Multilateral Nonproliferation Cooperation

US - Led Effort to Remove HEU/LEU Fresh and Spent Fuel from the Republic of Georgia to Dounreay, Scotland

(Auburn Endeavor/Project Olympus)

Thomas A. Shelton and James M. Viebrock
NAC International
Norcross, Georgia, USA

Alexander W. Riedy and Stanley D. Moses
Lockheed Martin Energy Systems
Y-12 Plant
Oak Ridge, Tennessee, USA

Ms. Helen M. Bird
U.S. Department of Energy
Office of Arms Control and Nonproliferation
Washington, D.C., USA

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In early March 1998, the United States Government approved a plan in cooperation with the United Kingdom (UK) and Georgian Governments to rapidly retrieve and transport about 4.3 kilograms of enriched uranium. This material consisted largely of highly enriched uranium (HEU) and a small amount of low enriched uranium (LEU) fresh fuel, as well as about 800 grains of HEU/LEU-based spent fuel from a shutdown IRT-M research reactor on the outskirts of Tbilisi, Georgia, a former Soviet Republic. A technical team lead by DOE consisted of HEU handling, packaging and transportation experts from the Oak Ridge Y-12 Plant, managed and operated by Lockheed Martin Energy Systems and spent fuel handling and transportation experts from NAC International in Norcross, Georgia, United States. The team was part of an interagency task force formed with Department of Defense military personnel under U.S. European Command and headed by a senior official from the Department of State. The operation was executed in full cooperation with the government of the Republic of Georgia and the staff at the Institute of Physics. In April of 1998, the fresh fuel was repacked in United States' supplied 6M-2R containers (USA/0002/B(U)F) and the spent fuel was repacked in the NAC-LWT cask (USA/9225/B(U)F-85). All the containers were then transported in one U.S. Air Force C-5B cargo aircraft via air-to-air refueling from Tbilisi, Georgia to Kinloss Royal Air Force Base outside Inverness, Scotland. In Scotland the fresh and spent fuel was transported north to the Dounreay Nuclear Complex west of Thurso, Caithness, Scotland for interim storage and final disposition. This successful national security project was the first time the United States teamed with a NATO partner to remove nuclear material from a site of proliferation concern.

The nuclear research reactor IRT-2000 of the Georgian Academy of Sciences' Institute of Physics achieved initial criticality in 1959 and remained operational until 1988. The IRT-2000 is a research and test reactor that was designed in the Soviet Union and has a thermal power of 2000 kilowatts (M). The reactor designation was changed to IRT-M in 1968 following "modernization" of the facility, including an upgrading of the thermal power to 8,000 M This reactor belongs to the group of light water pool-type reactors in which ordinary water (light, distilled) is used as heat carrier and moderator of neutrons and biological protection as well. A number of different fuel types were involved in the repacking operations (see Tables 1 and 2).

Table 1 - Fresh Fuel Elements

Fuel Assembly	Enrichment ^{235}U wt%	Quantity of ^{235}U per element
EK-10	10	8 grams
IVV-2	90	4.2 gram
TTR	90	4.5 grams
IRT-2M	90	2.4 grams

Table 2 - Spent Fuel Elements

Fuel Assembly	Enrichment ^{235}U wt%	Quantity of ^{235}U per element
IRT-1000	10	128 grams
IRT-2M	90	170 grams
TTR	90	410 grains

The National Security Council, answering to the Executive Branch, directed the United States' effort. The Departments of State, Defense, and Energy were directed to execute the mission. The State Department negotiated all agreements and managed the policy issues in the Republic of Georgia and in the UK. The Defense Department, through the European Command (USEUCOM), was responsible for logistics, transportation, and coordinating security with Georgia. The Energy Department was responsible for the repacking action and interface with the Georgian Institute of Physics and the UK Nuclear Industries Directorate and Directorate of Civil Nuclear Security.

The Office of Nonproliferation and National Security within the Department of Energy directed the repacking effort with support from the Oak Ridge and Oakland Operations. Oakland Operations provided the senior field manager and the Oak Ridge Operations and contractors provided the technical expertise. The technical experts were from the Y-12 Plant and the Oak Ridge National Laboratory. The spent fuel operations were conducted by technical experts from NAC International under contract with the Y- 12 Plant.

As a result of the requirements imposed upon the transport of spent nuclear fuel, as well as conditions at the nuclear facilities in Tbilisi and Dounreay, NAC International undertook several project specific activities to prepare for the upcoming shipment. These activities included a technical evaluation of the proposed spent fuel to be transported as related to the NAC-LWT cask and the design and fabrication of some special shielded handling equipment.

Evaluations and analyses were performed in support of the preparation of a Safety Analysis Report Amendment specifically for this shipment. Since NAC International typically performs all engineering evaluations and analyses in support of their transportation activities, all of this work was performed in-house in a very confidential manner. The evaluations and analyses included individual fuel assembly and total payload structural evaluations, thermal (decay heat load) evaluation, a containment analysis (releasable radionuclide inventory), a neutron and gamma source term evaluation and the criticality (reactivity) evaluations. These assessments were performed for both the normal conditions of transport as well as for the accident case, and demonstrated that the special spent fuel assemblies identified in Table 2 were fully bounded by the existing licensed payload for the NAC-LWT. Once complete, this amendment, along with the fresh fuel description, was transmitted to the U.S. Department of Energy for approval and then to the Republic of Georgia and the United Kingdom for concurrence and validation.

For more than ten years NAC International (NAC) has designed, fabricated, tested and operated a variety of dry transfer systems to transfer spent nuclear fuel from facilities with limited crane capabilities or limiting accesses and features to IAEA and USNRC licensed spent fuel transport casks. These dry transfer systems have been operated in diverse environments in the United States and throughout the world, including facilities located in Iraq and Columbia. Over the years, NAC has successfully and safely transferred well in excess of three thousand fuel assemblies using their dry transfer system equipment. Based upon information obtained from a variety of independent sources, it was determined that additional equipment would be needed to supplement NAC's versatile dry transfer system at the IRT-M reactor facility in the Republic of Georgia. This supplemental equipment was designed and fabricated to facilitate cask-loading operations in Tbilisi while utilizing NAC's dry transfer system equipment and the NAC-LWT cask. Following fabrication but before mobilization overseas, the equipment was tested in the United States to insure proper operation with the cask and all the existing equipment.

The mission was planned in cooperation with the USEUCOM, the government of the Republic of Georgia, and the UK Government. The basic mission plan required the United States to stage the various fresh and spent fuel equipment in Oak Ridge; debark from the McGhee-Tyson Air National Guard Base near Knoxville, Tennessee; refuel and collect additional assets in Germany; and embark at the Tbilisi airport. The equipment and team were transported by two, US Air Force C-5B Galaxy cargo planes. Air transport was chosen because there were no reliable land or rail routes through western Georgia. The bulk of the equipment was tied-down to three long-bed trailers and tractors supplied by the United States. Additional tractors and trailers in Georgia were contracted to transport the balance of the equipment from the airfield to the reactor and the subsequent return trip. A 70-ton crane was contracted from Georgian industries and set-up at the reactor site. The Georgian Government provided overall safety and security while the team was deployed and the weapons grade material was being moved.

On arrival at the reactor, the US team and Georgian scientists distributed the equipment to their respective areas of operations. The fresh fuel operations were concentrated near the vault located in the top floor of the reactor where the fresh fuel packages were secured. Once the vault was opened, the vault, packages, and fuel elements were surveyed to baseline the level of radioactive contamination, which was found to be very low. The Reactor Scientists and the US Specialists completed an inventory of the fuel elements and initiated the repacking operations. Each fuel element type was divided into lots that were limited to no more than 350 grams of ^{235}U. This was determined to be the safest accumulation of HEU consistent with the nuclear safety standards and the transportation requirements. Each lot of rods were weighed and accounted for. The lot was subjected to a nondestructive analysis using a high purity germanium detector to determine the enrichment and mass of the ^{235}U. The mass was compared to that declared to provide the US and UK sufficient proof of the amount of fissile material being transferred from Georgia to the UK. The lots were loaded into cans that were loaded and sealed in the U.S. Department of Transportation, 6M-2R package under the international authorization USA/0002/X. A total of 16 packages were loaded with the fresh fuel rods and elements. The fresh fuel repacking operation required 5 days to setup, walk through, repack, and teardown.

Meanwhile, the spent fuel operations were being conducted in parallel. These activities took place primarily just outside the reactor building and inside the reactor hall. Following receipt of the equipment at the site the shipping cask was prepared for loading by setting up and leveling the base plate, then upending the cask and placing it upon the base plate. The shipping cask adapter was then installed on top of the cask. Next, the transfer cask and fuel canister grapple were set up for proper operation, along with the facility transfer shield that would be loaded with spent fuel in the reactor building. Once the equipment was prepared, a dry run was performed to verify proper system operability prior to handling the highly irradiated fuel.

After authorization to proceed was given, an empty canister was placed into the facility transfer shield and the assembly was lowered into the spent fuel pool inside the reactor building. The spent fuel elements were then loaded into the canister and the transfer shield was removed from the pool and allowed to drain. The shield containing the spent fuel was then transferred outside to an area near the transfer cask and NAC-LWT. The transfer cask was used to remotely extract the canisters of spent fuel from the shield and then lower the canister into the NAC-LWT. All spent fuel operations were performed remotely using shielded equipment to minimize any radiation exposure to people in the vicinity of the operations. After the cask was loaded with fuel, shipment preparations were completed and all support equipment was packaged for transport. All operations associated with preparing the spent fuel for transport were safely completed, without incident, in only four days.

On completion of the repacking operations, all equipment, work areas, and packages were checked for surface contamination, which was found to be below allowable or nonexistent. The gear was repackaged and readied for the transfer to the airport. The fresh and spent fuel packages, support equipment, and the team were taken to the airport in a direct route under Georgian Security Forces protection. Personnel were taken to the airport hours later under escort. The nuclear weapons grade material and spent fuel were loaded onto one C-5B cargo plane and the remaining equipment and USEUCOM logistic gear were loaded onto the remaining plane. The plane with the fresh and spent fuel and the US team departed from Tbilisi on a non-stop flight path requiring two in-flight refueling operations to reach the Kinloss Royal Air Force Base east of Inverness, Scotland. The Dounreay team and the Scottish security forces were responsible for the cargo of nuclear fuels that were transported by truck to the Dounreay facilities on the northern coast of Scotland near Thurso.

Following the initial survey of the transport packages, the fresh fuel was removed from their packages and placed into temporary storage within a few days on arrival at the plant. The transfer of the spent fuel was delayed for three weeks, subject to authorization from the Nuclear Inspectorate's Office and final authorization by the Prime Minister. Once authorization was received, transfer of the spent fuel proceeded expeditiously and was completed in two days.