



## **JRC/IE Support Activities to PHARE Nuclear Safety Programmes: Dissemination of PHARE Project Results**

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### **ABSTRACT**

Nuclear safety in Europe is one of European Union's primary concerns, therefore the European Union decided to take a prominent role to help the New Independent States and countries of Central and Eastern Europe to ensure the safety of their nuclear reactors. The European Union TACIS<sup>1</sup> and PHARE<sup>2</sup> programmes in nuclear safety have been undertaken since 1990.

The European Commission's Directorate General External Relations (EC DG RELEX) and, Directorate General Europe Aid Co-operation Office (EC DG AIDCO), are responsible for programming and management of implementation of TACIS projects. Directorate General Enlargement (EC DG ELARG) is responsible for programming PHARE programmes, but implementation of most projects has been decentralised since 1999 budget year to the Beneficiary countries. DG ELARG acts as backstopping for the relevant EC Delegations.

In these activities, the TSSTP Unit at the JRC/IE in Petten, The Netherlands, is a technical and scientific adviser of DG RELEX and DG AIDCO and provides support to DG ELARG for very specific technical issues.

Several PHARE projects aiming at improving nuclear safety have been successfully implemented for a number of plants from Central and Eastern Europe. In some cases major safety issues have been addressed by means of multi-country projects and results have been disseminated to the rest of the nuclear community. Although a lot of information has been exchanged at a bilateral level, further effort is needed to collect the project results in a systematic way and make them available by means of the internet. At present the TSSTP Unit is implementing two projects for dissemination of PHARE project results.

This activity will take a better advantage of today's communication technologies and ensure the management of the acquired knowledge through preservation and user-friendly access and retrieval of the project results. The paper provides an outline of the TSSTP Unit relevant knowledge preservation initiative, a description of the web-based informatics platform used to support the dissemination of PHARE project results, and summarizes the results from the major PHARE Nuclear Safety projects.

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<sup>1</sup> TACIS stands for Technical Assistance to the Commonwealth of Independent States, and concerns mainly Russia, Ukraine, Armenia, and Kazakhstan.

<sup>2</sup> PHARE stands for Poland Hungary Aid for Reconstruction of the Economy (later on including other Central and Eastern European countries).

## **1 INTRODUCTION**

The safety of nuclear power plants is a primary concern of the European Union (EU) Member States. In the early 1990s, the EU decided to take a prominent role in the international efforts to help the New Independent States (NIS) and the countries of Central and Eastern Europe to ensure the safety of their nuclear reactors. The EU Commission's approach to nuclear safety in Central and Eastern Europe and the NIS was based on two main objectives, which were in line with the policy of the international community as promulgated by the G7 in 1992:

- (i) In the short term, to improve operational safety, to make near term technical improvements to plants based on safety assessments and to enhance regulatory regimes;
- (ii) In the longer term, to examine the potential for replacing less safe plants with alternative energy sources and more efficient use of energy and to examine the potential for upgrading plants of more recent design.

EC PHARE funded activities in the field of nuclear safety began for a number of nuclear power plants (NPPs) in 1990 and soon after that the programme was extended to include all PHARE beneficiary countries. In its early years, this programme principally dealt with support related to urgent matters at NPPs; later it increasingly provided assistance to publicly funded institutions, in particular, to nuclear safety regulatory authorities and bodies engaged in the management of the radioactive waste. To this end, PHARE projects were aimed at analyzing major nuclear safety concerns, formulating appropriate solutions, and supporting their implementation. More than 280 projects were subject of implementation under the PHARE programme from 1990 to 2003.

At the request of EC DG ELARG, the TSSTP unit of the Institute for Energy started in 2004 activity to retrieve, file, analyse and incorporate a brief summary of each of the PHARE projects in a dedicated Dissemination Website.

## **2 DISSEMINATION OF PHARE NUCLEAR SAFETY PROJECT RESULTS**

The website will make PHARE project descriptions and results available to practitioners in the field of nuclear safety and will also serve all interested bodies within the enlarged European Union and beyond.

### **2.1 Analysis of PHARE projects available information**

Several sources of information have been used to collect data on the status of PHARE projects. For projects that were initiated in 1990-1998 under the EC centralized scheme, the information was retrieved mainly from the DG-ELARG and TSSTP archives. The quality of the final reports varies significantly from one project to another and in a number of cases the retrieved information was limited. For the projects initiated in 1999-2003 under the EC decentralized implementation scheme, data were used mainly from the DG-ELARG planning project fiches and obtained from the national PHARE implementation authorities. By the end of July 2005, information on 189 PHARE projects had been processed and brief project descriptions/summaries (PS) had been prepared. For 16 projects, extended project summaries (EPSs) had been produced. Both PSs and EPSs had been prepared in a format to fit the requirements of the PHARE project results database/website.

The proportions of technical areas that were addressed by PHARE projects are indicated in Figure 1 below and the number of projects per year is shown in Figure 2.

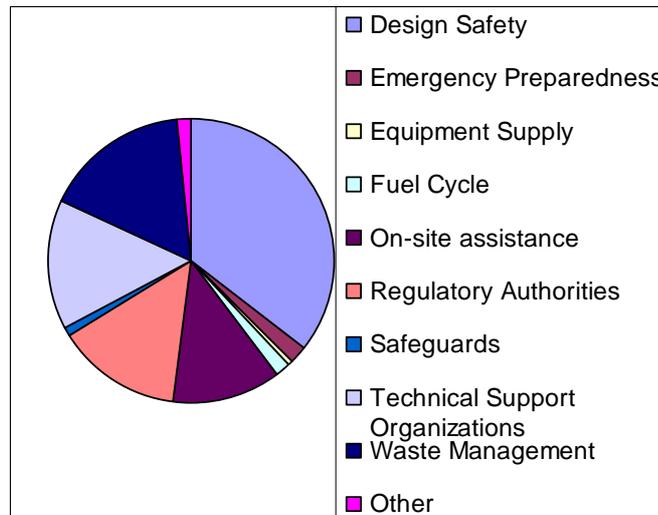


Figure 1: PHARE projects distribution by technical area

Most of the projects in the early 1990's contributed to solving critical safety design issues and supported on-site activities needed to enhance plant safety and/or to assist national regulatory authorities.

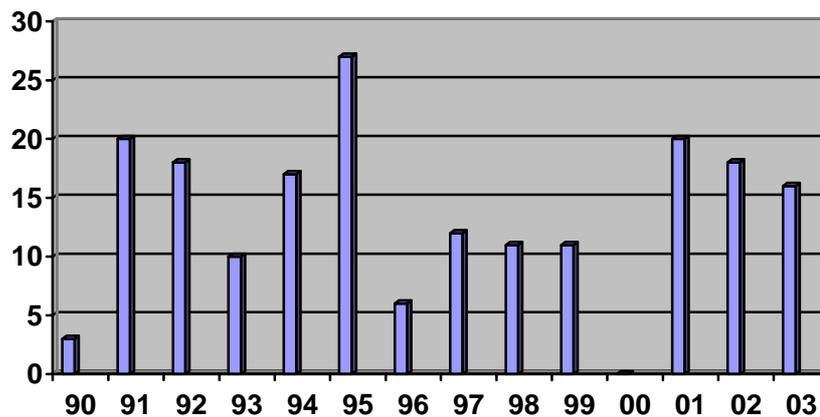


Figure 2: Number of PHARE projects per years

Many PHARE projects recorded unique information from experiments performed for WWER and RBMK type of reactors. These data support further safety evaluation and may be of interest to other utilities operating similar reactors or regulatory authorities. Examples of such projects are: Kozloduy RPV 1 Assessment: Testing (PH/93); Integrity assessment of WWER 440/213 RPVs (PH2.01/95) [1]; Handling large primary to secondary leakage resulting from steam generator collector failure ( PH2.02/94) [2]; Qualification of I&C equipment at accident conditions (PH2.03/95) [3]; Bubble condenser experimental qualification ( PH2.13/95); Experimental and calculational investigation of system behaviour during accident and AM in WWER reactors (SPR/3/95) [4]; Qualification of leak detection system (4.2.3/93) and Ignalina NPP Unit 2 Diverse Shutdown System (PH1.01/98).

## 2.2 Development of Project Summaries and Extended Project Summaries

In order to preserve the vast amount of knowledge and experience gained through the implementation of the PHARE programme, a data base containing the main projects results was developed. An effort was made to briefly summarize the main objectives, results and conclusions from each project, as well as to include data on project details such as the relevant plant site, contractor, local subcontractors, date of project programming and implementation, main beneficiary's contact details, etc. This information will make it possible to assess the relevance of each project to a particular safety issue and to search for more detailed information, if needed, from the corresponding beneficiaries. For a number of projects EPSs have been developed by TSSTP, which were based on available comprehensive project final reports. The EPSs describe the safety issue(s) addressed by the project and provide detailed information on each project task, results obtained and the recommendations issued. All information will be made publicly available through a dedicated Dissemination Website.

## 2.3 Project Dissemination Website

The TSSTP Unit of IE, JRC-Petten has developed and acts as the administrator of the Dissemination Website ( <http://www.jrc.nl/dissem>), which was opened for trial operation in July 2005. It is designed to serve both TACIS and PHARE programmes. Users can connect via the Internet to the server that will access the MySQL PHARE project results database. (Login is not required for public users who have only access to browse the database). A series of user-friendly PHP web pages allow easy retrieval of the required information.

A comprehensive *Search Tool* is included in the Website (Figure 3). It is possible to sort the projects by the following different subjects related to the projects:

- Programme year: TACIS or PHARE budget programme year.
- Number: Project Number.
- Title: Project Title.
- Start/End YYYY-MM-DD: Start and End dates of the contract/project execution.
- Countries: Country/ies of the beneficiary.
- Sector of Activities: *Design Safety, Equipment Supply, Emergency Preparedness, Euratom Loan Preparation, Fuel Cycle, On Site Assistance, Regulatory Authorities, Safeguards, Technical Support Organizations (TSO) and Waste Management.*
- Site: Site/s or NPP/s involved in the project.
- Installation types: Type of reactor, installation or site involved in the project.
- Duration (months): Duration of the project execution.
- Status of the project: Present status of the project.
- Contractors: Contractor/s, consortium involved.
- Local sub-contractors: Local sub-contractor/s in the beneficiary country.
- Description: To search information by keywords or phrases in the project description.

The screenshot shows a web browser window with the address <http://www.jrc.nl/dissemination/>. The page has a sidebar on the left with links for Home, TACIS Projects, PHARE Projects, Projects, Login, and Contact. The main content area is titled 'Search' and includes a 'Sort' section with radio buttons for 'Number', 'Start date', and 'End date'. Below this is a 'Project Summary' search form with the following fields:

Programme year	Phare	1994
Number		
Title		
Start/End YYYY-MM-DD		
Countries	Bulgaria	
Sector of Activities	Design Safety	
Sites		
Installation Types	VVER-440/230	
Duration (months)		
Status	Completed	
Contractors		
Local Sub-contractors		
Description		

At the bottom of the search form are 'Reset' and 'Search' buttons.

Figure 3: Dissemination Website- Search Tool

The project summaries are included in the description field of the data-base. For further project information, a link is provided either to an EPS or to the web page of the main beneficiary organization.

### 3 SOME EXAMPLES: PROJECTS DEALING WITH WWER-440/230 MAJOR SAFETY ISSUES

In response to requests from countries operating Soviet designed WWER-440/230 NPPs for assistance through the IAEA's nuclear safety services, the IAEA launched a major international programme in 1990 to evaluate these first generation reactors and identify safety shortcomings and deficiencies as well as to rank them according to their safety significance. The IAEA programme was later extended to cover the other WWER types of reactors. Issues related both to design and operation were ranked according to their safety significance in four categories of increasing severity [5]:

*Category I:* Issues in Category I reflected a departure from recognized international practices. In certain cases, it was appropriate to address them as part of actions intended to resolve higher priority issues.

*Category II:* Issues in Category II were of safety concern. Defense in depth was degraded. Action was required to resolve the issue.

*Category III:* Issues in Category III were of high safety concern. Defense in depth was insufficient. Immediate corrective action was necessary. Interim measures were possibly also necessary.

*Category IV:* Issues in Category IV were of the highest safety concern. Defence in depth was unacceptable. Immediate action was required to overcome the issue. Compensatory measures were to be established until the safety problems were resolved.

For WWER-440/230 reactors, some 100 safety issues have been identified, amongst which 15 (in seven major areas) were ranked at category IV at the time the project was launched [6]. To solve the issues of the highest safety concern, significant international assistance was provided, including the implementation of a number of PHARE projects. In particular the following projects (table 1) were carried out in relation to the safety issues identified in category IV:

Table 1: Examples of PHARE projects related to category IV safety issues for WWER-440/230 reactors

Number	Original Title	Programme Budget year/ Reference NPP	IAEA Safety Issue	Project Results
PH/91(Con)	Confinement and ECCS evaluation	Phare 1991 Bohunice NPP	Safety Systems Availability	The capability of the ECCS was evaluated and measures to improve ECCS performance were suggested
PH/93	Kozloduy RPV 1 Assessment: Testing	Phare 1993 Kozloduy NPP	Reactor Pressure Vessel Integrity	Six samples were taken from the Kozloduy unit 1 RPV to assess embrittlement and actual vessel properties. PTS analyses were performed.
PH/91(B)	WANO Six Months Programme for Kozloduy NPP, Leak Before Break, units 1-4 (Item D)	Phare 1991 Kozloduy NPP	Leak Before Break Applicability	Requirements for the establishment of three independent leak detection systems were established, and suggestions were made on how to demonstrate the applicability of the LBB concept to the primary circuit of WWER-440 reactors
PH/91(E)	WANO Six Months Programme for Kozloduy NPP, Qualification of safety related equipment (Item E)	Phare 1991 Kozloduy NPP	I&C Redundancy, Separation and Independence	Qualification methodology and operation conditions, to be applied in the qualification procedure were specified. A proposal for the list of plant equipment to be qualified, to be modified or to be replaced was produced.
PH2.03/95	Qualification of I&C equipment to accident conditions	Phare 1995 Dukovany NPP	I&C Redundancy, Separation and Independence	A procedure for I&C qualification to AA was developed, which might be applicable to WWER-440/230, as well.
PH1.04/95	QA implementation	Phare 1995 Bohunice	Management	Proposal for implementation of plant QA arrangements was developed

Number	Original Title	Programme Budget year/ Reference NPP	IAEA Safety Issue	Project Results
PH/91(K)	WANO Six Months Programme for Kozloduy NPP, Upgrading of Operating Procedures, units 1-4 (Item K)	Phare 1991 Kozloduy NPP	Emergency Operating Procedures	Plant Operating and Emergency Operating procedures were reviewed and a proposal was prepared for the priority for upgrading of the plant emergency procedures. An example was set based on Loviisa NPP experience.
PH/91	Housekeeping	Phare 1991 Kozloduy NPP	Equipment Material Conditions	Training in housekeeping was provided to the Kozloduy plant staff.

More information on the results of these and other PHARE projects can be obtained from the developed Dissemination Website.

#### 4 CONCLUSIONS

For the past 15 years more than 280 nuclear safety projects have been considered under the EC PHARE programme. Over 70 companies/entities/consortiums from Austria, Belgium, Finland, France, Germany, Italy, The Netherlands, Russia, Spain, Sweden, Switzerland, the UK have contributed in one way or another to the completion of these projects. The projects have been designed to assist Central and East European countries in improving and maintaining a high level of safety at their operating NPPs. Furthermore, within the framework of the PHARE programme, an enormous transfer of knowledge on design and operational safety aspects has been accomplished. The PHARE project Dissemination Website, which was developed by IE TSSTP unit, will help to facilitate the management of, and access to this acquired knowledge.

#### ACKNOWLEDGMENTS

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