

Appendix D

**Tables for Selected Activities
in Participating Countries**

Selected reactor safety projects are summarized in Tables D.1 through D.7 for each participating country (Armenia, Ukraine, Russia, Bulgaria, Czech Republic, Lithuania, and Slovakia).

Table D.1. Reactor Safety Projects in Armenia

Nuclear Power Plant <i>Reactor Type(s)</i>	Projects and Status	Start	Complete
Armenia Unit 2 <i>VVER-440/230</i>	Training		
	Control room reactor operator pilot course presented in November 1998. Radiation protection technician course under development.	11/97	9/02
	Fire Safety Upgrades		
	Flammable plastic floor covering replaced with nonflammable coating material in September 1998. Fire doors (140) provided in July 1998. Installation of all single fire doors completed in December 1998. Double fire doors to be installed in 1999. Fire detection and alarm system being installed.	10/96	1999
	Engineered Safety Systems		
	Nuclear Service-Water System - Six main water pumps for spray-pond cooling system delivered in October 1998. Workers installed three of the pumps in December 1998 and completed remaining U.S.-funded activities: installation of spray system piping and construction of three cooling ponds, pump houses, and cable tunnels.	6/97	1999
	Auxiliary Feedwater System - Diesel-driven pump for seismic-resistant emergency feedwater system to be installed in 1999.	1/97	1999
	Steam Line Isolation Valves - Seven fast-closing, main steam line isolation valves being provided to isolate reactor steam line in event of line break. Valves to be installed during summer 1999 outage.	4/97	1999
Safety Parameter Display System - Specifications developed in November 1998. Installation scheduled for fall 1999.			

Table D.2. Reactor Safety Projects in Ukraine

Nuclear Power Plant <i>Reactor Type(s)</i>	Projects and Status	Start	Complete
	Ukraine Special Training Programs		
Khmelnyskyy <i>VVER-1000</i>	Management and Supervisory Skills course implemented in December 1998.	5/93	8/98
	Ukraine Simulator Training and Engineering Support		
Chornobyl, Khmelnyskyy, South Ukraine, and Zaporizhzhya	Simulator Instructor training course presented at Khmelnyskyy NPP in December 1998.	5/98	9/01
	Ukraine Training Technology Transfer		
Ukrainian NPPS	Training and Qualification seminar held in Kyiv	10/98	10/98
Khmelnyskyy <i>VVER-1000</i>	Technical support being provided for the development of pilot training courses.	9/97	9/99
Rivne <i>VVER-1000</i>	Pilot course (Pressure Transmitter Calibration and Repair) presented April 1998. Unit Shift Supervisor course development started October 1998.	9/97	9/99
South Ukraine <i>VVER-1000</i>	Pilot course (Repair of Integrated Circuit Boards) presented June 1998. Unit Shift Supervisor course development started October 1998.	9/97	9/99
Zaporizhzhya <i>VVER-1000</i>	Pilot course (Chemical Operator) presented May 1998. Unit Shift Supervisor course development started October 1998.	9/97	9/99
Chornobyl Unit 3 <i>RBMK</i>	Management and Supervisory Skills course presented to upper management in December 1998.	9/95	12/98
	Simulators		
Chornobyl Unit 3 <i>RBMK</i>	Analytical Simulator - System declared ready for use in February 1998.	12/95	2/98
Khmelnyskyy Unit 1 <i>VVER-1000</i>	Full-Scope Simulator - System began operating in December 1997.	11/94	12/97
Rivne Unit 3 <i>VVER-1000</i>	Full-Scope Simulator - System under development.	12/96	5/01
South Ukraine Unit 1 <i>VVER-1000</i>	Full-Scope Simulator - System under development.	1/96	6/01
South Ukraine Unit 3 <i>VVER-1000</i>	Full-Scope Simulator - System under development.	7/95	10/99
	Fire Safety Systems		
Chornobyl Unit 3 <i>RBMK</i>	Fire Safety Upgrades - Fire door installation in progress as of December 1998. Fire detection and alarm system to be installed in 1999. Fire extinguishers, fire-brigade breathing units, fire-brigade radios and radio base station to be supplied in 1999.	4/96	2/99

Table D.2. Reactor Safety Projects in Ukraine (*cont'd*)

Nuclear Power Plant <i>Reactor Type(s)</i>	Projects and Status	Start	Complete
	Fire Safety Systems (<i>cont'd</i>)		
Zaporizhzhya <i>VVER-1000</i>	Fire Safety Upgrades - Fire door installation in progress as of December 1998. All U.S.-manufactured equipment on-site at plant. Installation of previously provided equipment began in September 1997.	7/93	12/98
	Safe-Shutdown Analysis - Initial training provided to Ukrainian analysts in October 1998.	7/97	11/99
	Engineered Safety Systems		
Chornobyl Unit 3 <i>RBMK</i>	Safety Parameter Display System - System installed in December 1998.	4/96	12/98
Khmelnysky Unit 1 <i>VVER-1000</i>	Safety Parameter Display System - System installed July 1998 and upgraded in November 1998. Site acceptance tests scheduled for early 1999.	1/97	1999
South Ukraine Unit 1 <i>VVER-1000</i>	Safety Parameter Display System - System installed in early 1998. Operational testing completed in June 1998. Final upgrades to be done in early 1999.	1/97	1999
Zaporizhzhya Unit 5 <i>VVER-1000</i>	Safety Parameter Display System - System installed August 1998. Final upgrades and site acceptance tests to be done in early 1999.	1/97	1999
Other <i>VVER-1000</i> reactors in Ukraine	Safety Parameter Display Systems - Work begun on systems for Rivne Unit 3, South Ukraine Unit 2, Zaporizhzhya Unit 3; to be installed during 1999. Systems for remaining five reactors to be installed in 2000 and 2001.	10/97	5/01
	Plant Safety Assessments		
Khmelnysky Unit 1 <i>VVER-1000</i>	In-Depth Safety Assessment - Assessment scope definition begun in June 1998. U.S.-provided computers and software installed in July 1998.	3/97	TBD
Rivne Unit 1 <i>VVER-440/213</i>	In-Depth Safety Assessment - U.S.-provided computers and software installed in March 1998. Project guidelines completed in June 1998. Design-basis accident analysis begun in July 1998. Documentation of previously performed probabilistic risk assessment completed in September 1998.	9/97	12/99
South Ukraine Unit 1 <i>VVER-1000/302 and 1000/328</i>	In-Depth Safety Assessment - Major tasks completed for probabilistic risk assessment by November 1998. Most data collection and analysis tasks completed by September 1998. Design-basis accident analysis begun in July 1998.	5/97	4/00
Zaporizhzhya Unit 5 <i>VVER-1000/230</i>	In-Depth Safety Assessment - Documentation of previous probabilistic risk assessment completed. Project guidelines for probabilistic risk assessment completed in September 1998.	4/97	12/99

Table D.3. Reactor Safety Projects in Russia

Nuclear Power Plant <i>Reactor Type(s)</i>	Projects and Status	Start	Complete
	Russia Special Training Programs		
Balakovo Unit 4 <i>VVER-1000</i>	Administrative procedures manual developed; to be adapted to all Russian NPPs.	5/93	10/98
	Russia Training Technology Transfer		
Balakovo <i>VVER-1000</i>	Technical support being provided for development of pilot training courses.	12/96	12/99
Beloyarsk <i>BN-600</i>	Implementation of pilot training courses at Beloyarsk (Sodium Systems Maintenance), Bilibino (Unit Shift Supervisor and Instrumentation and Control Technician), and Kalinin, Kola, and Kursk (Mechanical Maintenance). Second phase initiated to develop pilot courses for motor-operated valve repair technician and control room reactor operator.	12/96	12/99
Bilibino <i>LWGR-12</i>			
Kalinin <i>VVER-1000</i>			
Kola <i>VVER-440/230 and 440/213</i>			
Kursk <i>RBMK</i>			
Novovoronezh <i>VVER-440/230 and 440/213</i>			
Smolensk <i>RBMK</i>			
Leningrad <i>RBMK</i>			
	Simulators		
Balakovo Unit 4 <i>VVER-1000</i>	Analytical Simulator - VNIIAES and GSE Power Systems, Inc. collaborating on simulator development. U.S. and Russian experts updating model of reactor configurations for use in simulator.	5/95	5/99
	Full-Scope Simulator Upgrade - U.S. and Russian experts updating model of reactor configurations for use in simulator. New simulation and instructor station computers being provided.	11/96	9/99
Bilibino <i>LWGR-12</i>	Analytical Simulator - GSE Power Systems and VNIIAES collaborating on simulator development.	1/97	3/00
Kalinin Unit 2 <i>VVER-1000</i>	Full-Scope Simulator - Computer hardware and software provided. Control panel construction is under way. Simulator operation scheduled to begin in 2000.	5/95	4/00
Kola Unit 4 <i>VVER-440/213</i>	Full-Scope Simulator - Control panel construction nearly complete. Acceptance test procedures written and user's guide documentation completed under plant funding. Simulator operation scheduled to begin in February 1999.	5/95	9/99

Table D.3. Reactor Safety Projects in Russia (*cont'd*)

Nuclear Power Plant <i>Reactor Type(s)</i>	Projects and Status	Start	Complete
Novovoronezh Unit 3 <i>VVER-440/230</i>	<p style="text-align: center;">Simulators (<i>cont'd</i>)</p> Analytical Simulator - Simulator operation began September 1998.	5/95	9/98
Smolensk Unit 3 <i>RBMK</i>	<p style="text-align: center;">Fire Safety Systems</p> Safe-Shutdown Analysis - Additional training sessions provided in safe-shutdown methodologies. Electrical circuit tracer kits supplied during 1998 to determine paths of concealed electrical cable.	1/97	3/00
Smolensk <i>RBMK</i>	Fire Safety Upgrades - Fire detection and alarm system being designed. Fire brigade radio system design completed June 1998. Smolensk workers sealing room-to-room cable penetrations with U.S.-provided fire-retardant material.	10/92	12/99
Leningrad Units 1-2 <i>RBMK</i>	<p style="text-align: center;">Engineered Safety Systems</p> Fire Safety Upgrades - Expanded fire detection system designed for balance of Unit 1 and all of Unit 2. System production under way. Installation to be completed in December 1999.	5/95	12/99
Novovoronezh Unit 3 <i>VVER-440/230</i>	Safety Parameter Display System - System installed in November 1997. Site acceptance testing completed October 1998.	1/95	7/99
Novovoronezh Unit 4 <i>VVER-440/230</i>	Safety Parameter Display System - System installation expected in May 1998.	3/97	4/99
Novovoronezh <i>VVER-440/230 and VVER-1000</i>	Emergency Water Supply System - Site acceptance tests completed August 1998. Installation of pipes to connect system to plant feedwater system scheduled for 1999 plant outage.	5/95	1/99
Ten Russian <i>RBMK</i> reactors	<p style="text-align: center;">Technology Transfer</p> Safety Parameter Display System - System installed at Kursk plant in May 1997. Operator use began in September 1997. Kursk system being used as prototype for nine other RBMKs in Russia.	1/94	6/01
Kola Units 1-2 <i>VVER-440/230</i> Kursk Unit 2 <i>RBMK</i>	Direct-Current Power Supply (Battery) Technology - Burns & Roe mentoring in-country capability to design and produce safety-grade and non-safety-grade batteries for Russian nuclear power plants. Workshop held in July 1997 to begin effort.	10/96	6/99
Smolensk <i>RBMK</i> Pilot plant site	Circuit Breaker Technology - U.S. will begin work with Russian firm in 1999 to install 400-volt circuit breaker.	1/97	3/00
Kalinin <i>VVER-1000</i>	Valve Technology - Liberty Technologies demonstrated use of VOTES monitoring system for valve maintenance at Kalinin nuclear power plant in January 1998. Training provided to Russian specialists in July 1998.	1/97	12/98

Table D.3. Reactor Safety Projects in Russia (*cont'd*)

Nuclear Power Plant <i>Reactor Type(s)</i>	Projects and Status	Start	Complete
Plant Safety Assessments			
Kola Units 1-2 <i>VVER-440/230</i>	In-Depth Safety Assessment - Guidelines completed for deterministic risk analysis. RELAP5 model completed.	10/97	12/99
Kola Unit 4 <i>VVER-440/213</i>	In-Depth Safety Assessment - RELAP5 computer model completed for probabilistic risk analysis.	6/95	12/99
Kursk Unit 1 <i>RBMK</i>	In-Depth Safety Assessment - Training provided in September 1998 to Russian analysts for probabilistic risk analysis.	2/97	TBD
Leningrad Units 1-2 <i>RBMK</i>	In-Depth Safety Assessment - Initial quantification of probabilistic risk assessment completed September 1998.	9/96	6/00
Novovoronezh Units 3-4 <i>VVER-440/230</i>	In-Depth Safety Assessment - Quality assurance guidelines and data collection on plant reliability completed in 1998.	8/96	4/01

Table D.4. Reactor Safety Projects in Bulgaria

Nuclear Power Plant <i>Reactor Type(s)</i>	Projects and Status	Start	Complete
Kozloduy Units 1-4 <i>VVER-440/230</i>	Management and Operational Safety		
	Configuration Management System Implementation - System implemented at two pilot plant safety-related facilities in October 1998.	11/97	
Units 5-6 <i>VVER-1000</i>	Units 5 and 6 Full-Scope Simulator - Computer software being developed and tested for simulator to provide updated models congruent with recent physical upgrades to plant.	11/96	12/99
	Training Center Support - Comprehensive training program for plant personnel under development. Systematic Approach to Training being implemented. Basic equipment for course implementation being provided. Pilot course for control room reactor operators implemented March 1998. Courses for mid/upper-level managers presented in July 1998 (Management and Supervisory Skills) and August 1998 (Organizational Safety Culture).	12/95	9/00
	Organizational culture survey administered to representative Kozloduy NPP staff positions in September 1998. Survey results presented to upper management in November 1998.		
	Plant Safety Assessment		
	Unit 5 Seismic Analysis - Detailed seismic analyses of cooling system spray ponds and associated piping completed in 1997. Recommended design modifications based on analysis results provided for incorporation into plant's overall modernization plan.	12/95	9/98
	Safety Analysis Capability Transfer - RELAP5 computer code used to create models of plant's VVER-440/230 and VVER-1000 reactors. Computer hardware and software delivered January 1998. The United States provided technical basis calculations training June 1998.	5/93	12/98
Safety Analysis Workshops - Kozloduy hosted "Enhancement of Safety Analysis Capability for Nuclear Power Plants, Including Analysis in Support of Emergency Operating Instructions" in May 1998.			

Table D.5. Reactor Safety Projects in the Czech Republic

Nuclear Power Plant <i>Reactor Type(s)</i>	Projects and Status	Start	Complete
Dukovany <i>VVER-440/213</i>	Plant Safety Assessment		
	Human Reliability Analysis - Specialized technical support being provided to Czech analysts in collecting and analyzing human reliability data.	9/98	1999
	Level 2 Probabilistic Risk Analysis - U.S. and Czech analysts evaluated effectiveness of Dukovany's systems for confining radioactive materials under accident conditions in April 1998.		

Table D.6. Reactor Safety Projects in Lithuania

Nuclear Power Plant <i>Reactor Type(s)</i>	Projects and Status	Start	Complete
Ignalina <i>RBMK</i>	Management and Operational Safety		
	Configuration Management Implementation - Related training and technical assistance provided to Ignalina staff in June 1998. Additional computer hardware purchased in December 1998; delivery in early 1999 will complete U.S. participation in project.	10/96	1999
	Maintenance Technology Transfer and Training - During 1997, Ignalina received safety maintenance equipment and training for valve resurfacing, pipe lathe/weld preparation, vibration monitoring and shaft alignment, and infrared thermography. Insulation analysis equipment and related training provided in June 1998.	6/95	6/98
	Engineered Safety Systems		
	Safety Control Modules - 200 replacement electronic control-and-protection system modules manufactured by December 1998.	6/96	12/98
	Compensatory Control-and-Protection System - Backup system installed in Unit 1 September 1998. Backup system for Unit 2 to be installed in 1999.	6/97	1999
	Plant Safety Assessment		
	Pressure Tube Analysis - ABAQUS and RELAP5 safety analysis computer codes being used to assess potential damage to RBMK pressure tubes. Reports documenting thermal and stress analysis results, validation and verification, completed in September 1997.	3/97	5/98
	Code Validation - Swedish and Russian specialists validating two neutron-kinetics codes for application to RBMK reactors. Scope of project agreed on in September 1998.		
	Safety Analysis Capabilities - U.S. provided computers to Kaunas University for safety analyses in February 1998. Training provided on NEPTUNE and TEMP-STRESS codes. Follow-up training in June 1998. Training provided on NESTLE for staff from Kaunas and Lithuanian Energy Institute in 1998.		
Pressure Tube Analysis – ABAQUS and RELAP5 safety analysis computer codes used to assess potential damage to RBMK pressure tubes. Report completed June 1998.			

Table D.7. Reactor Safety Projects in Slovakia

Nuclear Power Plant <i>Reactor Type(s)</i>	Projects and Status	Start	Complete
Bohunice <i>VVER-440/230 and VVER-440/213</i>	Training		
	Trnava Training Center Support - Pilot course (Instructor Skills) presented February 1998.	6/96	TBD
	Simulators		
	Trnava Training Center Full-Scope Simulator Upgrade - Input-output system shipped in April 1998. VUJE staff trained in system operation and maintenance.	8/95	9/99
	Plant Safety Assessment		
	Plant Safety Analysis Capability - U.S. provided training on RELAP5 thermal-hydraulics code November 1998.	9/93	2/99