NORWAY, RUSSIA AND THE USA IN COOPERATION TO IMPROVE THE SITUATION REGARDING RADIOACTIVE WASTE IN THE NORTHWEST OF RUSSIA

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ABSTRACT

The Murmansk Initiative in the Russian Northwest was one of the first construction projects with foreign participation. Not only technical problems, but also many others had to be solved including barriers due to different languages, cultures and working methods; financial issues, e.g., how to transfer money to Russia on a tax-exempt basis; and communication (when the project started our Russian partners did not have e-mail). With a time difference of up to 11 hours, effective communication methods are of great importance. The cost and time scales were too optimistic and were not understood in enough detail when the project started. For example, the project was focused around the treatment plant and equipment needed for it, but it turned out that it was necessary to construct new rooms in the existing building (a house in the house). For this, additional time and money were needed. During these five years of close cooperation many lessons have been learned that can now be used to the advantage of other projects.

INTRODUCTION

Today Norway cooperates actively with Russia and collaborates with several other countries e.g., the US, the UK, Sweden, Finland, France and the European Commission, to improve the environmental situation in the Northwest of the Russian Federation. Large amounts of radioactive waste and spent nuclear fuel are stored in this area, often under unsatisfactory conditions. The lack of equipment and waste treatment methods is also a concern.

In 1994 Norway together with the US started discussions with RTP Atomflot and Murmansk Shipping Company about a joint project to expand and increase the capacity of the low-level liquid radioactive waste (LLW) treatment plant at the RTP site. At that time the plant treated ~1200 m³/year of liquid waste from the nuclear icebreaker fleet. The project goal was to increase the capacity to 5000 m³/year and also expand the treatment options to deal with two more types of liquid waste. This includes high-salt liquid waste coming from the Russian
Northern fleet. Building this facility and a similar facility in the Russian Far-East will give Russia the technology and capacity needed so they will not start dumping LLW at sea again and can sign the London dumping convention.

THE DESIGN PHASE

During the design phase in 1995 (1) the Russian technology and design were discussed and evaluated by US and Norwegian experts. In December a Protocol was signed to start the construction phase. The construction phase was expected to be 18 months. The US and Norwegian financial contribution to Russia was set at a total of 1.555M USD.

THE CONSTRUCTION PHASE

The design upon which the “Oslo protocol” is based was only a basic design. After the decision in December 1995 to proceed with the construction phase, the Russian side started working on the detailed design and drawings and plant layout. During this work some design changes were made. Equipment (units) was added. Some units were combined. The original plan to use totally separate lines for all three types of solutions had to be changed because of space and financial considerations. Now solutions #2 and #3 will use the same line (same units) but not at the same time. To the US and Norwegian teams, making such substantial changes after the design was supposedly finalized was quite unexpected. But apparently in Russia it is not uncommon to work like this.

At RTP Atomflot a small (~1200 m$^3$/year) treatment plant already existed. The intent was to place the new and upgraded facility in the existing buildings. It soon turned out that new construction was needed and some significant changes to the existing buildings had to be made in order to incorporate all needed equipment. New rooms were built by splitting existing rooms into smaller ones by constructing new walls and floors/roofs. This part of the new facility is now a 4-story building (12 m high) within the existing structure. The new plant was installed in existing buildings to make the plant cost-effective.

Besides ordering and manufacturing of equipment in 1997-1999, the Russian side also continued construction work during most of this period. Additional construction was necessary due to some changes in the legislation and regulatory basis of the Russian Federation that were made for the purpose of securing safety warranties. Passage of Russian federal laws on radiation safety (NRB-96 and NRB-99), nuclear power uses, ecological evaluation, and civil codes with stricter requirements necessitated revisions in documentation, equipment, and certain categories of the construction in order to comply with existing statutes. Since this was not anticipated in 1995, the project was delayed beyond the originally estimated completion date.

According to the “Oslo protocol,” the construction phase includes all activities up to Acceptance Testing, which covers hydraulic testing, start-up testing with water and with real waste solutions, and also “complex testing”. The test procedures are described in more detail in another paper (2).

THE POST-CONSTRUCTION PHASE

The post-construction phase will include approximately one year of test operation of the plant. During this time radioactive waste solutions from marine installations will be
processed. Attention will be paid to the input and output parameters of the solutions so that the efficiency of the decontamination process can be evaluated. Adjustments will be made to the equipment so that the most effective operating mode can be established.

BRIEF EQUIPMENT DESCRIPTION

The treatment plant consists of 10 units that include mechanical filters; columns with sorbents for Sr and Cs, ion-exchangers, and catalysts; an electrochemical destruction unit; electrodialysers and electroconcentrators; and a cementation unit. The decontaminated water will be discharged (after monitoring) into the Kola bay. Some of the secondary waste generated will be cemented for later final disposal.

The mechanical filters are basically sand filters. Ultrafiltration is accomplished with the use of Krapukhin filtering elements (FEK) (3) in combination with perlite to reduce the size of particles that can be filtered. Sorbents include a zeolitic type material for Sr and a nickel-ferrocyanide-based sorbent for Cs. Ion exchangers are typical anion and cation exchangers. The catalyst is composed of MnO$_2$ for the removal of products from the electrolytic decomposition of water containing various amounts of salt. The water and salt are decomposed during operation of the electrodestructor, which converts organic impurities to inorganic molecules that do not interfere with the removal of Sr and Cs. The electrodialysers reduce the amount of ionic species (mostly Na$^+$ and Cl$^-$) in the processed solution by producing streams with higher and lower contents of ionic species. The more highly concentrated solution is then fed to the electroconcentrator, where it is further concentrated to brine and process solution, which is combined with the less concentrated solution for further processing. The cementation consists of storage bins, a mixer, and containers for setting of the monoliths. The individual equipment items, except the PLCs, are all products of Russian technology. Some of the processes are also new and innovative.

PROJECT MANAGEMENT

The “Oslo protocol” defines the project structure.

Lead Project Organizations (LPO)
From the US: EPA; from Norway: NMFA; from Russia: Murmansk Shipping Co.

Technical Lead Organisations (TLO)
From the US: BNL; from Norway: NRPA; from Russia: RTP Atomflot/ASPECT

Technical team
The joint US/Norwegian/Russian Technical team constituted for the design phase continued to provide technical review during the construction phase. The team included members from BNL, NRPA, PNNL, Raytheon Engineers & Constructors, and VNIPLET.

One of the first enhancements of project management was made on the Russian side when in June, 1996, they established a “Project Management Group” (PMG) consisting of members from Russian authorities and involved organizations. Minatom joined as the leader of the group and ensured that both the Russian people and European countries had safety warranties at a higher level. ICC Nuklide played the role as the project leader and the contact point between Norway/US and Russia. RTP Atomflot has the technical lead. The US/Norway had an observer at the Russian PMG meetings that were normally held once a month.
This new structure on the Russian side was a “big step forward” because terms such as “project leader” were previously difficult to explain to the Russian organisations. Each Russian organisation intended to have a project leader.

ICC Nuklide became involved because the US and Norway recognized the need to find a way of sending money to Russia under tax-exempt status. Soon ICC Nuklide also played the role as the Russian project leader.

FINANCIAL ISSUES

Transfers

ICC Nuklide was introduced to the parties at a meeting in Moscow in April, 1996, by Minatom. They could provide assistance with money transfers to Russia. The US and Norway chose different ways of transferring money. The US used the Soros foundation and later the Civilian Research and Development Foundation (CRDF). Norway chose to send the money via normal bank transfer. To be able to do this, an agreement of cooperation between NRPA, RTP and Nuklide had to be made. This agreement had to be approved by several Russian organisations, a procedure that took about two months. After the agreement was signed, Nuklide could use the agreement to get a license from the Russian state bank that allowed them to receive foreign money (hard currency) in their local St. Petersburg bank. This exercise is an example of unexpected work that had to be done by the Norwegians. In the agreement the amount of money to be transferred is defined so an amendment had to be written and signed by the parties for any additional money for the project from the Norwegian side. However, even this approach during the initial stages required certain efforts (and time) to further refine legal questions of providing financing for the project with privileged taxation. At that time, Russian legislation granting a tax exemption for foreign assistance directed toward the solution of environmental issues had not yet been passed (becoming effective in May, 1999).

Once this procedure had been established it worked well. Delays due to money transfer were avoided. However, the financial resources available for the project were not always sufficient to pay promptly for the work. Therefore, to make the process even more effective, a larger sum than that due the Russian side for work completed was transferred to Nuklide’s account. However, the Russian side could release the money only after approval from NRPA. The experience gained by Norway and Russia during the Murmansk Initiative-RF has been very beneficial in financing other projects, eliminating many difficulties and saving much time.

Money releases have been based upon monthly Progress Reports (PR) in which the work done; equipment ordered, received or installed; and the costs for these (including the cost for upcoming equipment purchases) were described. Nuklide sent the PRs to NRPA and BNL for review and approval for money release. NMFA and EPA, respectively, then transferred or released the money.

Budget

All three parties shared the cost for the project. The original budget was a total of 1.55M USD from the US and Norway to be sent to the RF. The original Russian contribution was
equal to those of the US and Norway. This did not include the cost for the participation of US and Norwegian experts. The original budget was based more on available funding than on a detailed cost estimate. As mentioned above, the project became larger in scope and more complicated than first anticipated. In 1997, it was evident that more money was needed. The project had started with a comparatively very small budget. However, the general crisis in the Russian economy in 1998 and the issuance of NRB-96 with stricter radiation protection levels (the walls in the facility had to be thicker) increased the cost. It was therefore decided at the 50%-meeting in November, 1997, that the US and Norway would finance the project with an additional total of 750,000 USD to the RF partner. The cost to the US and Norwegian sides for participation of their experts was in addition to this.

The cementation unit (that will cement secondary waste from the process) was not included in the financing from the US/Norway. The Russian side announced their intention to assume the financial burden for this. The cementation unit was a part of the facility but was held outside of the tri-lateral project. In June, 1998, the US/Norway teams were informed that the Russian Ministry of Transport did not have enough money to finalise the construction of the cementation unit. After some discussion, it was decided that Norway would finance the cementation unit and that it would be a separate Norwegian-Russian project. The financial contribution from Norway to Russia was approx. 213,000 USD.

At this time it was also evident that the Russian side did not have enough money to continue/finalise the construction and the start-up testing. Based on their budget proposal, an additional 313,700 USD was needed. At this time no additional US money was available so Norway financed the full amount. Also at this time the most important thing was to have a successful completion of the project. The Norwegian side preferred to give the additional financial contribution instead of risking having another Russian “ghost” facility. But Norway clearly stated that this would be the last financial contribution. The Russian project leader was tasked to come up with a realistic budget proposal at this time that would cover everything needed to finalise the construction phase.

In March, 2000, the Russian side informed the Western partners that additional financing was needed. Based on the new NRB-99, the Murmansk environmental committee had given RTP new and additional requirements (for analyses of tritium in the wastewater). Based on the test results, some minor changes were necessary in the facility. The US and Norwegian sides agreed to pay (USD 23,500) for this equipment. Other requests for money for equipment not directly connected with environmental monitoring were denied. The Russian side was able to find the funds for these items.

Nevertheless, when Minatom joined the PMG in 1996, Russian governmental budget means were attracted to the project. For example, the project was included in the target federal program Russian Management of Radwaste and Spent Radioactive Materials, Their Treatment and Disposal, 1996-2000. It became one of the highest priority environmental projects implemented in the Russian Northwest. Being aware of the great importance of the problem to tackle, Minatom was gradually increasing the financing for some years. The initial 1996 Russian input was declared to be 3 M Russian rubles (RuR). That amount was doubled in 1997. As of December, 2000, the total contribution by Russia was 10.2 MRuR (over $1.4M taking into account the exchange rates).

Despite the fact that the budget of the Murmansk Initiative-RF is rather small compared with those of similar projects, the Russian side with financial support from the Kingdom of
Norway and the USA was able to build a facility comparable in capacity with other LLRW treatment facilities that were built with foreign assistance. This emphasizes that not only funds but also the enthusiasm and recognition of the importance of the problem to be solved stimulated the project.

LESSONS LEARNED

Cultural differences were responsible for all sides entering into the project with different expectations of when work would be completed, how financing would be arranged, and what level of documentation was necessary. Language barriers arose frequently, especially for monolingual participants who did not have the luxury of expert translators, but also for multilingual participants in those cases where all involved interpreted terminology differently. Finally, work ethics vary considerably around the world. This was quite evident shortly after the project started when all sides vocalized their expectations about what the pace of progress should be. In this respect it was important to establish a stable US/Norway team so that all members would utilize their experience on the project to formulate realistic expectations of the rate at which work could be completed. Furthermore, the close working relationships that are important to the Russian side developed comparatively slowly on this project for some as yet unknown reason.

Collaborative construction projects at Russian nuclear sites were virtually nonexistent at the time that the Murmansk Initiative began. Several construction projects were initiated subsequent to the Murmansk Initiative, in particular, under the auspices of US-government programs. However, the Murmansk Initiative is distinguished by an overall cost that is as much as an order of magnitude less than some other construction projects that are considerably smaller in scope. The costs for the project were held to a minimum mainly through the use of Russian subcontractors and suppliers. Foreign partners limited their efforts mainly to evaluation of construction progress, review of unit design, and verification of equipment orders and purchases.

Financial transfers require close cooperation between Russian and foreign partners. The role of ICC Nuklde in facilitating these transfers was essential to the success of the project. Initial attempts to transfer funds from foreign sources to Russian entities were cumbersome and time-consuming. The US side was successful in identifying the CRDF as an organisation through which funds could be transferred to Russian organisations. However, the transfer of funds requires not only a transferring organisation in the US but also a receiving organisation in Russia. Nuklde was ideally suited for this purpose after contracts were signed and recognised by the Russian tax authorities.

Communications must be effective and reliable. At the start of the project, only fax machines were available to the Russian side. Even these did not always provide the reliability needed to manage the project. The level of interaction between the Russian side and the Western partners was greatly enhanced when the Russian side acquired access to electronic mail. These electronic means of communication are especially important owing to the considerable differences in time at points in the Russian Northwest, Norway, and the east and west coasts of the US.

Regular joint meetings were critical to the success of the project owing to the great distances involved. Thus, formal review meetings were held at the beginning of the construction phase and at the 20, 50, 80, and 100% completion points. These meetings involved a thorough
review of progress achieved compared with the total estimated level of effort required to complete the project. In general, the three sides produced different estimates of the degree of progress achieved and discussed the data upon which their estimates were based in order to arrive at a mutually acceptable value. In addition to the formal review meetings, several additional technical meetings were held so that the Western partners could be kept updated on the progress of construction, receipt of ordered equipment, and results of facility testing.

Full-time presence at the RTP site of a US/Norway representative could perhaps have shortened some of the delays that were encountered. This method of collaboration has been employed on some other joint projects, e.g., the Zvezdochka project, and may be responsible for the rate at which this project was completed. However, the situation is somewhat clouded by the fact that Western technical personnel and equipment were used extensively on this project. In any case, the Western partners have the distinct feeling that some of the delays caused by miscommunication or lack of current data could have been avoided if a representative had been stationed full-time at the construction site. Unfortunately, the cost of supporting Western personnel in Russia is relatively expensive. Funds for this have not been available and were not provided within the project structure from the beginning. It has therefore been decided to finalise the project based on the original structure, even if this may not be the most effective way of conducting cooperative projects in Russia.

Project management systems differ greatly in the three different countries. The US side is familiar with a very detailed system in which the project scope is well defined, the schedule provides details for each task and subtask, and the budget is closely linked to the completion of work. The Norwegian system is similar with greater facility to accommodate changes. The Russian system of project management seems to be quite flexible, with a broadly defined scope, a very ambitious or perhaps even unrealistic schedule, and a high level of uncertainty in the budget owing to fluctuating exchange rates and volatile economic circumstances. Western partners contemplating collaborative construction projects with Russian organisations would be well advised to start with a well defined scope, resist any attempt to agree with “scope creep,” and provide reserve funding to cover any contingencies that will undoubtedly arise during the course of the project.

Documentation in the Russian system shares some similarities with Western systems. The initial design contains detailed drawings and specifications for equipment and facilities. However, it is common to incorporate engineering changes into the design documentation as construction proceeds. Thus, the initial design provides a framework upon which to initiate construction but evolves into an “as-built” during the actual construction. Design documents must be approved by the architect-engineer organisation, the owner of the site, and the appropriate regulator, in addition to other bodies. Testing documentation contains detailed procedures for conducting tests and is approved by the same organisations. A source of concern during the construction phase was the unfamiliarity of the Western partners with the Russian method of documenting the ordering and purchasing of equipment and supplies. For equipment purchases, the Russian side often orders the equipment based on the “first design” and then keeps in contact with the manufacturer regarding design changes and adjustments.

Licensing and regulatory requirements present a separate set of considerations. First, the regulatory system of Russia is still evolving after the break up of the Soviet Union. Although the structure of the regulatory system is essentially the same as the one that existed under the Soviet Union, it changes often and sometimes in unanticipated ways. For example, the issuance of new radiation safety standards during the course of the project necessitated
thicker walls in the facility and, consequently, higher costs for construction of new walls. In addition, new standards made it necessary to monitor both incoming and outgoing waste solutions for tritium. This required the purchase of modern radioanalytical equipment that can perform these analyses. The project was several times affected by new or changed Russian requirements. The project has been going on over several years, during which the Russian legislation was constantly under evaluation and development. Of course these issues must be addressed. However, it surely impacts both the project schedule and financing. The question can be asked, “How much should new requirements affect ongoing projects?”

CONCLUSION

The Murmansk Initiative-RF is one of the most important large-scale international projects being implemented in the Arctic region with foreign participation. Despite the economic difficulties, it has produced not “paper mountains” but a tangible stationary facility (essentially a plant for treating LRW). The facility provides a base for establishing a LRW treatment centre in the Russian Northwest. In combination with other facilities that were completed or are being built, this facility is a technical prerequisite for fulfilment by Russia of the regulations of the London Convention.

The first meeting in Murmansk in 1994 that started discussions of the possibility of initiating this project was held a long time ago. However, it should be remembered that substantial development and change in Russia and also in the cooperation between Russian and Western partners have occurred during this period. During this period several forums have been established, for example, the Contact Expert Group (CEG), to facilitate the cooperation with Russia. Multilateral agreements have been established so that work does not start from the ground up all over in each project. The NRPA-RTP-Nuklide agreement signed for this project has been a model for subsequent projects. In 1998, an intergovernmental agreement between Norway and Russia was signed. This represents a big step forward concerning liability. This project is covered under that agreement.

Many struggles have been overcome. Compared with other projects of this type, the Murmansk Initiative is a low-budget project. Funding restricted considerably what could be accomplished. Much closer follow-up on site is recommended for the future.

The experience of most westerners involved with construction projects in Russia suggests that the process is not easy and is often slow. For the Russian partners, the scrutiny of Western methods on their own territory is invasive and confusing.

The Murmansk Initiative has been going on for about 6 years. This is a relatively long time period. All involved parties did not expect that it would take this long. But all the time there has been a common goal and understanding that the project will have a successful completion.

The involvement of western parties also during full acceptance testing with real waste solutions is contemplated. However, the budget will remain low when compared with other projects. Therefore, the longer timeframes required to complete the Murmansk Initiative are understandable. In addition, this project is bigger in physical size than the others.

All involved parties have learned many lessons on this project. These lessons can be used on other important and bigger projects that address the environmental situation in the Russian
Northwest. Many problems that arose were dealt with for the first time. The countries participating in the project implementation used the lessons learned to find a shorter way to solve financial, managerial, and technical tasks. The project has been a forum where experts of the Kingdom of Norway, the RF, USA, and Great Britain have the opportunity to gain knowledge from the experience and achievements of the partners, to recognise more fully their responsibilities for the safety of future generations, and to combine efforts, funds and scientific potential for the improvement of the environmental situation. Thus, damage to the environment in Russia and beyond its borders by radioactive contamination can be held to a minimum by effective implementation of assistance programs. Successful completion of future projects can therefore have an effect on human health and life.

REFERENCES


(3) V. B. Krapukhin, “Filtering Element Krapukhina” [FEK], USSR Pat. No. 1,834,679 (1990)