie.gov.pl

The Implementing Agency for the project, responsible for tendering, contracting and monitoring of the project will be Central Contracting and Financing Unit (CFCU):

CFCU
Central Financing and Contracting Unit,
Co-operation Fund Foundation
ul. Górnoślaska 4a
00 - 444 Warszawa
Director: Mrs Barbara Kasnikowska
tel. (+48 22) 450 99 00

director person for nuclear projects:
Ms Izabella Nowakowska
Project Manager
tel (+48 22) 450 9916
fax (+48 22) 622 7565
e-mail: skorpion@cofund.org.pl

6.1. Beneficiary organisation: Ministry of Economy, Labor and Social Policy
Plac Trzech Krzyzy 3/5,
PL-00-535 Warszawa

Contact person: Mr. Bogdan Nowak
Section V,
Department of Innovation
Tel +48 (22) 661 90 38
Fax: +48 (22) 661 88 58
E-mail: bognow@mg.gov.pl
6.2. Project co-ordination in the Institute of Atomic Energy (the direct beneficiary and recipient of supplied components and equipment):

Institute of Atomic Energy,
05 400, Otwock, Swierk,
Grzegorz Krzysztoszek, Deputy director of the IAE
tel. +48 22 718 00 80,
fax. +48 22 718 02 18,
e-mail: gkrzysz@cyf.gov.pl;

Reactor Operation Department
Andrzej Golab, Head of Department
phone: 48 22 718 00 88,
fax: 48 22 718 02 18;
e-mail: a.golab@cyf.gov.pl

6.3 Contracts

6.3.1 Service- total value of 0.100 M€ including national co-financing of 0.025 M€

6.3.2 Supply - total value of 0.864 M€ including national co-financing of 0.216 M€

7. Implementation schedule (see also Annex 2-4)

<table>
<thead>
<tr>
<th>Contract</th>
<th>Start of tendering</th>
<th>Start of project activity</th>
<th>Completion</th>
</tr>
</thead>
</table>

8. General criteria

The implementation of the project will mitigate the threat of radioactive releases into the environment. The installation of new tubings in the heat exchangers will prevent to much extent the leakage of primary cooling circuits radioactive water into the secondary circuit and the new ionite – exchange bed in the filtration system will improve the water chemistry in the secondary circuit preventing to occurring the corrosion destruction of the heat exchanger tubings and in this way providing sealing of the tubes bundles.

8.2. Co-financing
The financial support of the PHARE constitutes 75% of the total project budget. National budgetary resources are ~ 25%

8.3. Additionality:

The PHARE financing will not displace any other sources.

8.4. Project readiness and size

Preliminary feasibility study has already been completed by the local design group. The project components will be installed in the reactor pumping room which is located in the vaults of the reactor bulleting.

Tender documents for the supply contract will be prepared under the service contract.

8.5. Sustainability

The further cost of service and maintenance of the project heat exchangers and the secondary circuit filtration system will be the part of the reactor operation cost and they will be covered by the national budget resources.

8.6. Compliance with the State aids provisions

Not applicable.

9. Conditionality and sequencing

Technical documentation of the heat exchangers and the secondary circuit filtration system along with the safety analysis and procedure required by the Reactor Safety Committee and the National Regulatory Body must be launched and completed on the first stage of the project realization in the framework of the technical assistance contract. As a result of this contract the detailed documentation will be completed by the Polish side and will be ready by the time of tendering. The Polish co-funding will be started available at the beginning of the implementation phase.
Annex 1:

LOGFRAME PLANNING MATRIX FOR PROGRAMME NUMBER: 5812.05.01

<table>
<thead>
<tr>
<th>Contracting period</th>
<th>Disbursement period</th>
</tr>
</thead>
<tbody>
<tr>
<td>expires 30.11.2005</td>
<td>expires 30.11.2006</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Total budget</th>
<th>PHARE budget</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.964 M€</td>
<td>0.723 M€</td>
</tr>
</tbody>
</table>

**Project**

Upgrading of the heat exchangers and ionic filters at the MARIA research reactor to reduce the possible radioactive release into the environment

<table>
<thead>
<tr>
<th>Overall objective</th>
<th>Objectively verifiable indicators</th>
<th>Sources of verification</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1)</td>
<td>(2)</td>
<td>(3)</td>
</tr>
<tr>
<td>The objective of the project is to mitigate the radiological threat for the people and environment by installing new heat exchangers internals in the reactor fuel and pool cooling circuits at the MARIA research reactor. Additionally, the refurbishment of the ionite – exchange filtration system will make available to improve the water chemistry and decrease the tubings corrosion rate which enable to retain the leak tightness of the tubings for a longer period.</td>
<td>The replacement of the existing tube bundles at the reactor fuel channels and pool cooling circuits will prevent to spreading out the radioactive releases contained in the water of primary circuits into the water at the secondary circuit and consequently their release through the open dripping cooling tower into the surrounding atmosphere.</td>
<td>Opinion of the reactor Safety Committee and National Regulatory Body.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Project purpose (Immediate Objectives)</th>
<th>Objectively Verifiable Indicators (5)</th>
<th>Sources of Verification (6)</th>
<th>Assumptions (7)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(4)</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>1. Construction of the new tube bundles inside the available vessels of the reactor fuel channels and pool cooling circuits</td>
<td>Increased safety level for the population and environment.</td>
<td>The protocols of the Reactor Safety Committee</td>
<td></td>
</tr>
<tr>
<td>2. Change of the ion-exchange beds and infrastructure at ion-exchange filtration system of the secondary cooling circuit (the fast and anthracite filters)</td>
<td></td>
<td></td>
<td>The installing of the heat exchanger internals and replacement of ionites at the filtration system along with refitting of the pipe fittings requires to shut down the reactor for a certain period. Proper planning and arrangement of the installing and refurbishment works will enable to accomplish them at the annual repair outage period.</td>
</tr>
<tr>
<td>Results (8)</td>
<td>Objectively Verifiable Indicatory (9)</td>
<td>Sources of verification (10)</td>
<td>Assumptions (11)</td>
</tr>
<tr>
<td>---------------------------------------------------------------------------</td>
<td>------------------------------------------------------------------------------------------------------</td>
<td>-----------------------------------------------------------------------------------------------</td>
<td>----------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>1. Full separation of the reactor primary circuit from the secondary cooling circuit for a long term period.</td>
<td>1. Lack of the primary circuit water leakage in the secondary cooling circuit.</td>
<td>The final report on the completion of the project approved by the IAE Deputy Director for the Research Reactor Matters based on opinion and recommendations of the Reactor Safety Committee and the National. Regulatory Body.</td>
<td>The procedures of acceptance of the technical documentation and the progress of work accomplished will be timely and successfully conducted.</td>
</tr>
<tr>
<td>2. Safety barrier prohibiting the radiation isotope contained in the primary coolant to be penetrated into the secondary cooling circuit water and further to contaminate the environment by means of their release into the atmosphere.</td>
<td>2. Significant reduction of the radioactive isotope penetration from the first cooling circuit into the secondary circuit and further into the ambient atmosphere.</td>
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<tr>
<td>3. The increased protection level of the MARIA research will enable the IAE to meet the standards and requirements of the National Regulatory Body and the recommendation of the International Atomic Energy Agency as well as the obligations imposed by the EU regulation on annual radioactive releases into the ambient atmosphere.</td>
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<tr>
<td><strong>Activities (12)</strong></td>
<td><strong>Means (13)</strong></td>
<td></td>
<td><strong>Assumption (14)</strong></td>
</tr>
<tr>
<td>- Review and updating of the Feasibility Study for installing the tube bundles into the reactor first circuit and pool heat exchangers;</td>
<td>Technical assistance for elaboration of technical and safety documentation. Supply and installation of the equipment as defined in the technical and safety analysis documentation.</td>
<td>Efficient co-ordination and component and material supply procedures. Well organised co-operation among entities involved in the implementation of the project.</td>
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<tr>
<td>- Assessment and calculational analysis for change and refurbishment of the ionite bed filtration system;</td>
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<tr>
<td>- Development of technical documentation for the upgraded heat exchangers and refurbishment ionite filtration complexes along with pipings and the fittings.</td>
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</table>
### Annex 2-4 Implementation, constructing and disbursement schedules

<table>
<thead>
<tr>
<th>Planning Period</th>
<th>Budget Allocation (Phare)</th>
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#### PLANNED

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#### Implementation Schedule

- **Service**
  - D
  - D/C
  - C
  - I
  - I
  - I
  - I

- **Supply**
  - D
  - D/C
  - C/I
  - I
  - I

#### Disbursement Schedule

<p>| | | | | |</p>
<table>
<thead>
<tr>
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<tbody>
<tr>
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<td>0.045</td>
<td>0.435</td>
<td>0.723</td>
<td>0.723</td>
</tr>
</tbody>
</table>

- **D** – design of sub-project
- **C** – Tendering and contracting
- **I** – contract implementation and payment