BNL-67301

THE MURMANSK INITIATIVE – RF: COMPLETING CONSTRUCTION AND START-UP TESTING*

Carl Czajkowski and
Biays S. Bowerman
Brookhaven National Laboratory
Upton, New York

Robert S. Dyer
U.S. Environmental Protection
Agency
Washington, DC

Anita A. Sörlie
Norwegian Radiation Protection
Authority
Østerå, Norway

Dennis Wester
Pacific Northwest National
Laboratory
Richland, Washington

* This work was performed under the auspices of the U.S. Environmental Protection Agency

The Murmansk Initiative - RF: Completing Construction and Start-up Testing

Carl Czajkowski,[1] Biays S. Bowerman,[1] Robert S. Dyer,[2] Anita A. Sörlie,[3] and Dennis Wester[4]

[1]Brookhaven National Laboratory, Building 830, Upton, NY 11973.
[2]US Environmental Protection Agency, 401 M Street S.W., Washington, DC 20460.
[3]Norwegian Radiation Protection Authority, PO Box 55, N-1345 Østerås, Norway
[4]Pacific Northwest National Laboratory, Richland WA 99352

ABSTRACT

"The Murmansk Initiative - RF" was instigated to address Russia's ability to meet the London Convention prohibiting ocean dumping of radioactive waste. The Initiative, under a trilateral agreement, will upgrade an existing low-level liquid radioactive waste treatment facility, increasing capacity from 1,200 m^3/year to 5,000 m^3/year, and expand the capability 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. All construction has been provided by Russia. Construction of mechanical systems (piping and valves, pumps, sorbent columns, settling tanks, surge tanks) is nearly complete, with instrumentation and control (I&C) systems the last to be installed. Delays to the I&C installation have occurred because changes in system specifications required some additional U.S.-supplied computer control equipment to be purchased, and clearance through customs (both U.S. and Russian) has been slow. Start-up testing has been limited to testing of some isolated sub-systems because of the delays in I&C installation. Final construction activities are also hampered by the current state of the Russian economy. The specific impact has been completion of the cementation unit, which was not funded under the trilateral agreement (but funded by the Russian government). Russian regulatory authorities have stated that final licensing for expanded capacity (5,000 m^3/year) will not be given until the cementation unit is on-line.

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. Co-operative 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 during 1999. 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 trilateral collaboration is the expansion and upgrade of the low-level liquid radioactive waste facility located in Murmansk, Russia. The capacity of the plant will be increased from 1,200 m^3/year to 5,000 m^3/year. It will also be expanded so it can 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 upgraded 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, 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 with Russian technology.

The June, 1998, site inspection showed that there was a significant amount of construction remaining in electrical and in instrumentation and control (I&C) systems. All equipment had been purchased and was either on-site (about 90%) or in transit to the site. Approximately 85% of mechanical equipment (piping and valves, pumps, sorbent columns, settling tanks, surge tanks) had been installed. Installation of much of the I&C systems had yet to be done. A major element of the I&C systems, computer-controlled programmable logic controllers (supplied by Honeywell) had been delivered, but installation was delayed. Changes in system specification required ordering additional components, and clearance through customs (permission to export from the U.S. and passage through Russian customs) has taken longer than expected.

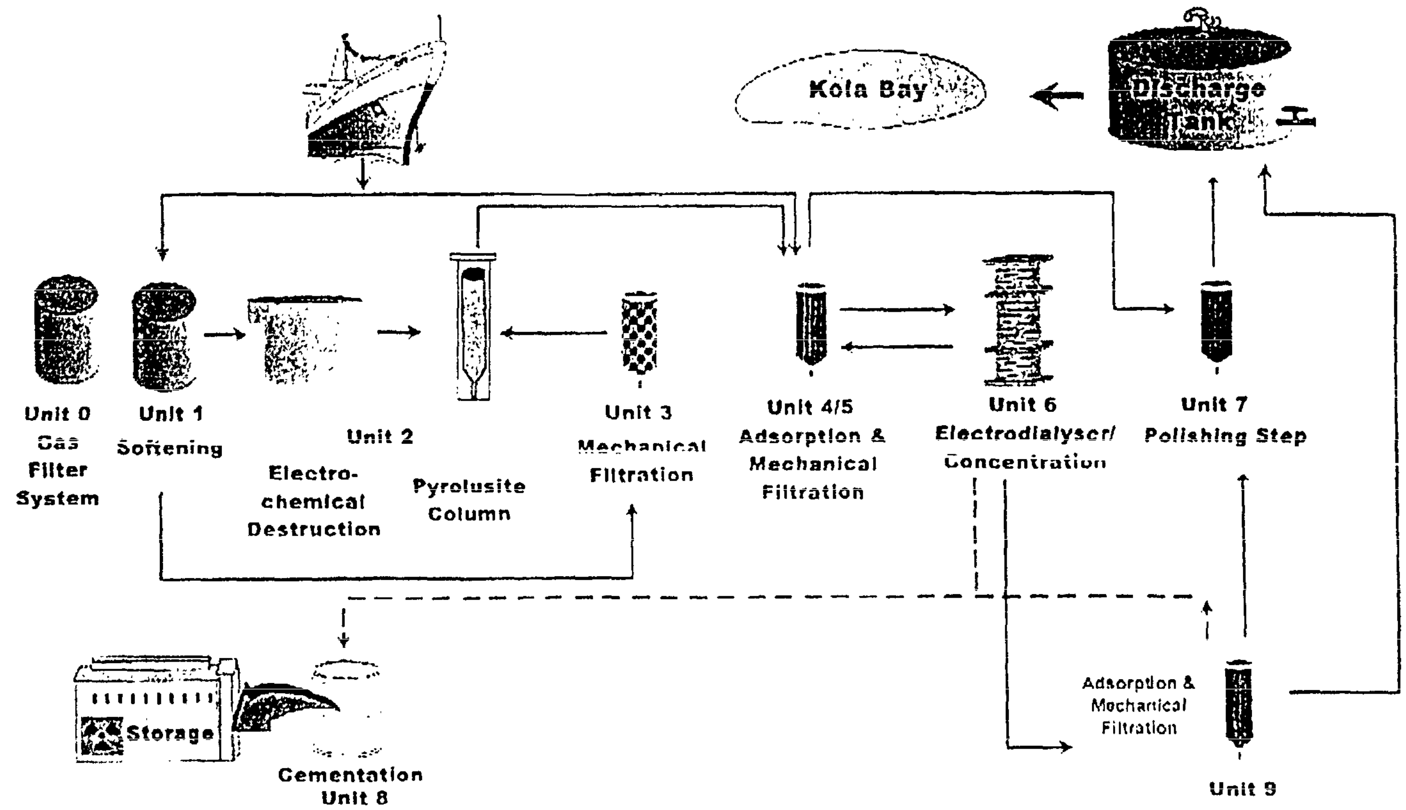
The start-up testing will be conducted using both clean water and actual wastes to be treated. Clean water will be used for hydraulic testing, and for system maintenance activities including addition and removal of sorbents. A Russian company, Energospetsmontazh, a subsidiary of Minatom, has been contracted to carry out the start-up testing together with RTP Atomflot, which is expected to last about 3 months.

As with each inspection meeting conducted to date, new obstacles to completion appeared. In this case, funding from the Russian government was not available to complete the cementation unit in the facility. This has final licensing implications. In addition, continued construction activities have been affected by the difficulties resulting from the problems with the overall economy.

FACILITY DESCRIPTION AND CONSTRUCTION STATUS

The final facility design and early construction phases have been described in detail in previous publications [1,2]. A schematic process diagram (Figure 1) illustrates the facility components and the process scheme to be used for one of the waste types to be treated (solution #2). 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, Solution #2 (containing an average of 2 g/L salt) and Solution #3

Decon/Salt Water (Solution #2) Treatment Scheme



EPA ASPECT bnl

Figure 1. Schematic representation of process steps for Solution #2

(containing 10 g/L salt) are treated in the same process units, although they will be treated separately. This is because decontamination reagents, especially complexants such as Trilon B (containing EDTA and oxalate) are also present in Solution #2. EDTA and oxalate present an additional challenge because, if their concentrations exceed 1 mg/L and 2 mg/L, respectively, they will degrade some of the specialized sorbents and the salt removal systems. Salt removal by electro-dialyzer and electro-membrane concentrators (Unit 6) are 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). (Figure 2 is a photograph of the installed electro-dialyzer units.)

One of the last major pieces of the processing system, the Unit 2 electrochemical destructor, was installed after the June inspection. (A photograph of installed unit is shown in Figure 3.) This unit will destroy the organic complexants by electrolysis, which also produces hydrogen gas as a by-product. Because of this feature, the need for and design of this unit were reviewed carefully to assure that safety requirements were met, and that projected facility treatment capacity would still be achieved. To meet facility capacity requirements, the operating parameters for the unit, which is an adaptation of a commercial hypochlorite generator, were modified from a recirculating "batch" mode to a once-through process. Immediately downstream is a catalytic bed composed of pyrolusite, to complete the destruction of EDTA and oxalate. Process requirements limit EDTA and oxalate to maximum concentrations of 1 mg/L and 2 mg/L, respectively. Hydrogen gas generated in the process is diverted to the off-gas system and mixed with air to below explosive limits, passed through a HEPA filter, and vented.

The I&C system installation has progressed since the June inspection. Wiring and motors for motor-operated valves are in place. Cable runs to switching and control points are nearly done. However, installation of the computer-controlled PLC system, a major component of the I&C system, only recently started. The PLC system was paid for separately under the US TIES program, and delays in the delivery of the PLC system occurred initially because there were problems with getting the equipment through Russian customs without paying import fees. In additions, slight changes in process design, identified after the equipment had been ordered, required the purchase of additional equipment. These items were identified specifically at the June inspection meeting, and ordered immediately. Delivery of the additional equipment is scheduled for January 1999, after a (delayed) US export license was obtained. Additional delays to initiating installation (which was included under the original contract) are the result of assigning responsibilities and finalizing the logistics of installation by a U.S. company through a Russian subsidiary located in Moscow at the facility in Murmansk. Training of Murmansk personnel (also included in the contract) on the use and maintenance of the PLC systems must also be organized and completed.

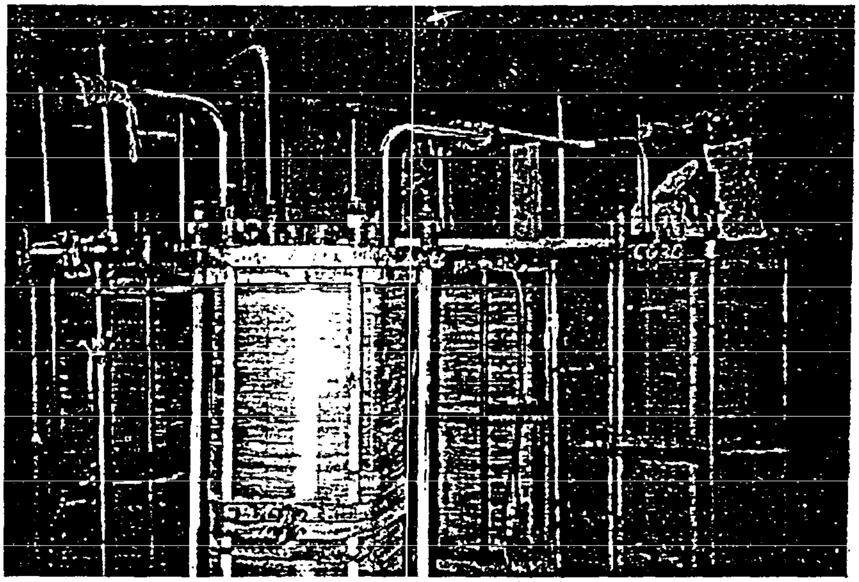


Figure 2. Photograph of installed electro-dialyzer unit for salt removal (Unit 6)

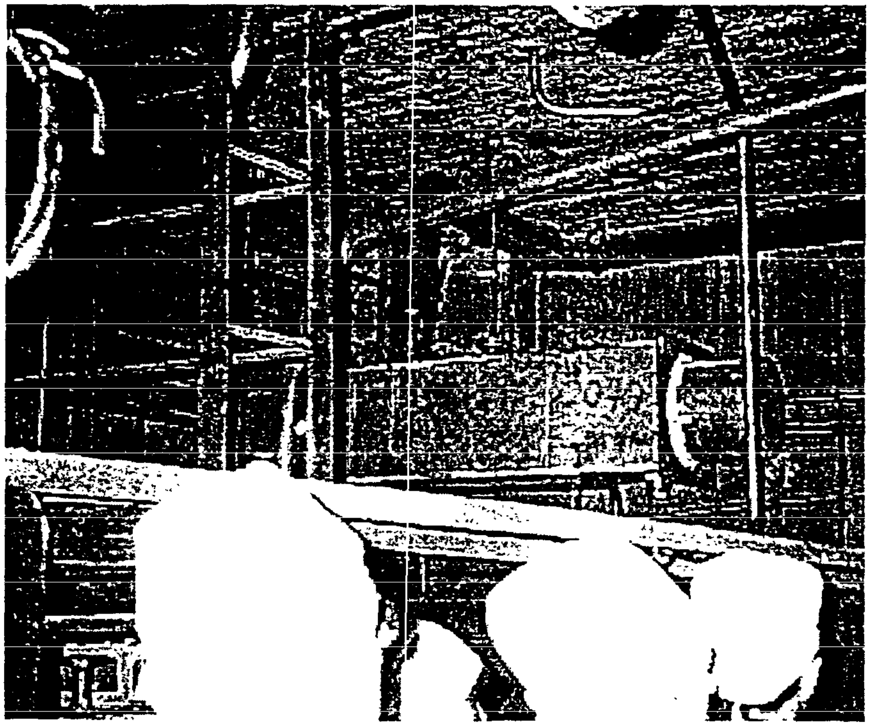


Figure 3. Photograph of installed electrochemical destructor (Unit 2)

START-UP TESTING PLAN

Financial support from the Russian central government has essentially disappeared, forcing a halt to completion of the cementation unit (Unit 8) at the facility. In spite of the financing problem (see more details below), and because of their commitment to initiating operations as soon as possible, the Russians proposed a graded approach to start-up at the June 1998 inspection. Their proposal involved starting processing before the cementation unit was finished. The cementation unit, because it was to provide a solid product as a final waste form of secondary waste from the treatment process, was a necessary component to Russian regulatory approval of the process for upgrade to 5,000 m^3/yr.

The Russian-proposed graded approach will consist of testing and using the facility to treat all three waste solutions as originally planned, but without the cementation unit. Since the cementation unit was to be used to solidify brines resulting from the desalination of solutions #2 and #3, the brines will be diverted to tank storage until the cementation unit becomes available. Other wastes, such as spent sorbents, will also be stored in smaller tanks constructed for this purpose. The proposed quantity of liquids to be processed was limited to a total of 2,000 m^3 per year, or the upper limit of the current treatment license. It was stated that the facility could operate for as much as a year and a half under these conditions, before tank capacity was reached.

The start-up plan for testing treatment systems consists of three stages: individual unit and piping systems tests using non-radioactive liquids. These will be conducted as each unit is completed and becomes capable of being tested, and is essentially a physical check for piping leaks and valve operability. As noted earlier, Energospetsmontazh (ESM), a Russian subsidiary company of Minatom, has been contracted to carry out this stage of testing. ESM was said to have extensive experience in conducting start-up activities at other Russian nuclear facilities. At the June inspection meeting, ESM presented a draft plan and procedures for their activities at the Murmansk facility. However, all ESM testing will be limited to non-radioactive testing.

Testing with radioactive solutions will be carried out once all systems have been certified for operability, and it is expected that actual waste solutions will be used for this testing stage. It was noted at the June meeting that some radioactive systems testing would be carried out by the Institute of Physical Chemistry, which had a large part in designing and constructing the micro-filters and the electro-destructor unit (Unit 2). Otherwise all radioactive testing will be carried out by Atomflot staff.

MORE LESSONS LEARNED

Financing has been the more significant issue in the last year. At the June inspection meeting, the Russian project managers pointed out that completion of the construction phase of the project was impossible without additional funds. In addition financing is needed to cover completion of the cementation unit, on which work had stopped because Russian government funding had dried up. Local regulatory authorities stated unequivocally that final licensing to 5,000 m^3 capacity would not be approved without cementation capability. As found in earlier stages of the work, continuation through the end of this work requires a strong commitment to finish. The additional funding requirements will be met by Norway. The finalization of the cementation unit will be done as a separate "new" project between Norway and Russia.

One lesson continues in different forms. The complexity of project monitoring (not quite as rigorous as project management) from a distance of 5,000 km and over eight time zones continues to be challenging. Previously, finding out about and reviewing facility and process design changes in a timely manner proved difficult. The most recent element involves the US-supplied computer-controlled system and PLC components. These had to be ordered and manufactured specifically for the facility, and a subsequent design change added approximately 5% to the cost of the equipment. Installation and training were included in the contract, but arranging this aspect of the work has been troublesome. The Russian project managers for the Murmansk project have had discussions with the Russian Honeywell subsidiary, which helped develop specifications for the system, but the contract principals are BNL and Honeywell, USA. Thus, scheduling installation and training has been difficult. Installation began in December, 1998, and, as a result, the start-up testing program has been affected.

CONCLUSIONS

The project has fostered co-operation 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, and in the process, the Russian authorities are gaining an appreciation for Western methods of achieving environmentally acceptable technologies.

There have been and 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.

The Murmansk Initiative is an introduction to other more important projects within Russia. This project is important because it represents one of the first waste management construction projects in the north-west of Russia with foreign partners. When it is operational, the Russian Federation will be able to comply with the current prohibition on dumping of low-level nuclear wastes. Additionally, the completion of a similar plant in the Far East of Russia will allow the Russian Federation to sign the amendment to the London Convention.

The treatment facility in Murmansk will be able to handle waste from the northern navy and will play an important role in the treatment of the liquid radioactive wastes to be generated during the dismantling of decommissioned nuclear submarines. While it is a civilian plant, its military use makes this project of special interest for the Norwegian and US partners and for future co-operative projects with the Russian Federation.

REFERENCES

[1] Dyer, Robert S., et al, "Low-Level Liquid Radioactive Waste Treatment at Murmansk, Russia: Technical Design and Review of Facility Upgrade and Expansion," Brookhaven National Laboratory, BNL-52505, July, 1996.

[2] Sörlie, Anita A., et al, "Low-Level Liquid Radioactive Waste Treatment at Murmansk, Russia: Facility Upgrade and Expansion," Proceedings, Waste Management '98, Tucson, AZ