SPECIAL NUCLEAR PROJECT FICHE

1. Basic information

1.1 CRIS Number: 5812.04.02

1.2 Title: Support to VATESI and its TSOs in assessment of beyond design basis accidents for RBMK-1500 reactors

1.3 Sector: 23064

1.4 Location: Lithuania

2. Objectives:

2.1. Overall objective:

The overall objective of this 0.65 MEUR project is to provide EU expertise to the Lithuanian nuclear safety authority (VATESI) and its technical support organizations (TSOs) on the assessment of a number of critical safety issues that requires new or deepened review efforts compared to the previous SAR-1, SAR-2 and PSA Level 2 review, specifically, in the field of the beyond design basis accidents (BDBA) for Ignalina NPP.

2.2. Project purpose:

The purpose of the project is to provide VATESI and its TSOs with the support in assessing the BDBA considering the RBMK-1500 characteristics in the following areas: accident scenarios regarding fuel behaviour, neutronics and thermo-hydraulics of the reactor, criticality safety and radionuclide discharge to the environment. The adaptation of computer codes for RBMK-1500, conduction of experimental measurements in situ and validation of modelling results by experimental data are foreseen in the project.

2.3. Accession Partnership and NPAA priority:

The Accession Partnership 2001 indicates for Lithuania “To implement the recommendations contained in the Council report on “Nuclear Safety in the Context of Enlargement” with due regard to the priorities assigned in the report”. The Council report on “Nuclear Safety in the Context of Enlargement” of June 2001 concluded in the second general recommendations that all Candidate States with nuclear power plants should, as a short term priority, ensure that their nuclear safety programmes include notably the completion, including regulatory reviews and approval, of plant-specific, in-depth safety analysis reports.

Additionally, the Council peer review status report on “Nuclear Safety in the Context of Enlargement” of June 2002 recommended for Lithuania further monitoring of the following commitments:
- “amending of the existing Emergency Operating Procedures with guidelines for management of beyond design basis accidents should be ensured” (2nd recommendation type I)

- “strengthening of the resources of the regulatory body (VATESI) should be ensured and an evaluation made whether resources prove to be sufficient” (1st recommendation type I).

3. Description of the Project:

3.1. Background and justification:

The study of beyond design basis accidents and accident progression modelling for RBMK-1500 is a very important issue, because this area has not been sufficiently investigated theoretically and experimentally. VATESI capabilities are currently lacking in this area because efforts have been concentrated on establishing the licensing regime for design basis events. Furthermore, capabilities in the area of BDBA assessment and mitigation of severe accident sequences is now required particularly because Ignalina NPP is preparing BDBA management guidelines and technical justification documents (the list of BDBA for RBMK-1500, deterministic analysis of BDBA) to complement the existing Emergency Operating Procedures (EOP). As mentioned above, amending of the EOPs with guidelines for management of BDBA is highlighted also in the Council peer review status report on “Nuclear Safety in the Context of Enlargement”. The guidelines for management of BDBA in Ignalina NPP and corresponding technical justification documents will be the subject of a regulatory audit. Hence, there is a need for transfer of expertise and knowledge to ensure that this regulatory review reflects international best-practice.

In order to assess the consequences of severe accident with significant radioactivity release from reactor, radionuclide content in the reactor core and main circulation circuit must be known with sufficient precision. There is lack of available experimental data on the radionuclide content in the fuel assemblies of RBMK-1500 reactor. The existing data that are used by Ignalina NPP are calculation results for situation in 1987. There were significant changes in fuel composition during recent years of reactor operation. The new experimental data on the radionuclide content in the fuel assemblies are of great importance.

3.2. Linked activities:

VATESI started investigation of BDBA issues from the beginning of 2001. VATESI and its TSO specialists received initial training in the area from the IRSN and GRS experts (under PHARE project LI9806.01). The training covered aspects of the analysis of severe accidents for PWR type reactors, including phenomenology of in-core and ex-core phases, overview and structure of computer codes for severe accidents, possibilities for and status of code validation, capabilities and limitations of codes, approaches for different applications. Training on the regulatory approach to BDBA assessment and mitigation of severe accident sequences, and development of Requirements on the assessment and management of BDBA for RBMK-1500 reactors were foreseen in the frame of PHARE project LI01.18.03 Task 4. The scope of the previous training covered only initial activities for full implementation of overall objectives and responsibilities of VATESI. It is essential that further VATESI activities for the regulation of specific BDBA related issues be based on international knowledge and experience.

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1 Recommendations with the highest priority.
3.3. Results:

The main result of the project would be increased competence of the Lithuanian nuclear safety authority and strengthened technical expertise resources of VATESI and its TSOs in the area of the beyond design basis accidents for Ignalina NPP.

In the frame of this project a list of the transients that potentially could develop into BDBA with core damage, and important accident phenomena that need to be addressed with accident progression models should be prepared. The absence of an overall external protective shell means that in some core damage cases the discharge of fission products is inevitable. These specific cases for RBMK-1500 reactor should be evaluated and BDBA analysis should be performed. For cases when the total damage of the core is unavoidable and it results in loss of the general structural integrity of the reactor system, the in-core, ex-core and containment phenomena should be analysed. Experimental measurements in situ of the radionuclide content in the main circulation circuit of the operating reactor and determination of activity ratios of certain isotopes should be conducted. The input decks of fuel behaviour, neutronics and thermo-hydraulic computer codes, adapted for RBMK-1500, should be developed starting with verification, validation (based on data from experimental measurements in situ) and ending with ongoing training. The information concerning the results of BDBA analysis should be collected. Based on this information the accident management principles should be evaluated and, as ultimate result, Regulatory Guides on the assessment and management of BDBA for RBMK-1500 should be produced.

The improvement of scientific knowledge on specific phenomena and understanding of BDBA for RBMK-1500 reactors, gained expertise on BDBA analysis and experimental data would constitute an important safety improvement during the remaining time of INPP operation and the initial face of decommissioning after final shut-down of the reactors.

3.4. Activities:

Service:

- Development of Regulatory Guides on the assessment and management of BDBA for RBMK-1500 reactor (including a list of the transients that potentially could develop into BDBA with core damage and important accident phenomena that need to be addressed with accident progression models, evaluation methodology of the accident management principles and etc.).

- Analysis of the RBMK-1500 reactor core and main circulation circuit behaviour under various BDBA scenarios by using fuel behaviour, neutronics and thermo-hydraulic modelling codes provided for implementation of this task (accident scenarios describing propagation of DBA into range of BDBA and BDBA into accidents with core damage, fuel behaviour, thermal hydraulics, heat transfer, solid-state diffusion, high temperature chemistry, etc.);

- Criticality safety analysis at different stages of the BDBA, considering radionuclide composition dependence on the nuclear fuel burnup;

- Modelling of the radionuclide discharge during BDBA using appropriate computer codes provided for implementation of this task. Modelling results shall be validated by
experimental measurements of the radionuclide content in the main circulation circuit of the operating reactor;

- Experimental measurements *in situ* of the radionuclide content in the main circulation circuit of the operating reactor and determination of activity ratios of certain isotopes.
- Validation of modelling results by experimental data (codes and models validation).
- Development of BDBA analyses database.
- Arrangement of workshops, seminars and training courses for staff of VATESI and its TSOs on key processes, assessment and management of BDBA for RBMK-1500 reactors.

4. Institutional framework:

The project would support the work of the Lithuanian nuclear safety authority (VATESI). VATESI is state institution that is subordinate directly to the Government of the Republic of Lithuania. The main functions of VATESI are:

1. state regulation of nuclear safety at the Ignalina Nuclear Power Plant State Company and other nuclear facilities;
2. state regulation of the safety of radioactive waste management in nuclear facilities;
3. state regulation of the safe use of nuclear materials;
4. state regulation of the physical protection of nuclear facilities, nuclear and radioactive materials used in nuclear energy;
5. state regulation of radiation protection within its competence in the Ignalina Nuclear Power Plant and other nuclear facilities.

VATESI consists of five main divisions: Decommissioning and Radiation Protection Division, Safety Assessment Division, Licensing Division, Nuclear Material Control Division and Resident Supervision Division at INPP.

5. Detailed budget (in M EUR)

<table>
<thead>
<tr>
<th>Project Components</th>
<th>Investment Support (IS)</th>
<th>Institution Building (IB)</th>
<th>Total Phare (IS + IB)</th>
<th>National financing</th>
<th>Co-financing</th>
<th>IFI</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Service</td>
<td>-</td>
<td>0.65</td>
<td>0.65</td>
<td>-</td>
<td>-</td>
<td>0.65</td>
<td>0.65</td>
</tr>
<tr>
<td>TOTAL</td>
<td>-</td>
<td>0.65</td>
<td>0.65</td>
<td>-</td>
<td>-</td>
<td>0.65</td>
<td>0.65</td>
</tr>
</tbody>
</table>

The Phare amount is binding as a maximum amount available for the project.

6. Implementation arrangements

The CPMA (Central Project Management Agency) will be the Implementing Agency responsible for tendering, contracting, and accounting:

6.1. **Implementation Agency:** Mr. Aloyzas Vitkauskas
    Director of the CPMA
6.1.1. **Beneficiary organisation:** Mr. Saulius Kutas  
Head of VATESI  
Sermuksniu, 3  
LT-2600 Vilnius  
Lithuania  
Phone: +370 5 266 16 20/262 41 41  
Fax: + 370 5 261 44 87  
E-mail: kutas@vatesi.lt

6.1.2. **Contact person:** Mr. Michail Demcenko  
Head of Safety Assessment Department  
VATESI  
Sermuksniu, 3  
LT-2600 Vilnius  
Lithuania  
Phone: +370 5 266 15 80  
Fax: + 370 5 261 44 87  
E-mail: demcenko@vatesi.lt

6.2 **Twinning:** not applicable

6.3 **Non-standard aspects:** Non standard aspects, in line with the "New rules for contracts in the field of nuclear safety" COM(2000)493 final, might arise.

6.4 **Contract:** One PHARE contract should be placed.

7. **Implementation schedule**

<table>
<thead>
<tr>
<th>Component</th>
<th>Start of Tendering</th>
<th>Start of Project Activity</th>
<th>Project Completion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Service</td>
<td>2Q, 2004</td>
<td>4Q, 2004</td>
<td>3Q, 2006</td>
</tr>
</tbody>
</table>

8. **General criteria:**

<table>
<thead>
<tr>
<th>8.1 <strong>Catalytic effect:</strong></th>
<th>The Phare contribution will act as catalyst for priority Accession-driven actions in the field of nuclear safety.</th>
</tr>
</thead>
<tbody>
<tr>
<td>8.2 <strong>Co-financing</strong></td>
<td>N/A</td>
</tr>
<tr>
<td><strong>8.3. Additionality:</strong></td>
<td>PHARE intervention does not displace other financiers.</td>
</tr>
<tr>
<td>-------------------------</td>
<td>--------------------------------------------------------</td>
</tr>
<tr>
<td><strong>8.4. Project readiness</strong></td>
<td>The beneficiary will prepare the TORs possibly with the support of external experts for the Service contract.</td>
</tr>
<tr>
<td><strong>8.5. Sustainability:</strong></td>
<td>Maintenance to be supported by VATESI as is foreseen in the project.</td>
</tr>
<tr>
<td><strong>8.6. Compliance with state aids provisions:</strong></td>
<td>The investment part of the project will respect the state aids provision of the Europe Agreement should they be applicable.</td>
</tr>
</tbody>
</table>

### 9. Annexes to project Fiche

1. Logical framework matrix in standard format.
2. Detailed implementation chart.
3. Contracting and disbursement schedule.
# LOGFRAME PLANNING MATRIX

For Project: **Support to VATESI and its TSOs in assessment of beyond design basis accidents for RBMK-1500 reactors**

<table>
<thead>
<tr>
<th>Overall Objective:</th>
<th>Objectively Verifiable Indicators:</th>
<th>Source of Verification</th>
</tr>
</thead>
<tbody>
<tr>
<td>To provide EU expertise to the Lithuanian nuclear safety authority (VATESI) and its TSOs on the assessment of a number of critical safety issues that requires new or deepened review efforts compared to the previous SAR-1, SAR-2 and PSA Level 2 review, specifically, in the field of the beyond design basis accidents (BDBA) for Ignalina NPP.</td>
<td>Safety improvement during the remaining time of INPP operation and the initial face of decommissioning after final shut-down of the reactors.</td>
<td>VATESI</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Project Purpose:</th>
<th>Objectively Verifiable Indicators:</th>
<th>Source of Verification</th>
</tr>
</thead>
<tbody>
<tr>
<td>To provide VATESI and its TSOs with the support in assessing the BDBA considering the RBMK-1500 characteristics in the following areas: accident scenarios regarding fuel behaviour, neutronics and thermo-hydraulics of the reactor, criticality safety and radionuclide discharge to the environment. The adaptation of computer codes for RBMK-1500, conduction of experimental measurements in situ and validation of modelling results by experimental data.</td>
<td>Approach to safety assessment and verification issues in Lithuania is in line with IAEA recommendations and reflects international best-practice.</td>
<td>VATESI</td>
</tr>
<tr>
<td>踢</td>
<td>Strengthening of the resources of VATESI and its TSOs in the field of safety assessment and verification.</td>
<td>Project Reports</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
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</thead>
<tbody>
<tr>
<td>Total Budget: 0.65 MEUR</td>
<td>Phare Budget: 0.65 M€</td>
<td></td>
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</tbody>
</table>

**Assumptions**
### Results:
- Regulatory Guides on the assessment and management of BDBA for RBMK-1500 reactor developed.
- The fuel behaviour, neutronics and thermo-hydraulic computer codes, adapted for RBMK-1500 reactor, received (including qualified documentation).
- The qualified master input decks of fuel behaviour, neutronics and thermo-hydraulic computer codes (adapted for RBMK-1500 reactor) developed.
- The specific cases for RBMK-1500 reactor evaluated and BDBA analysis performed (including in-core, ex-core and containment phenomena).
- Experimental measurements in situ of the radionuclide content in the main circulation circuit of the operating reactor and determination of activity ratios of certain isotopes conducted and experimental data received.
- Validation of modelling results by experimental data conducted (codes and models validation).
- The information concerning the results of BDBA analysis collected (database developed).
- The skills and capacities concerning assessment and management of BDBA for RBMK-1500 reactors of VATESI and its TSOs improved.

### Objectively Verifiable Indicators:
- Regulatory Guides on the assessment and management of BDBA for RBMK-1500 reactor approved by VATESI.
- The computer codes adapted for RBMK-1500 reactor as planned.
- Qualified master input decks developed as planned.
- Reports on BDBA analyses delivered as planned.
- Reports on experimental measurements delivered as planned.
- Reports on codes and models validation delivered as planned.
- BDBA database delivered as planned.
- Materials of workshops, seminars and training courses delivered as planned.

### Source of Verification:
- Project Reports
- VATESI

### Assumptions
<table>
<thead>
<tr>
<th>Activities:</th>
<th>Means:</th>
<th>Assumptions:</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Development of Regulatory Guides on the assessment and management of</td>
<td>• One service contract</td>
<td>• Successful start of the project.</td>
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<tr>
<td>BDBA for RBMK-1500 reactor;</td>
<td></td>
<td>• Smooth process of procedures concerning tendering, contracting and</td>
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<tr>
<td>• Analysis of the RBMK-1500 reactor core and main circulation circuit</td>
<td></td>
<td>implementation</td>
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<tr>
<td>behaviour under various BDBA scenarios by using fuel behaviour,</td>
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<tr>
<td>neutronics and thermo-hydraulic modelling codes (accident scenarios</td>
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<td>describing propagation of DBA into range of BDBA and BDBA into accidents</td>
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<td>with core damage, fuel behaviour, thermal hydraulics, heat transfer,</td>
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<td>solid-state diffusion, high temperature chemistry, etc.);</td>
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<td>• Criticality safety analysis at different stages of the BDBA, considering</td>
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<tr>
<td>radionuclide composition depending on the fuel burnup,</td>
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<tr>
<td>• Modelling of the radionuclide discharge during BDBA using appropriate</td>
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<tr>
<td>computer codes received for implementation of this task, Modelling results</td>
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<tr>
<td>shall be validated by experimental measurements of the radionuclide</td>
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<tr>
<td>content in the main circulation circuit of the operating reactor.</td>
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<tr>
<td>• Experimental measurements in situ of the radionuclide content in the</td>
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<tr>
<td>main circulation circuit of the operating reactor and determination of</td>
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<tr>
<td>activity ratios of certain isotopes.</td>
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<tr>
<td>• Validation of modelling results by experimental data (codes and models</td>
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<tr>
<td>validation).</td>
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<tr>
<td>• Development of BDBA analyses database.</td>
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<tr>
<td>• Arrangement of workshops, seminars and training courses for staff of</td>
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<tr>
<td>VATESI and its TSOs on key processes, assessment and management of</td>
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<td>BDBA for RBMK-1500 reactors.</td>
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<tr>
<td>Preconditions</td>
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### Detailed Implementation Chart for the Project

<table>
<thead>
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<th>Year</th>
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<tr>
<td>Service</td>
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</table>

- **Design**
- **Tendering**
- **Implementation**

Annex 2
## CUMULATIVE CONTRACTING AND DISBURSEMENT SCHEDULE (Phare Contribution only– 0.65 MEUR)

<table>
<thead>
<tr>
<th>Date</th>
<th>2004</th>
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<th>2006</th>
<th>2007</th>
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<td>31/12</td>
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<tr>
<td><strong>Total contracting (cumulative)</strong></td>
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<tr>
<td><strong>Disbursement</strong></td>
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<tr>
<td><strong>Service</strong></td>
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<td>0.195</td>
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<tr>
<td><strong>Total disbursement (cumulative)</strong></td>
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<td>0.315</td>
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