

***Ceremonies and
signings mark
official system
turnovers at three
Ukrainian plants***

Highlights

The U.S. team officially turned over safety parameter display systems (SPDSs) to three nuclear power plants in Ukraine this month. Team representatives from Westinghouse Electric Company, Burns & Roe Enterprises, Inc., and Pacific Northwest National Laboratory participated in turnover ceremonies at Zaporizhzhya, Khmelnytsky, and South Ukraine nuclear power plants (NPPs). These three plants were the first designated to receive SPDSs supplied by the U.S. team; they are the first of eleven eventual installations throughout Ukraine.

The first system turnover ceremony was held at Khmelnytsky Unit 1 on October 29. Plant representatives included the chief engineer for the site, his deputy chief engineers, and instrumentation and control specialists. The official turnover was documented in a protocol, indicating acceptance of the system for pilot operation as required by Ukraine's State Nuclear



Volodymyr Sofiuk, chief engineer for Khmelnytsky NPP, signs protocol documenting official turnover of SPDS from U.S. team to the plant.

Ukrainian and U.S. participants gather in front of Zaporizhzhya NPP before the SPDS turnover ceremony.



Georgiy Balakan, reactor shift supervisor and site manager for the South Ukraine SPDS installation project, demonstrates displays on system monitors in Unit 1 control room.



***WANO-MC approves
central reliability
database for soviet-
designed reactors***

Regulatory Administration. Organizations whose representatives signed the turnover protocol included Burns & Roe, Westinghouse, Westron, and Energoatom.

Turnover ceremonies and protocol signings were held also for Zaporizhzhya Unit 5 on November 1 and South Ukraine Unit 1 on November 3.

With the completion and turnover of these three pilot SPDSs, plus additional systems now being installed for completion by late January 2000, more than half of the eleven SPDS installations targeted are nearly done. The current schedule calls for all eleven systems to be installed and operational by 2002.

(Norman Fletcher, DOE, 301-903-3275; Mike Durst, PNNL, 509-372-4698)✓



Reliability data on systems at Soviet-designed reactors will be collected in a central database and distributed first to six pilot plants and eventually to all plants with Soviet-designed reactors in nine countries to improve preventive maintenance. Left, 400-mm piping system in the turbine generator building at Smolensk NPP. Right, electric isolation valves in the ventilation system at Kola NPP.

A subproject under the World Association of Nuclear Operators-Moscow Center (WANO-MC) Reactor Safety Project initiative was approved to support the development of a centrally located safety component reliability database for Soviet-designed reactors. The WANO-MC Board of Governors granted the approval at its annual meeting in Sofia, Bulgaria, November 23. The board's approval allows the nine countries with Soviet-designed reactors access to a safety component reliability database that compiles operational equipment history from all of the participating nuclear power plants. This is a significant step in improving safety at these plants. It is the first time that data and lessons



learned for safety equipment will be able to be shared formally among all Soviet-designed nuclear power plants.

Reliability databases collect information on the operations and malfunctions of the reactors' mechanical, electrical, and instrumentation systems important to safety. Once implemented, the availability of these reliability data to all Soviet-designed plants will be a significant enhancement to their safety.

A key use of such data is in improving preventive maintenance programs. In addition, the data support probability risk assessments that examine risks and set priorities for safety improvements. The involvement of more nuclear power plants in the database improves the quality of the data.

The International Component Reliability Database is the culmination of efforts that began independently in Russia in 1997 and Ukraine in 1998, supported through cooperative safety efforts with the United States. As each country developed its separate database, care was taken to make the structures of the databases compatible with each other and with the generic reliability database maintained by the International Atomic Energy Agency. Meanwhile, other countries, including the Czech Republic, Hungary, Slovakia, and Lithuania, have developed similar databases, which also will be combined into the final database.

Meetings in September and October 1999 laid the groundwork for the WANO-MC-approved agreement that will eventually involve all 21 Soviet-designed nuclear power plants and 65 operating reactors. The October meeting, held at the Russian Institute for Nuclear Power Plant Operations (VNIIAES) in Moscow, involved some 70 representatives from the various plants and technical organizations. The plan for merging the existing Russian and Ukrainian databases was discussed.

Following the successful connection of the pilot plants to their respective plant database, the Russian and Ukrainian databases will be merged into a central data repository at the WANO-MC. Pilot plants then will be linked to the database via the existing WANO-MC telecommunications network. This linkage will allow each participating plant to access the database and will provide plant-specific data to be entered into the database. The plan is to eventually link all 21 Soviet-designed plants to the system. The timing of completion of the project depends on available funding. (Grigory Trosman, DOE, 301-903-3581; Thomas Vehec, PNNL, 509-372-4072)✓



***Balakova simulator
upgrade completed***

***Simulator for Bilibino
nearing completion***

***Simulator
development progress
reviewed
in Ukraine***



Russia

On November 19, specialists from LAKROM, a Russian firm, turned over a newly upgraded full-scope simulator to the Balakovo Training Center. Representatives of Balakovo NPP and Gosatomnadzor (Russia's nuclear regulatory agency) also were at the training center for the event.

At the same time, LAKROM workers also transferred the upgraded models to the new analytical simulator provided to Balakovo in May 1999 with U.S. support. As a result, both simulators will provide trainees with identical models of the reactor systems, enhancing the validity and reliability of their training.

The effort began in November 1996, when the U.S. team started work to upgrade the full-scope simulator used to train reactor operating staff for Balakovo Unit 4. U.S. specialists from GSE Power Systems, Inc., subcontracted with LAKROM to accomplish the upgrade work. The effort involved updating the simulator's computer model of reactor configurations, providing new computer workstations for the instructor and trainees, and obtaining regulatory approval for the modifications.

In December, control room operators and supervisors will begin using the upgraded simulator for actual training. The final turnover ceremony is planned for January 2000, after initial operations are completed successfully. Members of the U.S. team will participate in that ceremony at the plant. (John Yoder, DOE, 301-903-5650; Joe Cleary, PNNL, 509-372-4079)✓

The analytical simulator being developed for Bilibino NPP underwent factory acceptance testing in November. A U.S. team member from Brookhaven National Laboratory reviewed the test results in Moscow with technical specialists from LAKROM, the Russian subcontractor for the simulator development. The review showed the simulator meets technical requirements specified for its development. Simulator developers GSE Power Systems, Inc., and LAKROM expect the simulator to be ready in early December for shipment to the Bilibino plant site in north-eastern Russia. (John Yoder, DOE, 301-903-5650; Joe Cleary, PNNL, 509-372-4094)✓

Ukraine

During November, U.S. specialists from Brookhaven and Pacific Northwest national laboratories began work on one new simulator project and conducted reviews of two others. The projects involve three separate nuclear power plant sites in Ukraine.

In Odessa, the U.S. team members joined representatives of Energoatom, LAKROM, Zaporizhzhya NPP, and U.S. simulator vendor GSE Power Systems, Inc., to kick off a new safety project

**Training program
being readied for
transfer to plants in
Ukraine**

**Zaporizhzhya
safe-shutdown
analysis project
reviewed**



for the plant. Under the project, GSE and LAKROM will develop a full-scope simulator for Zaporizhzhya Unit 1. Completion is targeted for April 2002.

During on-site visits to two more nuclear power plants, the U.S. team verified that the full-scope simulators for South Ukraine Unit 1 and Rivne Unit 3 meet the contractual and technical requirements at the intermediate design stage of their development. They also reviewed the status of the simulator control panels at Energotraining facilities in Ukranka. Energotraining, a Ukrainian firm specializing in simulator control panel design and manufacturing, is a subcontractor to GSE. Energotraining representatives reported that panels for the Rivne simulator had been completed and delivered to the plant site. Panels for the South Ukraine simulator are being completed; delivery to the plant is expected in February 2000. (John Yoder, DOE, 301-903-5650; Joe Cleary, PNNL, 509-372-4094)✓

Training specialists from Khmelnytsky NPP, the Engineering and Technical Center for the Training of Nuclear Industry Personnel, and the U.S. team collaborated in Kyiv November 9 through 18 on efforts to transfer the Control Room Reactor Operator training program to three additional nuclear power plants in Ukraine. The training specialists worked with technical and training personnel from Rivne, South Ukraine, and Zaporizhzhya NPPs to develop plant-specific versions of the training program for the three sites. Work to transfer this training program began in July 1999 at the request of the participating plants. The program supports effective use of control room simulators for personnel training at each plant site. (John Yoder, DOE, 301-903-5650; Don Draper, PNNL, 509-372-4079)✓

U.S. fire safety specialists from Brookhaven and Pacific Northwest national laboratories met in Ukraine November 6 through 11 with the host-country working group conducting the safe-shutdown analysis for Zaporizhzhya Unit 5. The Ukrainian working group presented its report, *The list of the unit systems and their functions to be used for safe shutdown in case of fire.*

After some discussion, the U.S. and Ukrainian specialists agreed that some of the systems and functions included in the report were not necessary for safe shutdown in the event of a fire and removed them from the original list. The reduced number of systems will simplify the work of the Energoproekt specialists doing the analysis tasks for the project.

Other topics covered in the review included submittal dates for Energoproekt's reports on specific analysis tasks, draft statements of work for the next phase of the project, and whether the Level 1 probabilistic risk assessment for Zaporizhzhya Unit 5 will be available as a resource for the project's next phase. In addition, Energoproekt representatives suggested a need for developing a national regulation for performing safe-shutdown analyses at Ukraine's nuclear power plants. They agreed to prepare a request for funding and present it to Energoatom for inclusion in

***Khmelnyskyy safety
assessment team
completes project
guidelines, optimizes
local area network for
Y2K compliance***

***Key analytical
models, systems
descriptions
documentation
completed for Rivne
safety assessment***



the budget for the year 2000. (Rich Reister, DOE, 301-903-0234; Andrew Minister, PNNL, 509-376-4938)✓

During November, specialists from Khmelnyskyy NPP and Kyiv Energoproekt, the plant's Ukrainian subcontractor, completed the project guidelines for the plant's in-depth safety assessment. The guidelines specify modern nuclear power plant safety techniques to be used in performing the assessment. Technical staff from U.S. contractor Data Systems & Solutions collaborated with the Ukrainian team members in developing the guidelines.

Khmelnyskyy members of the in-depth safety assessment team also received training on the local area network established for the project's computer system. The Ukrainian contractor Frehat provided the training, which included system optimization and compliance with year 2000 (Y2K) requirements. (Walter Pasedag, DOE, 301-903-3628; Charles Dickerman, ANL, 630-252-4622)✓

Specialists from Energorisk, Ukrainian subcontractor to Rivne NPP, recently completed all development work on two analytical models critical to the Rivne Unit 1 in-depth safety assessment of Rivne's VVER-440 reactors in Units 1 and 2. The models—also referred to as ***input data decks***—are essential technical components of modern safety assessment methodology for assessing risks and identifying areas on which to focus resources for safety upgrades.

The RELAP5 model is the basic thermal-hydraulic input data deck for the Rivne in-depth safety assessment. Energorisk specialists finished its development, including verification and validation of input data, input models, and computer input, on October 8. Specialists will modify the input deck as needed for specific individual calculations for both the probabilistic risk assessment and the deterministic design-basis accident analysis.

The CONTAIN input deck, completed on November 12, will be used in analyzing the capability of the Rivne Unit 1 and 2 reactors to contain consequences of accidents.

Energorisk specialists developed the analytical models with technical assistance from SCIENTECH, Inc. Development of the models in accordance with modern quality assurance and validation/verification techniques demonstrates the successful transfer of this technology to the Ukrainian members of the Rivne safety assessment team.

Also on October 8, specialists from Rivne NPP and Energorisk completed all documentation for the Rivne Unit 1 systems descriptions. Systematic, verified documentation of plant systems is a key component of the modern approach to nuclear power plant safety. Preparation and verification of the Rivne Unit 1 documentation in accordance with international practices also demonstrates an important step in the transfer of nuclear power plant safety technology. (Walter Pasedag, DOE, 301-903-3628; Charles Dickerman, ANL, 630-252-4622)✓

***Host-Country firm
will support South
Ukraine safety
assessment***

***Plant physical
security
upgrades under way
at Khmelnytskyy***

***Dukovany workshop
transfers guidance
on severe accident
management***



Engineering Technologies and Developments (ET&D), a Ukrainian firm based in Kyiv, will perform the quality assurance and peer review functions for the in-depth safety assessment under way at South Ukraine NPP. Earlier this fall, the U.S. team selected the company for this work.

In early November, ET&D staff and a U.S. specialist from Brookhaven National Laboratory reviewed the firm's plans for the upcoming work. They also made preparations for a related seminar on quality assurance/peer review methodology scheduled for ET&D staff in early December (see "Planned Activities"). (Walter Pasedag, DOE, 301-903-3628; Ted Ginsberg, BNL, 516-344-2620)✓

Progress to date on work to upgrade physical security measures at Khmelnytskyy NPP underwent review in late October. A U.S. team member from Pacific Northwest National Laboratory toured the plant site and held subsequent discussions with security personnel from Khmelnytskyy NPP and representatives of Energoatom and the State Nuclear Regulatory Administration in Kyiv. The discussions with Energoatom led to development and agreement on the final list of internal areas and basic equipment needing upgrades at the plant. The scope of work will include equipment purchases, installation, testing and commissioning; procedures development; and personnel training.

The U.S. team began the equipment purchasing process in November. Next, a request for proposal will be transmitted to the Ukrainian participants. In December, the Ukrainian team will prepare and submit technical and price proposals covering the balance of the work scope. The work to be done will augment the personnel badging system provided by the U.S. team in June 1999. That system enables plant management to replace the former easily altered personnel identification badges with plastic cards, each imprinted with a color photographic image of a plant employee. The images are captured and maintained in an electronic database of bonafide plant personnel. (Grigory Troshman, DOE, 301-903-3581; Andrei Glukhov, PNNL, 509-375-3961)✓

Czech Republic

Four specialists from Westinghouse/Pittsburgh, Westinghouse/Brussels, Farley NPP, and Argonne National Laboratory conducted a workshop on severe accident management guidance (SAMG) November 2 through 5 at Hrotovice, Czech Republic, near the Dukovany NPP site. The workshop objective was to assist the Czech utility CEZ in planning to introduce such guidance at Dukovany NPP. In attendance were 26 persons from CEZ, Dukovany NPP, the Czech Republic research and development organization REZ, and the State Office for Nuclear Safety (SUJB), plus invitees from Slovakia, including representatives from Bohunice and Mochovce NPP and the Nuclear Power Plant Institute (VUJE). The workshop was timely for personnel from

***VEIKI completes
hydrogen mixing
analysis***

***Ignalina managers
observe U.S. training
practices***



the three participating nuclear power plants because introduction of SAMG is among their top safety-related priorities as they complete implementation of their symptom-based emergency operating instructions. Severe accident management measures have been implemented at all operating U.S. nuclear power plants and are required in most countries. The guidance adds an additional defense-in-depth safety measure at nuclear power plants focusing on accident mitigation, supplementing the extensive accident prevention measures already in place. (Walter Pasedag, DOE, 301-903-3628; Bruce Spencer, ANL, 630-252-6564)✓

Hungary

The Institute for Electric Power Research (VEIKI) in Hungary completed an analysis of multi-compartment hydrogen mixing in the Paks VVER-440/213 reactor for a loss-of-coolant accident (LOCA) associated with a 100-mm pipe break. The VEIKI researchers used the state-of-the-art GASFLOWII 3-D CFD computer code to evaluate the time history of hydrogen concentration on a compartment-by-compartment basis. Hydrogen safety is one of the key issues in addressing beyond-design-basis accidents in nuclear power plants. Support for running the GASFLOW code was provided by Argonne National Laboratory. One of the objectives was to compare the hydrogen distribution results obtained using GASFLOW with results using a lumped-parameter code CONTAIN. Results have indicated very significant differences, with GASFLOW providing the more conservative results. (Walter Pasedag, DOE, 301-903-3628; Bruce Spencer, ANL, 630-252-6564)✓

Lithuania

Four managers from Ignalina NPP toured three U.S. nuclear-related enterprises in mid-November, getting a first-hand look at American practices for selecting, qualifying, and training nuclear power plant workers. The visiting managers, all involved in personnel training at Ignalina NPP, toured facilities and talked with representatives of the U.S. Nuclear Regulatory Commission, the Institute for Nuclear Power Operations, and Sequoyah NPP in southeastern Tennessee. Training specialists from Human Performance Analysis Corporation and the U.S. Department of Energy also participated in the event, which was organized to provide the visitors with demonstrations and information on requirements and practices involved in training workers for the U.S. nuclear industry. Information gained during these visits will assist the Ignalina representatives in maximizing the effectiveness of their plant's personnel training program and practices. (John Yoder, DOE, 301-903-5650; Don Draper, 509-372-4079)✓

***Project ends but
technology transfer
continues***

***Computer codes
assessed for use
in RBMK analysis***

***Host-country plant
sites continue Y2K
preparations***



Cross-Cutting Activities

Since 1996, the United States has been involved in transferring safety maintenance technology and training to Soviet-designed nuclear power plants with RBMK reactors. Russia's Kursk, Leningrad, and Smolensk NPPs and the Smolensk Training Center—plus Ignalina NPP in Lithuania and Chornobyl NPP in Ukraine—all have received equipment for performing safety maintenance on critical piping and electrical systems. U.S. manufacturers and suppliers of the equipment have provided equipment-specific training at the plant sites.

As of the end of November, all equipment had been delivered and all related training provided to the RBMK plants. U.S. involvement in this effort is essentially finished, with only formal project closeout remaining. However, the transfer of training technology among the recipient countries continues. Earlier this fall, Kursk NPP maintenance staff hosted their counterparts from Armenia NPP for training on the EFCO valve-seat resurfacing equipment supplied by the U.S. team. (Grigory Trosman, DOE, 301-903-3581; Thomas Vehec, PNNL, 509-372-4072)✓

In November, the Kurchatov Institute in Moscow and the Stockholm Royal Institute of Technology (KTH) submitted their reports on the recently completed assessment of neutron kinetics computer codes for application to RBMK reactor analyses. The year-long project defined neutron kinetics benchmarks for application to RBMK reactors and assessed the performance of neutron physics codes. Code assessment increases the confidence in the safety analyses performed with the computer codes. Kurchatov Institute scientists provided data and defined the benchmark problems. They also analyzed the problems with a Kurchatov computer code. Researchers from the KTH conducted a parallel analysis with another computer code and provided guidance to Kurchatov staff members. Specialists from Argonne and Pacific Northwest national laboratories provided technical assistance in scope definition and peer review activities. Negotiations for extension to the second year, which would include assessment of coupled neutron kinetics-thermal hydraulics codes, are under way. (Walter Pasedag, DOE, 301-903-3628; Jordi Roglans, ANL, 630-252-3283)✓

By the end of November, virtually all nuclear power plant sites with Soviet-designed reactors had completed the first three phases of their five-phase program to prepare the plants for Y2K. The last two phases include remediation and contingency planning, both of which are well along.

The international community has supported work on resolving the Y2K computer problem in the nine countries with Soviet-designed reactors. The United States has focused most of its support in Russia and Ukraine, with some assistance provided to Armenia, Lithuania, the Czech Republic, and Kazakhstan. Primary safety systems at nuclear power plants are not affected by the computer glitch, so efforts have focused on remediating

computer systems important to safety. Remediation efforts include purchasing new software and hardware to replace systems known to have problems.

Also in November, Russia performed several drills related to Y2K. One on November 7 involved Kursk NPP plus Rosenergoatom and the local transmission and distribution system. On November 18 and 19, Russia completed a national transmission and distribution Y2K drill in St. Petersburg. The drill bounded worst-case scenarios and assessed the transmission and distribution sector's ability to operate with loss of all computer systems and loss of all normal communications. Another drill will be held at Leningrad NPP in December. These drills help operating staff prepare for potential Y2K events. In addition, contingency plans are being prepared to guide plant operators through potential challenges and to ensure that resources (e.g., diesel fuel for emergency generators) are available to respond to events like loss of offsite power. (Norman Fletcher, DOE, 301-903-3275; Tye Blackburn, PNNL, 509-372-4092)✓

Planned Activities

• *Indicates the event is new or has been changed in some way since the last report was issued*

• **November 29-December 10 — Kyiv, Ukraine**

Training. U.S. training experts from Sonalysts, Inc., and Human Performance Analysis Corporation, along with representatives of Ukrainian nuclear power plant organizations and the Engineering and Technical Center for the Training of Nuclear Industry Personnel, will discuss ongoing modifications to the current one-week simulator instructor training course. (John Yoder, DOE, 301-903-5650; Joe Cleary, PNNL, 509-372-4094)

• **December 2 — Kyiv, Ukraine**

Plant Safety Assessment. Participants in in-depth safety assessments under way at Rivne, South Ukraine, and Zaporizhzhya NPPs will review the status of their respective projects. Others expected to participate in the reviews include representatives of Energoatom; technical contractors Energorisk, Kyiv Energoproekt, and Joint Stock Enterprise-EIS; SCIENTECH, Inc., and Science Applications International Corporation; and U.S. specialists from Argonne and Pacific Northwest national laboratories. (Walter Pasedag, DOE, 301-903-3628; Christian Kot, ANL, 630-252-6151)

• **December 3-4 — Kyiv, Ukraine**

Plant Safety Assessment. Technical staff from Zaporizhzhya NPP and the plant's primary contractor, Joint Stock Enterprise-EIS, will meet with U.S. team representatives. Participants will discuss detailed plans for the in-depth safety assessment of Zaporizhzhya Unit 5. (Walter Pasedag, DOE, 301-903-3628; Christian Kot, ANL, 630-252-6151)



• **December 6-10 — Argonne National Laboratory, Argonne, Illinois, USA**

Plant Safety Assessment. U.S. team members from Argonne National Laboratory will host a project review meeting for Ukrainian and U.S. participants in the Rivne and South Ukraine NPP in-depth safety assessments. Attendees will review and coordinate schedule recovery activities and plans for the two projects. Ukrainian bounding mode analysis scenarios for analyzing the Rivne Unit 1 emergency operating instructions will be reviewed. (Walter Pasedag, DOE, 301-903-3628; Charles Dickerman, ANL, 630-252-4622)

• **December 6-10 — Kyiv, Ukraine**

Plant Safety Assessment. U.S. specialists from Brookhaven National Laboratory will present a seminar on methodologies for quality assurance and peer review activities. Technical staff of Engineering Technologies and Developments, the Ukrainian firm to provide those services for the in-depth safety assessment of South Ukraine NPP, will participate. (Walter Pasedag, DOE, 301-903-3628; Ted Ginsberg, BNL, 516-344-2620)

• **December 6-17 — Armenia NPP, Armenia**

Training. Training experts from the International Atomic Energy Agency and Sonalysts, Inc., will work with Armenia NPP training and technical specialists to complete preparations for implementation of training programs for radiation protection technicians and senior foremen for the reactor equipment maintenance shop. (John Yoder, DOE, 301-903-5650; Don Draper, PNNL, 509-372-4079)

• **December 7-10 — Ignalina NPP, Lithuania**

Simulators and Training. Ignalina NPP will host a seminar on use and management of full-scope simulators at nuclear power plants with RBMK reactors. Two representatives each from the Smolensk Training Center and Chornobyl, Kursk, Leningrad, and Smolensk NPPs are expected to attend. A U.S. training expert from DOE and a utility representative from Seabrook NPP also will participate. (John Yoder, DOE, 301-903-5650; Don Draper, PNNL, 509-372-4079)



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