CHALLENGES & ACHIEVEMENTS

from

THE "OLD" MILLENNIUM

October 1999

Thomas A. Shelton
Vice President
&
James M. Viebrock
Senior Vice President

NAC International
655 Engineering Drive
Norcross, GA 30092
United States of America

Telephone: +1 770 447 1144
Fax: +1 770 447 1797

Since 1968 NAC International has been dedicated to the search for excellence through achieving safe, reliable and sometimes unique solutions to our customers' problems and needs. In furthering our commitment to excellence in customer service, we have re-dedicated ourselves to providing the best in spent fuel cycle and transportation services into the year 2000 and beyond. In order to accomplish this forward looking process, we have peered into the past and evaluated some of our challenges and achievements over the past decade.

Long before DOE's FRR Fuel Return Program was restarted in 1996, NAC was involved in sophisticated and unique research reactor transportation projects. NAC's initial foray into the research reactor transportation realm began in the mid 1980's with the Taiwan Fuel Movement Project. This project was one of the U.S. Department of Energy's major spent fuel shipping projects for the return of irradiated natural uranium fuel from a foreign research reactor to the Savannah River Site. Removing the fuel from the reactor facility at the Institute of Nuclear Energy Research required the design and fabrication of transfer equipment to adapt a transfer cask to the spent fuel shipping casks being used. This prototype shielded transfer system was designed by NAC and was used to accomplish the dry transfer. This was a semi-automated system specifically designed to minimize operator radiation exposure and to operate efficiently without significant operator input. The second significant challenge on this project was the transfer of irradiated fuel from the dry storage facility into the pool, packaging the significantly failed fuel into canisters, and then transferring the canisters into the casks for loading. This was accomplished over a two year period with everyone involved learning lessons along the way.

Fifteen spent fuel casks of three designs were used on the eight year long transportation project. Shipment was via land transfer to an ocean-going charter vessel for the overseas move, followed by land transfer from the U.S. east-coast port in Norfolk, VA to the Savannah River Site. A total of 125 loaded cask transports were completed.

The Iraqi fuel movement contract involved the removal of 209 MTR spent fuel assemblies from two destroyed research reactors and the air shipment of this fuel to a Russian reprocessing facility. This work was done under an IAEA contract with MINATOM (Russian Federation). NAC was responsible for providing the necessary equipment to remove the spent fuel (including four NAC-LWT spent fuel shipping casks to transport the fuel) and the necessary licensing documentation to support the air shipment of this material.

Because as the reactor facilities were destroyed during the Persian Gulf War, the spent fuel could not be removed from the facilities by normal means. NAC developed and supplied the necessary equipment to remove this equipment, including our second-generation dry transfer system. NAC also supplied the manpower required to perform the actual fuel removal, packaging and cask loading operations. This portion of the contract was finished one month ahead of schedule.

Since the removal operations involved air shipment of loaded spent fuel casks from Iraq to Russia, the NAC-LWT spent fuel cask had to be licensed by the Russian Competent Authority for the specific types of Russian research reactor fuel for both land and air transport. Each of the two shipments from Baghdad to Chelyabinsk involved four fully loaded NAC-LWT casks and an Antonov 124-transport plane. These two shipments were - and are to this day - the largest amount of spent fuel ever air-shipped in the world. NAC was able to prepare the necessary licensing documents within two months and obtained the appropriate Russian licenses within two additional months, all in accordance with the initial contract schedule.

During the same time period (early to mid 1990's), NAC embarked on yet another DOE support program - the Mark 42 Project. This project was a major campaign to ship highly irradiated fuel target material from Savannah River to Hanford and then to Oak Ridge. Facility modifications at Hanford and Oak Ridge were required to adapt the receipt and loading facilities to the transportation package. In fact, a facility specific cask unloading

system was developed and used to unload and transfer the irradiated material from the cask to the hot cell and storage facility. A license amendment and special cask internals were also required specifically for this project. NAC was responsible for all cask handling, loading, unloading and transportation arrangements for this project.

NAC's initial participation on the FRR program originated with the first shipment of fuel from Demokritos, Greece. This shipment involved the use of two NAC-LWT spent fuel shipping casks to transport 66 irradiated MTR fuel elements from the GRR-1 research reactor to the RBOF facility at the Savannah River Site. The shipment was performed in 1995 under DOE's Urgent Relief Program for the Return of U.S.-Origin Research Reactor Fuel. In support of this shipment, our third-generation dry transfer system was developed to allow the use of the NAC-LWT spent fuel cask at facilities with crane capacities down to 7 metric tons.

In the summer of 1995, the U.S. Nuclear Regulatory Commission (NRC) modified the Georgia Institute of Technology's Neely Nuclear Research Center reactor's operating license, authorizing the conversion from high-enriched fuel to low-enriched fuel, and granted Georgia Tech a certificate of compliance to move the highly-enriched fuel. In early 1996, NAC completed the loading and shipment of spent nuclear fuel from the Georgia Tech to the Savannah River Site. This shipment was performed to safeguard the reactor's nuclear fuel during the 1996 summer's centennial Olympiad. The shipment took place as part of DOE's RERTR (reduced enrichment of research and test reactors) program, in which the DOE replaces high-enriched fuel with low-enriched fuel. The Georgia Tech fuel transfer involved the preparation, loading and shipment of 25 irradiated MTR fuel elements from the reactor to the Savannah River Site. Further validation of NAC's dry transfer system was obtained during cask loading operations on this project.

In addition to completing the initial shipment of irradiated MTR fuel from South America (Chile and Colombia) through the Charleston Naval Weapons Station (CNWS), NAC also completed the shipment of irradiated MTR fuel from the McMaster Nuclear Reactor in

Hamilton, Ontario, Canada to the Savannah River Site. This shipment utilized the North – South U.S. overland spent fuel transportation corridor, yet another "first and only" for NAC and DOE. NAC successfully completed the transportation logistics, routing and security for this project first.

Between December 1996 and September 1997, NAC completed five shipments of irradiated MTR fuel from the Brookhaven National Laboratory to the Savannah River Site. This project was performed on an emergency basis - due to problems with Brookhaven's spent fuel pool – and was completed ahead of schedule and within budget constraints. This significant undertaking involved the use of all five NAC-LWT casks for each of the five shipments. Each multi-modal shipment was performed via truck/barge/truck over a three-day period. An extraordinary shipment planning effort was undertaken with both the enroute emergency service providers as well as the public stakeholders. NAC completed the comprehensive transportation and security plans, and no unplanned adverse conditions arose either during the cask loading phases of the project or during the multi-modal shipments. A total of 1,040 MTR assemblies were transferred to the Savannah River Site over the ten-month duration of the project.

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 grams of HEU/LEU-based spent fuel from a shutdown IRT-M Russian 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. 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 and the spent fuel was repacked in the NAC-LWT cask. 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.

A shipment of 299 irradiated TRIGA® fuel elements was made from South Korea to the United States in July 1998. This first ever FRR shipment of irradiated TRIGA® fuel was made from two facilities in South Korea to the Irradiated Fuel Storage Facility (IFSF) at the Idaho National Engineering and Environmental Laboratory (INEEL). A quite diverse compilation of TRIGA® fuel types were shipped, including aluminum and stainless steel clad standard fuel elements, instrumented and fuel follower control elements, as well as FLIP elements and failed fuel elements. Three particularly significant issues arose during this project. First, the Seoul TRIGA® facility was sufficiently degraded to require a modified piece of equipment for the transfer system. This modification allowed the safe and efficient transfer of irradiated fuel with a 2 metric ton crane capacity and normal sized door access. Successful transfer operations in Seoul confirmed this capability. Secondly, NAC safely and successfully handled, containerized and transported damaged and grossly failed research reactor fuel under the FRR program. Lastly, the west-coast port and transportation corridor to INEEL were being used for the first time. As confirmed by everyone involved, this shipment was performed under particularly critical circumstances and was deemed a resounding success for the DOE/NAC team and the FRR program.

The North Korean Fuel Project has presented very unique challenges and achievements. Under contract to DOE since 1995, NAC is supplying the specialized operations/transportation personnel, packaging containers and equipment to clean,

containerize and stabilize spent fuel from the research reactor in Nyongbyon, North Korea. This project has been undertaken as part of the United States and Democratic Peoples Republic of Korea Agreed Framework to cooperate in finding a safe method of storing spent magnox clad fuel that avoids reprocessing. Due to both safety limitations and nonproliferation concerns, an accelerated timeline has been established for the project. The radiological conditions at the Nyongbyon facility have been degraded by total fuel cladding failure as a result of storage well beyond the designed duration. The project is being accomplished under international scrutiny, complicated safety and radiological environments, and with critical schedule milestones. The initial phase of the project is nearly complete, with approximately 8,000 fuel elements safely containerized, stabilized by vacuum drying and thermal conditioning, and stored and safeguarded underwater in a manner acceptable to the IAEA.

NAC's efforts at the BN-350 site near Aktau, Kazakhstan have also been quite challenging and successful. Once again under contract to the DOE, NAC is providing both technical, field engineering and operational support to secure and safeguard plutonium-bearing irradiated nuclear fuel. This key U.S. non-proliferation project was initiated in 1997 and is the largest fuel stabilization program funded by the United States. The fuel stabilization phase is currently in progress. This involves the containerization, stabilization and storage of 3,000 fuel assemblies containing more than three tons of bomb-grade plutonium from the BN-350 fast breeder reactor. The long-term storage and transportation phases of the program are currently under review by the DOE, with decisions forthcoming during the first quarter of 2000.

Earlier this year, NAC completed the first shipment of MTR fuel from Southeast Asia under the FRR program. Using a total of five NAC-LWT casks and two IU-04 casks, a shipment was completed from Thailand, Indonesia, Philippines and Taiwan to the Savannah River Site via the Charleston NWS. Two unique challenges were presented. First, this was the first time that NAC had teamed with Transnucleaire to complete a

shipment under the FRR program. The team performed flawlessly and coordination of the work and transportation activities proceeded smoothly.

Secondly, NAC and DOE security personnel identified a serious concern. In early 1999, the likelihood of a boarding attempt while the shipment vessel was in transit in the South China Sea was deemed credible. This conclusion was based on the threat assessment conducted by the assessment team, evaluation of several maritime incidents during the previous year, and the assessment of NAC and DOE through various federal and foreign government agencies. In late January 1999, NAC was instructed to proceed with the organization and equipping of an armed shipboard security team capable of preventing the unauthorized boarding of the shipment vessel by privateers. Notification of this action set into motion the rapid development of additional security plans and specific post orders to instruct the security team on the protection strategy and physical protection elements for spent nuclear fuel in transit. In accordance with the IAEA recommendations, and using U.S. Nuclear Regulatory Commission and DOE orders and directives as guidelines, shipment specific security post orders were developed by NAC and implemented during the shipment. This was the first time that shipboard security was to be utilized during an overseas shipment by the DOE. The NAC security team was debriefed after completion of their mission. The shipboard security mission took 17 days, called on four foreign ports, and possibly prevented two unauthorized boardings of a DOE shipment on the high seas. The team and their commander maintained a high professional standard and performed their mission flawlessly.

Most recently, the second shipment of irradiated TRIGA® fuel was completed – this time from several European countries via the Charleston NWS and Savannah River Site to INEEL. This shipment consisted of spent fuel from research facilities in Germany, Denmark, Romania, Slovenia, Italy and Portugal. This undertaking was one of the more complex logistical efforts successfully completed to date under the FRR program. The inclusion of both high and low income countries, as well as both TRIGA® and MTR fuel, in a single shipment was unprecedented. Additionally, it was deemed prudent to provide

overland transport of the Romanian and Italian fuel to the port of Koper. This necessitated the transit of Hungary during the overland shipment Romania to Slovenia. The logistics of both overland shipments, the domestic shipment of spent fuel from Ljublana to Koper and the transit of the charter vessel to Koper after loading spent fuel onboard in Denmark were extremely challenging to say the least. The NAC team, including Schenker, TLI, NCS and Transnucleaire, once again stepped up and performed the task beyond most expectations.

Last but certainly not least, this shipment was also the first time the East – West U.S. spent fuel transportation corridor was utilized for a shipment of spent fuel under the FRR program. As indicated by DOE, this cross-country operation was a significant challenge for those involved. Most importantly, the cross-country portion of the shipment was completed safely and very successfully.

NAC and DOE have encountered many challenges together while proceeding down our long path in the “old” millennium. Problems have arisen, some anticipated – some not. We have worked together to implement unique solutions to our problems and we have worked together to achieve our successes. As we move forward into the “new” millennium, we will take note of our challenges, achievements and shortcomings from the past - and not only have a vision of our future, but clearly see the path.