THE MURMANSK INITIATIVE - RF: SUCCESSFUL COMPLETION OF CONSTRUCTION – NEXT STEP: ACCEPTANCE TESTING

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ABSTRACT

“The Murmansk Initiative - RF” was conceived to address Russia’s ability to meet the London Convention prohibiting ocean dumping of radioactive waste. The Initiative, under a trilateral agreement initiated in 1994, has upgraded an existing low-level liquid radioactive waste treatment facility, increased its capacity from 1,200 m³/year to 5,000 m³/year, and expanded the capability of the facility to treat liquids containing salt (up to 10 g/L). The three parties to the agreement, the Russian Federation, Norway, and the United States, have split the costs for the project. Russia conducted all construction activities at the facility. Construction is complete. Start-up testing has been completed both in manual phase and with automation controls in effect. These start-up activities have included processing of actual radioactive liquid waste from the Arctic icebreaker fleet, and incorporation of these wastes into a cementation process of Russian design. With the completion of these activities, the requirements of the tri-lateral agreement, known as the “Oslo Protocol” have been fulfilled. This paper will report on the results of the start-up testing activities in addition to the “acceptance testing” phase of the project. The acceptance testing requires the processing of 2000m³ of decommissioned submarine LLRW over a six-month time frame. This important phase of the project began on 01 October 2000. Progress of this phase of the project, including Russian licensing activities will be reported. Discussion will also report on any modifications to the proposed operational schedule for the facility. “Lessons Learned” will be evaluated and discussed, in addition to a discussion of potential follow-on activities for this unique region of the Russian Federation.

INTRODUCTION

The Project known as the "Murmansk Initiative," an ongoing collaboration between Norway, the Russian Federation and the United States of America [1], started in 1994. Cooperative design and feasibility studies were conducted from April to December 1995, when an agreed-upon scheme for the financing and construction upgrade for the facility was approved. The protocol (signed in Oslo in December 1995) between the three member nations specified financing responsibilities and called for construction evaluations at the 20, 50, 80 and 100 % completion milestones in the project. Completion of the construction phase of the project was scheduled for the first half of 1998. Under the conditions of the Oslo protocol, the construction phase includes start-up testing, now
scheduled to be completed by December 31 2000. In June 1998, a technical review team inspected the facility at Murmansk, to assess progress and to finalize plans for start-up testing.

The objective of the tri-party collaboration is the expansion and upgrade of the low-level liquid radioactive (LLRW) waste facility located in Murmansk, Russia. The capacity of the plant has been increased from 1,200 m$^3$/year to 5,000 m$^3$/year. Plant capability has been expanded to treat three different liquid waste streams: Low-salt solutions (#1); Decontamination and laundry waste, medium salt content solutions (#2); and High-salt solutions (#3). The low-salt solutions are currently treated at the facility. The upgrade project adds the capability to treat solutions #2 and #3, and will automate most of the processing with computer-controlled programmable logic controllers supplied by the U.S. to reduce occupational exposures.

The treatment plant is located at the facilities of the Russian company RTP Atomflot, in Murmansk, Russia, which provides support services for the Murmansk Shipping Company's nuclear icebreaker fleet. Except for the U.S.-supplied process control equipment, the new facility has been built completely with Russian technology.

The start-up testing will be conducted first using clean water and then using actual liquid wastes to be treated. Clean water will be used for hydro testing, and for system maintenance activities including addition and removal of sorbents. A Russian company Energospetsmontazh (ESM), a subsidiary in the Minatom system, has been contracted to carry out the start-up testing.

The September 2000 inspection showed that hydro tests had been initiated, and that the system components were watertight. Loading of sorbent columns and discharge of waste sorbent materials to waste storage tanks had been demonstrated. The Honeywell control system installation had been completed, and the final phases of the control system tests were in progress. Clean water tests of the full system using the Honeywell controllers were planned in October, after which a test operation run of 2,000 m$^3$ of was to be initiated using solution #1 that was stored on-site.

FACILITY DESCRIPTION

The final facility design and early construction phases have been described in detail in previous publications [1-3]. Solution #1, the low-salt and lower radioactivity waste, has historically been processed at the facility with filtration, sorbent and ion-exchange technologies. Because of their similarities and higher salt content, Solutions #2 (Figure 1) and #3 (containing an average of 2 g/L salt, and 10 g/L salt, respectively) are treated in the same process units, although the liquids will be treated separately.
The presence of decontamination reagents, especially complexants such as Trilon B (containing EDTA and oxalate) in solution #2, presents an additional challenge because the complexing agents must be destroyed to prevent the degradation of specialized sorbents and salt removal systems. Salt removal by electro-dialysis and electro-membrane concentrators (Unit 6) is required because discharges into the Kola Bay have regulatory maximum concentration limits for salinity (about that of freshwater, even though the Bay is salt water).

CONSTRUCTION STATUS

Piping, valves, column containers for sorbents, and specialized treatment units (electro-membranes, and electro-destructor unit) have been installed and hydro-tested manually. Physical installation of the Honeywell computer-control system, a major component of the instrumentation and control (I&C) system, was verified complete by the inspection team in September 2000. The programmable logic controller (PLC) system (financed separately under the US TIES program) experienced delays in delivery and actual installation. Initially there were problems with getting the equipment through Russian customs without paying import fees. After delivery, slight changes in process design, identified after the equipment had been ordered, required the purchase of additional
equipment. This last purchase included both Honeywell and Allan Bradley components.

Final connections of all wiring and testing of some of the control algorithms were completed as of September 2000. Training of Murmansk technical personnel (also included in the contract) on the use and maintenance of the PLC systems is completed, as well. However, two algorithms of the software still had not been installed and tested.

The cement solidification system, funded separately from the main project, has yet to be completed. This system was not part of the original agreement, but was funded by Norway after it was determined that Russian waste disposal regulations mandated that the brines and spent sorbents, from the treatment process, could only be disposed of after being solidified in cement. The start-up testing described below will result in the generation of a small quantity of waste that will be stored in tanks on-site. Clearly, the facility will not become fully operational until the cement system is completed and approved by the regulatory authorities. This completion and approval is expected by the Spring 2001.

START-UP TESTING

As defined in the Oslo protocol, the “construction phase” ends when the Acceptance Testing is completed and approved. Acceptance testing includes treatment of actual radioactive waste solutions. This means that the project will not be considered complete and the facility “open for business” until Acceptance Test have been conducted successfully.

The initial start-up testing consisted of pressurizing individual unit and piping systems using water and air. These were conducted as each unit was completed, essentially to check for leaks in welds and for valve operability. Single- and multi-unit tests were conducted manually. Subsequent start-up tests with water and the PLC system fully in operation were initiated in September 2000, and completed in October. This last set of tests also included addition of sorbent materials to and their removal from the sorbent columns. There were some problems associated with the unloading of spent sorbents from the columns. This problem was remedied by using an “ejector” design from the Mayak facility. Complex (whole system) tests with radioactive solution #1 were initiated after this, as part of the Acceptance Testing phase. The use of solution #1 (low salt liquid waste from icebreaker operations) represents a first stage in the expansion of the facility, since these solutions had been treated routinely prior to the initiation of the project. Testing of Solutions #2 and #3 were scheduled for December 2000. It is expected that this work will be completed during the Spring 2001.

A January 9, 2001 update from the Russian partner (ICC Nuclide/RTP Atomflot), indicated that successful testing has been performed on the main facility using radioactive simulants. These simulants had the following characteristics:

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>specific activity</td>
<td>$10^{-8}$ Ci/l</td>
</tr>
<tr>
<td>salt content of dialyzate for desalting</td>
<td>13.7 g/l</td>
</tr>
<tr>
<td>salt content of the brine</td>
<td>9 g/l</td>
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</table>
The Murmansk Initiative, under the Oslo protocol, also has a phase of continuing partner involvement after the Acceptance testing phase. Under the post-construction phase (also called test operation phase), the US/Norwegian teams will continue monitoring operations at RTP Atomflot until the treatment of 2000 m$^3$ of liquid waste has been successfully demonstrated.

**APPROVAL PROCEDURES**

A “State Commission,” consisting of representatives from all involved Russian authorities and organizations and headed by Minatom has approval authority. In order to obtain approval for “test operation,” RTP Atomflot has to prepare reports documenting the test results for each unit in the facility and submit them to the State Commission. Based on the reports and site inspections, the State Commission gives its approval to RTP Atomflot to start “test operation”. Approval may be conditional, in that there may be requirements or restrictions that have to be addressed during the test operation phase. There may also be additional requirements before RTP Atomflot gets final approval to start normal operation.

In addition to the State Commission approval, RTP Atomflot needs an operating license from GOSATOMNADZOR (GAN, the Russian Radiation and Safety Authority), and an expanded discharge license from Murmansk Environmental Committee. At present the facility has a discharge limit of 2000 m$^3$/year.

**CONCLUSIONS**

The project known as the Murmansk Initiative was one of the first examples of civilian, tri-lateral cooperation involving Russia. The project has fostered cooperation between different Russian organizations and authorities, and between governments. Western methods of project management, with close project follow up, including quality control and quality assurance, are being adapted to Russian methods. In the process, the Russian authorities are gaining an appreciation for Western methods of applying environmentally acceptable technologies. Western participants, in turn, have learned more about innovative treatment technologies developed by Russia.

Other cooperation projects may have been finalized more quickly, but starting at a later date, lessons learned from this project have been a benefit to other projects. Especially on the Russian side they now have a much more organized structure than was the situation in 1995.

There have been and will continue to be many challenges to overcome. Cultural differences and the continuing funding problems have tested all parties' patience and professional and technical skills. However, the fact that there is a common goal and vision shared by all parties has meant that work continues to progress and is rapidly nearing completion.

The treatment facility in Murmansk will play an important role in the treatment of the
liquid radioactive wastes generated during the dismantling of decommissioned nuclear submarines.

REFERENCES

