Improving the Safety of Day-to-Day Operations

Tools, Training Reduce Risk of Equipment Malfunction

To reduce malfunctions of safety equipment at Soviet-designed RBMK reactors, the United States is supplying up-to-date tools and training for maintenance workers. None of this assistance prolongs the lifetimes of these reactors, which the United States believes should be shut down as soon as practical. The 14 operating RBMK reactors are located at three nuclear power plants in Russia, one in Ukraine, and one in Lithuania.

Infrared thermal imaging equipment helps identify hazards that could lead to electrical system failure. Now, components can be replaced before they fail.

Older models of RBMK reactors lack emergency core-cooling systems. All RBMKs are susceptible to power instabilities. The hazards posed by these design flaws can be compounded by inadequate maintenance. However, the power plants have lacked modern maintenance equipment and have had inadequate facilities and programs for training maintenance workers. To address these problems, the United States has supplied modern technologies to repair and maintain crucial valves, pipes, electrical systems, and rotating machinery. U.S. experts have trained technicians to use the tools, and the United States has provided funds to refurbish and equip maintenance training rooms.

The United States supplied the first equipment in 1996, when the Ignalina plant in Lithuania urgently needed to replace cracked piping in its two RBMK reactors. Workers lacked a machine commonly used in the United States to cut pipes precisely and prepare them for welding. Workers had been cutting pipes by hand, resulting in radiation exposure and often leading to faulty welds and leaking pipes. Within six weeks of the plant manager's request, the United States delivered a pipe lathe/weld-preparation machine to improve weld integrity, reducing the risk of leaks that could cause loss of cooling water to the reactor core. Within another three months, the United States delivered pipe lathe/weld-preparation machines to the remaining four RBMK sites—Russia's Leningrad, Kursk, and Smolensk plants and Ukraine's Chornobyl plant. By November 1997, the United States had delivered five more pipe lathe/weld-preparation machines to Ignalina for use in major cooling system repairs.

U.S. specialists have worked with RBMK managers to identify additional tools needed for rapid maintenance improvements and significant reductions in radiation exposure. Based on their agreements, the United States supplied the following equipment:

- **Valve-seat resurfacing equipment** allows workers to repair leaking valves without having to remove them from pipes. By maintaining the integrity of pipes, the equipment reduces the risk of leaks that could lead to a loss-of-coolant accident.

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Contractor EFCO USA, Inc., delivered the equipment to all RBMK sites in 1997. Ignalina technicians received it just in time for major cooling system repairs.

- **Vibration monitoring and shaft alignment systems** detect and correct imbalance and shaft misalignment in rotating machinery. Each RBMK reactor has about 2,000 high-speed pumps, some of which supply cooling water to the reactor core. When a pump is misaligned or out of balance, its bearings and seals can fail, possibly leading to a loss-of-coolant accident. In 1998, two RBMK sites—Ignalina in Lithuania and Chornobyl in Ukraine—received the vibration monitoring and shaft alignment equipment, and staff were trained in its use. The three remaining RBMK plants in Russia (Kursk, Leningrad and Smolensk) and the Smolensk Training Center will receive the equipment as soon as customs clearance is received, expected sometime in 1999. Personnel from these sites have already been trained. Equipment also will be provided to plants in Armenia and Bulgaria, as well as the Bilibino plant in Russia.

- **A thermo-mechanical training loop** was installed at the Smolensk Training Center in May 1998. The loop is a matrix of pipes, valves, pumps, heat exchangers, and controllers that together simulate the mechanical, electrical, and control-and-protection systems of a nuclear power plant. The loop provides hands-on training for a variety of technicians, including mechanics, pipefitters, electricians, instrument mechanics, welders, millwrights, and radiation protection specialists. The loop also can be used to simulate scenarios that require the various technicians to coordinate their work.

- **Insulation analysis equipment** detects breakdown of the insulation around high-voltage lines and electrical equipment, such as the transmission lines between site transformers and a plant's main generators. Detecting and correcting insulation breakdown can prevent loss of electrical power to the reactor. The loss of power is the trigger most likely to lead to severe accidents at RBMK reactors. The United States delivered insulation analysis equipment to the Chornobyl and Ignalina plants in 1998 and trained workers to use it. The RBMK sites in Russia also are scheduled to receive the equipment.

Operating RBMK Reactors

Leningrad, Russia	4 units
Smolensk, Russia	3 units
Kursk, Russia	4 units
Ignalina, Lithuania	2 units
Chornobyl, Ukraine	1 unit

The United States is supplying the following equipment:

- **Infrared thermography equipment** detects heat buildup in electrical systems, identifying hazards that could lead to equipment failure and loss of power. The United States shipped a thermography unit to Chornobyl. U.S. experts will work with plant personnel to conduct a baseline thermography survey of electrical equipment and supplies essential to safety. Technicians will receive on-the-job training while they locate wiring, insulation, and electrical connections that need repair. Technicians at Russia's three RBMK sites (Leningrad, Smolensk, and Kursk) will receive training in the use of thermography equipment in summer 1999.

- **Bolt stress analysis equipment** uses ultrasound to analyze the amount of torque on bolts that hold down valves, pumps, and turbine casings. Bolts with improper torque can shear or break loose, causing pipe flanges and other bolted connections to leak. The United States is supplying bolt stress analysis equipment to Russia's Smolensk and Leningrad plants.

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The United States is involved in additional projects to improve maintenance at RBMK reactors:

- **Maintenance information.** U.S. specialists are working with RBMK managers to improve access to maintenance information. Historically, workers at Soviet-designed plants had little opportunity to exchange information with their colleagues at other plants. U.S. and host-country experts are establishing databases of technical information for maintaining Soviet-designed reactors, including RBMKs.

- **Training facilities.** The RBMK sites have lacked adequate facilities for training maintenance workers. Through U.S. funding, each of the five sites and the Smolensk training center have refurbished and equipped facilities dedicated to maintenance training.

- **Maintenance advisory board.** In 1996, with U.S. support, RBMK managers formed a Maintenance Advisory Board to oversee the cooperative projects. The information they exchanged during meetings proved so valuable they began holding regular forums at RBMK sites, enabling maintenance workers to exchange technical information and lessons learned. These exchanges are a significant milestone in overcoming the isolation of maintenance workers at nuclear power plants.

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