INSP
International
Nuclear Safety
Program

Activity Report
March 2000

Office of International Nuclear Safety and Cooperation - Dr. Terry Lash, Director
Improving the Safety of Soviet-Designed Nuclear Power Plants

Highlights

Full-scope simulator completed for Kola

Russian and U.S. technical specialists completed work during March to build and install a state-of-the-art full-scope simulator at Russia's Kola nuclear power plant (NPP). The simulator will be used to train control room operators for Kola's Unit 4, a VVER-440/213 reactor.

A full-scope simulator provides hands-on training by replicating the control room of a nuclear power plant. A computer links an instructor station with a full-size physical replica of the control panels. As reactor operators manipulate controls, the simulator responds by displaying the changes in conditions that would occur in the plant. The instructor can select the initial plant state, introduce malfunctions and failures, freeze the exercise, and enable retrospective viewing. Full-scope simulators have proven to be a very effective tool for preparing reactor operators to respond appropriately to actual emergency situations.

Panels and other components for the Kola Unit 4 full-scope simulator are shown in this 1998 photo. Electronics experts from VNIIAES completed assembly of the simulator prior to delivery to Kola NPP for installation.

Completion of the site acceptance testing at the plant in mid-March represents the culmination of a jointly funded Russian/U.S. project that began in May 1995. Through the U.S. Department of Energy's cooperative program to improve the safety of Soviet-designed reactors, the United States purchased the computer hardware, software, input/output system, power supplies, and control panels. Kola NPP funded development of the system software, as well as the modeling and testing, through the Moscow-based General Energy Technologies, a joint venture between the All-Russian Institute for Nuclear Power Plant Operations (VNIIAES) and GSE Power Systems, Inc., a U.S. contractor.

Official turnover of the new full-scope simulator to the plant is scheduled for mid-April (see **Planned Activities**). (John Yoder, DOE, 301-903-5650; Joe Cleary, PNNL, 509-372-4094) V

Energoatom issues nuclear industry training standards

In March, Ukraine's national nuclear energy generating company, Energoatom, issued three new standards for training personnel for work in Ukraine's nuclear power plants:

- ***Statute of Nuclear Power Plant Training Center***
- ***Standard Terms and Definitions in the Training Field***
- ***Requirements for Training Materials for NPP Personnel Training***.

The new standards will ensure institutionalization and maintenance of the Systematic Approach to Training (SAT) methodology within Ukraine's nuclear power industry. The SAT methodology was transfered to Ukraine under the U.S. program to improve safety at Soviet-designed nuclear power plants.

Regulations related to training and qualification of nuclear industry personnel had been developed previously and issued by the State Nuclear Regulatory Administration. However, industry-specific training standards to support these regulations were needed. Industry training standards and guidelines are critical to successful implementation of training and qualification programs at the operating level.

Ukraine also has developed a draft guide on SAT and draft standard procedures for implementing SAT. A similar regulation and standard for simulators is currently under development.

A critical aspect in the drafting and subsequent finalization of all three standards and support procedures was the high level of involvement of key Ukrainian agencies and entities: Energoatom, the Main State Inspectorate, the Engineering and Technical Center for the Training of Nuclear Industry Personnel, and the State Scientific and Technical Center. Ukraine's nuclear power plants also had a high level of involvement through participation in working meetings to discuss and review the standards as well as provide input into their development.

The standards grew out of an October 1999 workshop, which involved participants from all Ukrainian organizations mentioned above, as well as representatives of Lithuania's Ignalina NPP and Bulgaria's Kozloduy NPP. U.S. technical specialists from Sonalysts, Inc., Human Performance Analysis Corporation, and commercial utilities also participated in this work to provide perspective on commonly accepted U.S. industry standards and practices. As part of the process of developing the standards, the U.S. team provided detailed information on modern regulations, standards, and practices related to nuclear power plant simulators and training.

The cooperative efforts to provide simulators and training to Ukraine's nuclear power plants enabled participating organizations to support this change in safety culture for Ukraine's nuclear industry. (John Yoder, DOE, 301-903-5650; Don Draper, PNNL, 509-372-4079) V

Russia

Bilibino simulator passes factory acceptance tests

A cooperative Russian/U.S. effort to develop an analytical simulator for Bilibino NPP recently achieved a major milestone. In Moscow in late February, the simulator successfully underwent factory acceptance testing at the facilities of LAKROM, the Russian subcontractor for simulator software development. Factory acceptance testing involves a final evaluation of the simulator's computer model before the equipment is shipped to the Bilibino plant site.

In comparison to a full-scope simulator, an ***analytical simulator*** uses computer monitor screens instead of replicated control panels. The computer's graphic displays represent plant systems. Operators practice responding to various conditions by entering computer commands.

Following successful test completion, U.S. contractor GSE Power Systems, Inc., will oversee shipment of the simulator hardware and software to Bilibino NPP for setup, installation, and site acceptance testing. When this project is completed in May 2000, Bilibino will have a state-of-the-art tool with which to train the plant's reactor operators. (John Yoder, DOE, 301-903-5650; Joe Cleary, PNNL, 509-372-4094) V

INSP
International Nuclear Safety Program

Ukraine

Energoatom tests events reporting database

An events reporting database developed for Ukraine's nuclear power industry underwent testing in Kyiv on March 20 through 24. The testing was conducted in preparation for installing the database onsite at Zaporizhzhya NPP for its pilot implementation.

Specialists from Novator-Kiev, a Ukrainian subcontractor, installed and operated the database on computers at Energoatom in Kyiv. Energoatom staff specializing in plant operating experience and a specialist from Zaporizhzhya NPP tested the database and provided comments for improvement. Actual event data were used to determine whether the database will support implementation of the event reporting and analysis procedures developed for Ukraine's nuclear power plants. (Dennis Meyers, DOE, 301-903-1418; Lief Erickson, PNNL, 509-372-4097) V

System software development completed for two Ukrainian plant simulators

By mid-March, two projects to develop full-scope simulators for Rivne Unit 3 and South Ukraine Unit 1 reached their halfway point when the software development work for each system was completed. The software development team, who performed work in Kyiv, was composed of technical specialists from GSE Power Systems, Inc., LAKROM, and the Engineering and Technical Center for the Training of Nuclear Industry Personnel. GSE is the primary U.S. contractor for simulator development work. Subcontractors LAKROM (Russia) and the Engineering and Technical Center (Ukraine) provide most of the simulation engineers for the project.

The objective of the 16-month effort was to design computer-based models to replicate each of the two nuclear power plants. Now that the models have been completed, the staff for each project has transitioned from Kyiv to its specific nuclear power plant site, where the testing phase of each effort will begin. Final completion of the two simulator projects will significantly increase the capabilities of each plant's training organizations. (John Yoder, DOE, 301-903-5650; Joe Cleary, PNNL, 509-372-4094) V

New simulator project gets under way for Rivne

The U.S. team is supporting development of a full-scope simulator for Rivne NPP's two VVER-440/213 reactors. On February 29 and March 1, key participants in the project met in Columbia, Maryland, USA, to discuss roles, responsibilities, scope, and schedules for the effort. Participants included representatives of GSE Power Systems, Inc. (primary contractor); the Engineering and Technical Center for the Training of Nuclear Industry Personnel (major subcontractor); Energoatom, acting on behalf of Rivne NPP and the central Energoatom organization

in Kyiv; the U.S. Department of Energy; and Brookhaven and Pacific Northwest national laboratories.

The meeting marked the beginning of a significant safety improvement effort for Rivne NPP. The simulator will enable the reactor operators of both Units 1 and 2 to undergo simulator-based training for their specific assignments. Such training currently is not available to the VVER-440/213 operators at the plant. (John Yoder, DOE, 301-903-5650; Joe Cleary, PNNL, 509-372-4094) V

Site-specific training programs under development at Rivne and Zaporizhzhya

The U.S. Department of Energy is supporting the development of a training program for control room reactor operators at both Rivne and Zaporizhzhya NPPs. For two weeks in late February and early March, teams of training specialists from Khmelnytskyy NPP, the Engineering and Technical Center for the Training of Nuclear Industry Personnel, and Sonalysts, Inc., conducted working sessions at each of the two plants. During the sessions, the specialists incorporated site-specific details for each plant into the generic program instructional materials developed previously. The training program for each plant is to be implemented in June 2000. (John Yoder, DOE, 302-903-5650; Don Draper, PNNL, 509-372-4079) V

U.S. team transfers technology for training nuclear power plant simulator instructors

In late March, host-country personnel conducted a recently expanded training course at Zaporizhzhya NPP for simulator instructors. The session at Zaporizhzhya was the first presented entirely by Ukrainian training specialists and represents the culmination of U.S. efforts to transfer technology to Ukraine for training simulator instructors. The specialists, from Zaporizhzhya and Khmelnytskyy NPPs and the Engineering and Technical Center for the Training of Nuclear Industry Personnel, had presented the course at Khmelnytskyy NPP in late January 2000 but with the direct involvement of U.S. consultants from Sonalysts, Inc.

In October 1999, the Ukrainian training specialists began working with their U.S. counterparts to modify the course in response to requests from host-country simulator instructors. They extended the course length from one week to two weeks and expanded the content to include more in-depth treatment of relevant topics.

U.S. team members from Sonalysts observed and reviewed the March training session. Review comments will be incorporated into the training course; the course then will be integrated into the training program at each of Ukraine's nuclear power plants with VVER reactors. (John Yoder, DOE, 301-903-5650; Al Ankrum, PNNL, 509-372-4095) V

INSP
International Nuclear Safety Program

Rivne safety parameter display system completes site acceptance tests

On March 30, a U.S.-provided safety parameter display system successfully passed site acceptance tests at Rivne Unit 3. A Ukrainian commissioning team accepted the test results and approved a final protocol, stating that the system is ready for pilot operation. The start of pilot operation now awaits formal approval from the State Nuclear Regulatory Administration.

Rivne NPP is the fifth Ukrainian nuclear power plant site to have installed at least one safety parameter display system with U.S. support. In addition to the one at Rivne Unit 3, systems now are in place for Khmelnytskyy Unit 1, Zaporizhzhya Units 3 and 5, and South Ukraine Unit 1 (all VVER-1000 reactors). The U.S. team also supported installation of a safety parameter display system in Chornobyl Unit 3, an RBMK reactor.

Westinghouse Electric Company, under subcontract to Burns & Roe Enterprises, Inc., is the U.S. supplier of the systems. Specialists at Westron facilities (a consortium between Westinghouse and Hartron Corporation of Ukraine) assemble the systems in Ukraine for the host-country nuclear power plants. (Richard Reister, DOE, 301-903-0234; Rich Denning, PNNL, 614-424-7412; Frank Panisko, PNNL, 509-372-4472) V

Ukrainian company facilitates second-generation transfer of safety analysis technology

In March, Energoatom Engineering Service (EIS) Company successfully completed a trial program aimed at transferring safety analysis technology within Ukraine. In the program's series of "hands-on" training sessions, individual staff members from Ukraine's nuclear power plants were paired with experienced EIS analysts to work with U.S. safety analysis computer codes.

The program had two underlying purposes. The first was to augment previous "academic" instruction for nuclear power plant analysts with actual experience. The second was to help move U.S. technology transfer into a "second-generation" mode, in which selected Ukrainian analysts provided training to new nuclear power plant analysts needed in support of work at their own plants.

Six analysts, three each from Rivne and Khmelnytskyy NPPs, were trained in individual one-month sessions during 1999. EIS used its self-developed training materials in conjunction with two U.S.-developed computer codes for safety analyses—SAPHIRE (probabilistic risk assessment) and RELAP5 (thermal-hydraulic analysis). The training resulted in providing Khmelnytskyy and Rivne analysts with practical experience in use of modern computer codes to support the ongoing in-depth safety assessment work at their respective plants. In addition, the EIS program provides a model strategy for advanced technology transfer to even greater numbers of analysts. (Walter Pasedag, DOE, 301-903-03628; Christian Kot, ANL, 630-252-6151) V

INSP
International Nuclear Safety Program

New training program implemented

Armenia

In March, Armenia NPP training personnel implemented a new instructional program for workers at the plant. The program, developed with technical assistance from training specialists at Balakovo NPP and Sonalysts, Inc., is designed specifically for senior foremen in the plant's reactor equipment maintenance shop. Both incumbent and trainee foremen participated as students in the first training session, which was offered during the week of March 27.

Training specialists from the International Atomic Energy Agency and Human Performance Analysis Corporation were at the plant for the implementation activities, to observe and provide their comments and suggestions to plant trainers. Support for training program development at Armenia was provided jointly by the International Atomic Energy Agency and the U.S. Department of Energy to assist in improving training methodology and expertise at Armenia NPP. (John Yoder, DOE, 302-903-5650; Don Draper, PNNL, 509-372-4079) V

Planned Activities

• indicates the event is new or has changed in some way since the previous report was issued.

April 3-7 — Zaporizhzhya NPP, Ukraine
Simulators/Training. Zaporizhzhya NPP will host a training course on the validation and verification of simulators at nuclear power plants. Technical specialists from the Balakovo Training Center, VNIIAES, and Brookhaven National Laboratory will present the course. Three representatives each from the training centers at Rivne, South Ukraine, and Zaporizhzhya NPPs will participate, as will staff of the Engineering and Technical Center for the Training of Nuclear Industry Personnel and the Ukraine State Nuclear Regulatory Administration. (John Yoder, DOE, 301-903-5650; Joe Cleary, PNNL, 509-372-4079, Peter Kohut, BNL, 631-344-4982)

April 10-13— Boston, Massachusetts, USA
Engineering and Technology. Specialists from Engineering Planning and Management Inc. (EPM) will host a progress meeting on the safe-shutdown analysis under way at Zaporizhzhya NPP. Participants will include analysts from Kyiv Energoprojekt as well as technical specialists from EPM and Brookhaven and Pacific Northwest national laboratories. Participants will review comments on two reports documenting specific analysis tasks. They also will discuss the start of the deterministic and probabilistic analysis tasks. (Grigory Trosman, DOE, 301-903-3581; Andrew Minister, PNNL, 509-376-4938)

• **April 10-14 — Kyiv, Ukraine**
Plant Safety Assessment. The International Peer Review Service of the International Atomic Energy Agency will review the Level 1 internal events probabilistic risk assessment for Unit 1 of South Ukraine NPP. Review participants will include representatives of South Ukraine NPP, Energorisk, Ltd., the State Nuclear Regulatory Administration, SCIENTECH, Inc., and Argonne National Laboratory. (Walter Pasedag, DOE, 302-903-3628; Christian Kot, ANL, 630-252-6151)

• **April 10-21 — Armenia NPP, Armenia**
Training. A U.S. training expert from Sonalysts, Inc., will work with training and technical specialists at the plant site to develop a plant-specific training program for control room turbine operators. This, the first of three planned onsite working sessions, will focus on task analysis and initial development of training materials. The International Atomic Energy Agency and the U.S. Department of Energy jointly are providing support to transfer this training program to Armenia NPP. (John Yoder, DOE, 301-903-5650; Don Draper, PNNL, 509-372-4079)

• **April 10-21 — Kozloduy NPP, Bulgaria**
Training. Training specialists from Sonalysts, Inc., and Kozloduy NPP will continue their joint work to develop a program for training plant personnel on use of emergency operating instructions. Kozloduy technical personnel will provide their expertise on the operating instructions for the VVER-1000 reactors. (John Yoder, DOE, 301-903-5650; Don Draper, PNNL, 509-372-4079)

• **April 11-13 — Kola NPP, Russia**
Simulators and Training. The U.S. team will formally turn over the full-scope simulator for Kola Unit 4 to the plant. In addition, Kola NPP training staff will present a detailed demonstration of the training program they developed for the plant's reactor operators. Participants in the turnover and training demonstration are expected to include representatives of VNIIAES, General Energy Technologies, Rosenergoatom, Gosatomnadzor, Kola NPP, the U.S. Department of Energy, and Pacific Northwest National Laboratory. (John Yoder, DOE, 301-903-5650; Joe Cleary, PNNL, 509-372-4094)

April 25 — South Ukraine NPP, Ukraine
Engineering and Technology. The safety parameter display system for South Ukraine Unit 2 will undergo site acceptance testing. (Richard Reister, DOE, 301-903-0234; Rich Denning, PNNL, 614-424-7412; Frank Panisko, PNNL, 509-372-4472)

• **April 26-28 — Kaunas, Lithuania**
Plant Safety Assessment. Representatives of the U.S. Department of Energy and Argonne National Laboratory will meet with counterparts at the Lithuanian Energy Institute to coordinate a proposed analysis of pipeline whipping resulting from a guillotine pipe break. The proposed analysis will support the Safety

Analysis Report for Ignalina Unit 2. Meeting participants will discuss other safety analysis capability needs as well. (Dennis Meyers, DOE, 301-903-1418; Mark Petri, ANL, 630-252-3719)

• **April 27-30 — Armenia NPP, Armenia**
Training. A training specialist from Human Performance Analysis Corporation will conduct a workshop for managerial and supervisory staff at Armenia NPP. The workshop, presented previously at nuclear power plants in Russia, Ukraine, and Bulgaria, covers basic management skills including communication, decision making, teamwork, motivation, human factors, and organizational structure. (John Yoder, DOE, 301-903-5650; Don Draper, PNNL, 509-372-4079)

• **May tbd (rescheduled from March 17) — Zaporizhzhya NPP, Ukraine**
Engineering and Technology. The U.S.-provided safety parameter display system for Zaporizhzhya Unit 3 will undergo site acceptance tests at the plant. (Richard Reister, DOE, 301-903-0234; Rich Denning, PNNL, 614-424-7412; Frank Panisko, PNNL, 509-372-4472)

• **May tbd — South Ukraine NPP, Ukraine**
Engineering and Technology. The U.S.-provided safety parameter display system for South Ukraine Unit 2 will undergo site acceptance tests at the plant. (Richard Reister, DOE, 301-903-0234; Rich Denning, PNNL, 614-424-7412; Frank Panisko, PNNL, 509-372-4472)

• **Early May tbd — Armenia NPP, Armenia**
Engineering and Technology. The U.S.-provided safety parameter display system for Armenia NPP will undergo site acceptance testing at the plant. Plant technical staff and representatives of U.S. contractors Science Applications International Corporation, Data Systems & Solutions, and Burns & Roe Enterprises, Inc., will participate in the testing. (Richard Reister, DOE, 301-903-0234; Rich Denning, PNNL, 614-424-7412; Frank Panisko, PNNL, 509-372-4472)

• **May 8-12 — Pittsburgh, Pennsylvania, and Argonne, Illinois, USA**
Plant Safety Assessment. With U.S. support, a technical expert from the Lithuanian Energy Institute will attend PHYSOR 2000, the American Nuclear Society (ANS) international topical meeting, ***Advances in Reactor Physics and Mathematics and Computation into the Next Millennium***. Following the ANS meeting, he will join U.S. team members from Argonne National Laboratory to plan pipeline whipping analyses for Ignalina NPP. (Dennis Meyers, DOE, 301-903-1418; Mark Petri, ANL, 630-252-3719)

INSP
International
Nuclear Safety
Program

May 22-27 (tentative) — Kyiv and South Ukraine NPP, Ukraine

Management and Operational Safety. U.S. specialists will work with Ukrainian team members to prepare a plan for auditing radiation safety management at South Ukraine NPP. Representatives of South Ukraine NPP, Energoatom, the Nuclear Power Plant Operational Support Institute, SCIENTECH, Inc., and Pacific Northwest National Laboratory will participate. The South Ukraine audit plan and resulting audit will provide a framework and field data from which a functional area performance guide can be developed for use at all nuclear power plants in Ukraine. (Dennis Meyers, DOE, 301-903-1418; Lief Erickson, PNNL, 509-372-4097)

May 27-June 4 — Scholkino, Ukraine

Management and Operational Safety. Specialists from Ukraine's Crimea Scientific and Engineering Center and Zaporizhzhya NPP will present a training seminar on the application of procedures for event analysis and reporting. Additional personnel from Zaporizhzhya NPP will participate as trainees. The seminar seeks to provide a plant-wide understanding of procedures and improved practices for nuclear power plant event analysis and reporting to Energoatom. (Dennis Meyers, DOE, 301-903-1418; Lief Erickson, PNNL, 509-372-4079)

The Activity Report is prepared by Pacific Northwest National Laboratory for the U.S. Department of Energy Office of International Nuclear Safety and Cooperation under Contract DE-AC06-76RLO 1830.