

**EQUIPMENT CERTIFICATION FOR RUSSIAN LOW LEVEL RADIOACTIVE WASTE VOLUME  
REDUCTION FACILITIES AT ZVEZDA AND ZVEZDOCHKA SHIPYARDS**

By:

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**ABSTRACT**

U.S. and Russian strategic dismantlement of weapons of mass destruction included decommissioning and dismantling Russian Delta-class nuclear submarines. Limited nuclear waste processing and storage facilities in the Northern Fleet and Far East, however, could not support the dismantlement effort. The U.S. Defense Department's Low Level Radioactive Waste Volume Reduction projects were designed for processing radioactive wastes generated by submarine dismantlement at two Russian shipyards in compliance with international environmental and safety standards. Low level radioactive waste streams from submarine dismantlement included solid and liquid wastes. The treatment systems included specialized components from Europe and the United States. In addition to regulatory approvals for the design, construction, and operation of the treatment systems, these imported components also required certification for use in Russia.

The certification of foreign equipment for these facilities was one of several complex regulatory challenges which was obscured by an evolving regulatory environment. Existing international agreements waived the customs licensing and tariff requirements and thereby obviated the need to certify the foreign components prior to shipment to the shipyards. Certification of selected major and minor components, however, was still required onsite prior to system operation. The certification of components involved both "nuclear" and "non-nuclear" equipment. Nuclear equipment was classified by the Russian Federation nuclear regulatory body Gosatomnadzor as either Category III (related to safety and requiring rigorous nuclear certification) or IV (not safety related). Non-nuclear equipment, such as forklifts, was certified in accordance with consumer and labor safety standards issued by Gostandart. The dynamic nature of the Russian certification process required constant interaction and negotiation between project staff and regulators. This constant interaction helped navigate the complex certification process under an aggressive schedule, often using processes and procedures for the first time.

Final certifications are expected to take place after installation in some cases, but before system "hot" tests are conducted. The methodologies and generalized procedures used in this project are timely, have set a precedent for certification of components for nuclear facilities in the Russian Federation, and could be used successfully on other planned, or future, joint U.S.-Russian nuclear waste projects.

**INTRODUCTION**

Radioactive waste management in the Russian Federation (RF) poses great challenges. Two separate LLRW volume reduction facilities were planned respectively at the Zvezda (Star) and Zvezdochka (Little Star) facilities in the Far East and Northern Fleet areas of the Russian Federation, as part of the U.S.-Russia agreements on the strategic dismantlement of weapons of mass destruction. Low level radioactive waste streams destined for these new facilities included solid waste, decontamination and mixed wastewater, primary loop wastewater, bioprotection wastewater, and laundry wastewater.

The submarine service plant, Zvezda is located at the city of Bolshoi Kamen, 35 km east of Vladivostok. Zvezda was founded in 1954 as a dock for warships and submarines, and has historically been responsible for refueling, repairing, and decommissioning of nuclear submarines (Bradley 1997) (1). The Zvezdochka facility is one of two shipyards located at Severodvinsk, 35 km west of Arkhangelsk. Zvezdochka is one of the largest naval yards in Russia, has been operational since 1936, and nuclear submarines were both built and serviced there. A 1992 decree established the Severodvinsk shipyards as the main centers for decommissioning nuclear submarines.

The U.S. Cooperative Threat Reduction (CTR) program, was developed to help the countries of the former Soviet Union destroy nuclear, chemical and biological weapons of mass destruction and associated infrastructure, and

establish verifiable safeguards against the proliferation of those weapons. The U.S. Defense Threat Reduction Agency (DTRA) consolidates and streamlines the management and implementation of the CTR program. The subject LLRW project was conceived by DTRA in 1997. It was planned as a 13-month effort to design, construct, and license the facilities that reduce LLRW from dismantled Delta Class submarines. The Zvezda project was aimed at volume reduction of solid and laundry water wastes, and the Zvezdochka project was aimed at volume reduction of liquid, solid, and contaminated laundry water wastes. The systems were to have a minimum 7-year operational life. The methodologies and generalized procedures used in certification of specialized LLRW equipment have the potential to be used successfully on other planned, or future, joint U.S.-Russian nuclear waste design-build projects.

## **CERTIFICATION OF FOREIGN-MADE EQUIPMENT**

The technical approach for the LLRW project called for segregation, size reduction, decontamination, and low-force compaction to achieve volume reduction goals for solid wastes. Liquid waste would undergo filtration, selective sorption, reverse osmosis, and direct precipitation. Sorbents were already employed in Russia at Murmansk, some technologies were ISO 9000 compliant, and/or equipment was considered to be “low technology.” Therefore, negotiating the complexities of licensing and permitting in the RF system were expected to be favorable. Permitting and licensing of the subject LLRW facilities are the theme of Abstract #31, Paper #3 in the Waste Management 2000 Conference Proceedings.

Not all of LLRW equipment and components were Russian-designed or Russian-made; this alone required the foreign equipment to have certification in Russia. All of the non-Russian equipment was declared by the Ministry of the Economy (MinEcon) to be exempt from customs duties, tariffs, licenses, and certifications, based on RF Regulation 39, Customs Directive 01-14-990, and MinEcon and its predecessor organization agreements and confirmations. The legislation and agreements were based on international nuclear weapons disarmament treaties. Foreign components also did not require certification prior to consignment to the shipyards, because of these existing international agreements.

The certification of non-Russian equipment and components involved “nuclear” and “non-nuclear” categories. Foreign supplier companies hailed from Estonia, France, Georgia, Germany, Kyrgistan, Lithuania, Ukraine, USA, and, Uzbekistan. Attention was paid to suppliers who could provide non-nuclear equipment that had the required Russian certifications. Some non-nuclear items, including heavy equipment such as forklifts, were certified in accordance with consumer and labor safety standards issued by Gosstandart, the GOST-R standards. Non-nuclear equipment included laboratory supplies and appliances, data management systems, waste tracking systems, tools, containers, plumbing fixtures, power supplies, and the like. Laboratory, data management, plumbing, and electrical components were generally acceptable in the RF as a result of ISO 9000 compliance and prior certifications. Issues related to certification of non-nuclear equipment were avoided or delayed until system qualification testing.

Certification of foreign nuclear equipment, however, became an obscure regulatory challenge that was complicated by an evolving statutory environment. A new RF approach to both certification and accreditation was outlined during meetings in April 1999, held with GAN and the newly formed joint certification center, ATOMCERTIFICA (Figure 1, see figures at the end of paper). The Working Body, Certification Bodies, and Commission of Experts were not expected to be in place until the end of calendar year 1999, and the approach appeared to be a complex dispersal of funding to organizations which would not hold to any schedule discipline. Assurances were made that this was the correct process, and complete information regarding each piece of equipment was requested in order to begin the application process.

In June and July 1999, Factory Acceptance Tests (FAT) were conducted on three pieces of non-Russian equipment, including the low force compactor (fabricated at Tech Oil Products), the waste transfer box (fabricated at Container Products Corporation), and the sorting box (constructed at SGN/AMCI). The FAT were primarily intended to assure that:

- Units were designed and manufactured to specifications
- The compactor would successfully compact the waste forms, and achieve specified volume reduction and throughput efficiencies

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- The waste storage box would successfully mate to the sorting box and allow its contents to be transferred to the sorting box
- The sorting box and associated tools could be used to successfully receive, segregate, size reduce, and package the waste forms
- Industrial safety and radiation control devices such as interlocks and survey meters worked

A second element of the FAT, however, included an expert panel of Russian representatives to evaluate the design, manufacture, and operation of the units. This assessment activity supported certification of these components. The expert panel was able to ensure compliance with applicable Russian industrial safety and radiation protection requirements at the point of manufacture, and presumably recommend the elimination of the testing process for certification. The acceptability of the equipment in Russia and at the shipyards also rested, in large measure, on the approval of the units during FAT.

Certification packages for the critical nuclear components were assembled at approximately this time. Exhaustive sets of specifications and designs were provided in anticipation of what was hoped would be a lesser set of documents required for maneuvering through the process. As an example, the certification package for the low force compactor included the following information in great detail:

- Operation Manual Maintenance and Trouble Shooting Guide (9 engineering drawing packages of schematics and parts lists)
- Engineering Data (structural analyses; engineering drawings for various US certifications)
- Parts Lists (electrical; hydraulic; HEPA filter assembly; mechanical)
- Engineering Drawings (9 packages for general arrangements; erection procedure package; 8 packages for electrical systems; hydraulic schematic package; 23 structural packages)
- Main Electrical Parts Specifications (12 parts description packages)
- Hydraulic Parts Specifications (12 parts description packages)
- HEPA Parts Specifications (4 parts description packages)
- Other Electrical Parts Specifications (4 parts description packages)
- Applicable US Codes and Regulations:
  - OSHA 29 CFR, Chapter 17, Section 1910.147
  - ANSI Z245.2, Part 4; Z245.2, Part 4.1; Z245.2, Parts 5.1, 5.2, 5.3, 5.4; Z245.2, Parts 7.1, 7.2, 7.3, 7.5, 7.7, 7.8, 7.9; AWS D1.1
  - NFPA70 and NFPA79
  - NEC Article 430-71 and Article 670-2
- Certification Steel (10 steel certificate packages)
- Spare Parts List (recommended lists for electrical; hydraulic; mechanical; and HEPA assembly)
- Consumables Parts List
- House Test Program
- Test Report
- Installation Manual (installation manual; master list of nuts, bolts, and connections; eight engineering drawings)
- On Site Test Program

Similar documentation packages for several other critical pieces of equipment were assembled as well. Since the certification process was ill-defined, and the certification of selected major and minor non-Russian components would be required prior to system operation, certifications now became a high profile, critical path activity, and was given a great deal of scrutiny and attention by the LLRW Project team. A generalized LLRW project Nuclear Equipment Certification Process for non-RF equipment was conceptualized (Figure 2) to be assured that nothing was omitted. Nuclear equipment was classified by the Russian Federation nuclear regulatory body Northern European Gosatomnadzor (SE GAN) as either Category III (related to safety and requiring rigorous nuclear certification) or IV (not safety related and having a less rigorous certification process). As late as September 1999, LLRW Project specialists were led to believe that almost all components would be classified as Category IV, non-safety related nuclear components.

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U.S. manufactured air flow meters were purchased late in the project. The subcontractor responsible for installation believed that certification in Moscow was required before shipment could be made to the site. The Zvezdochka Chief Metrologist, however, ruled that in accordance with their current practice, airflow devices should be registered in each shipyard's metrological center. All questions about the certification of these devices would be resolved after mounting them according to the technical specifications of the instruments and approved design documents. The metrological center of each shipyard would decide whether certification was necessary, based upon the presumed accuracy of the air flow meters during operation of the system. This regulatory ruling was confirmed by the Moscow Metrology Institute (VNIIMS). The instruments were shipped directly to the sites without occurrence.

The majority of foreign nuclear equipment either had prior certification, or did not require testing prior to delivery. The reviews of equipment by SE GAN indicated that the documentation submitted for review was satisfactory, that certification was assured as Category IV, and its approval for use in LLRW systems was deferred until system qualification testing on-site. However, in October 1999 five pieces of nuclear equipment were identified by SE GAN as nuclear safety equipment, Category III. These components, including the compactor, sorting box, drum dryer, drums, and the high integrity container (HIC), required a more rigorous review. Issues related to certification of the remaining non-nuclear equipment were avoided or delayed until system qualification testing.

### **NUCLEAR SAFETY EQUIPMENT CERTIFICATION**

Equipment that SE GAN considered critical to ensuring nuclear safety was classified as RF Category III nuclear safety equipment, and was required to undergo a nuclear equipment safety review as a part of the certification process. All previously assembled documentation for Category III equipment was provided to the newly formed Joint Certification Centre, ATOMCERTIFICA. ATOMCERTIFICA is a review coordination center created by MinAtom and GAN (under the supervision of Gostandardt) for the purpose of combining and expediting the equipment certification process, in this case Category III nuclear components (Figure 3). Historically, Gostandardt was the predominant standard setting body for all regulations applicable to equipment certification, and did not recognize MinAtom guidance or regulations. The LLRW project was, therefore, likely to be a true test of the joint collaboration on certification, and the LLRW project team was motivated to foster a very close dialog with the responsible individuals at ATOMCERTIFICA.

The ATOMCERTIFICA equipment reviews continued well into the construction phase of LLRW project, and ATOMCERTIFICA was not able to provide a specific completion date for any phase of its reviews. Because ATOMCERTIFICA was newly formed, there was no previous experience to gauge how long the combined review process would take. In addition, it was not clear whether the testing laboratories would require trials or inspections. On-site certification was discussed with the regulators, and anticipated in lieu of pre-shipment testing however. The equipment was ultimately shipped in anticipation that no interference with the systems qualification tests or final acceptances would occur. If testing was required by ATOMCERTIFICA, it would have to be performed on site. An additional issue regarding pressure gauge certification was raised. It was not clear whether components, including these gauges, required certification, apart from the French-built sorting box unit to which it was attached. The sorting box was one of the major Category III units already undergoing a certification review. The issue was resolved when the head of the RF Instrumentation Standards Society determined that instrument gauges, such as those found on the sorting box to indicate pressure and verify the hermetic qualities of the box, were considered to be "secondary equipment," or "complementaries." Complementaries did not require certification apart from the equipment to which it was attached. The head of the Certification Centre at the Metrological Institute (VNIIFTRI) concurred with this assessment, with the exception that gauge calibration may be required by the local or regional GAN for each shipyard. Other possible complementaries were thought to include hand tools, power tools and air filtration for the sorting box. Calibration or testing would, again, be performed on site.

In November 1999, ATOMCERTIFICA approved the documentation for the compactor, sorting box, drums, and HIC. The detailed design documentation previously assembled for each component was appended to relevant sections of the LLRW Project Working Design (Volume 2 Process Engineering Concepts; Volume 4 Safety Provisions; Volume 8 Equipment Specifications). The "Decision on Certification Procedure" was signed by GAN as a result of this approval, and was transferred to MinAtom for its approval. These actions authorized the formation of the expert review commission by the State Laboratories. Their review was expected to take 45 days. Documentation for the Drum Dryer was submitted a little later, but still included in the decision.

## **CONCLUSIONS**

The methodologies and generalized procedures used in this project for equipment certification for a nuclear facility in Russia are timely, and could be used successfully on other planned, or future, joint U.S.-Russian nuclear waste design-build projects.

Russian Federation regulations regarding foreign equipment certification for the LLRW Project, and other such undertakings, are unstable and evolving. The focus of certification of non-RF equipment associated with treatment of LLRW resided with several supervising bodies including Customs authorities, GAN, MinAtom, and GosGorTechNadzor. The legislation and agreements were based on international nuclear weapons disarmament treaties with the RF Ministry of the Economy. Foreign components did not require certification prior to consignment to the shipyards, because of these existing international agreements.

Equipment certification for LLRW facilities was complicated, and involved coordination of multiple activities undertaken within a newly formed joint entity in Russia. The exhaustive and detailed documentation provided to the regulators was the principle vehicle for eliciting and securing regulatory approval by GAN. Approval of the WD included independent reviews of the design for nuclear radiation safety by expert organizations licensed to review nuclear projects. Approval also included review of the projects by panels of experts in evaluating the environmental impacts of the proposed activities. Approval of the designs would not have taken place in such expedited fashion without constant interaction and coordination between designers and a broad array of local and federal entities.

Attention was paid to suppliers who could provide non-nuclear equipment that already had the required Russian certifications. Some non-nuclear equipment, was certified in accordance with consumer and labor safety standards issued by Gosstandardt, the GOST-R standards, and others were deemed generally acceptable in the RF as a result of ISO 9000 compliance and prior certifications. Certification of nuclear equipment was more complicated, and five pieces of equipment were classified as RF Category III nuclear safety equipment. These five items required a nuclear equipment safety review as a part of the certification process.

Overlapping, conflicting, and evolving regulations were recognized by many organizations and officials in the RF, which allowed those officials some latitude in making decisions. As the new Joint Certification Centre ATOMCERTIFICA, had time to grow and develop, project personnel fostering close personal relationships which kept the certification process moving. On-site certification was discussed with the regulators, and anticipated in lieu of pre-shipment testing. The equipment was ultimately shipped with the expectation that no interference with the systems qualification tests or final acceptances would occur, and any required testing would be performed on site.

## **FOOTNOTES**

- (a) Lockheed Martin Environmental Services, Las Vegas, Nevada
- (b) Booz-Allen & Hamilton, Inc., McLean, Virginia
- (c) Booz-Allen & Hamilton, Inc., Moscow, Russia
- (d) Association ASPEKT, Moscow, Russia
- (e) State Unitary Enterprise All-Russian Design and Research Institute for Complex Power Technology, VNIPIET, St. Petersburg, Russia

## **REFERENCES**

- (1) D. J. BRADLEY 1997, "Behind the Nuclear Curtain: Radioactive Waste Management in the Former Soviet Union." Edited by D. R. Payson, Battelle Memorial Institute. Battelle Press 505 King Avenue, Columbus Ohio, 716 pp.



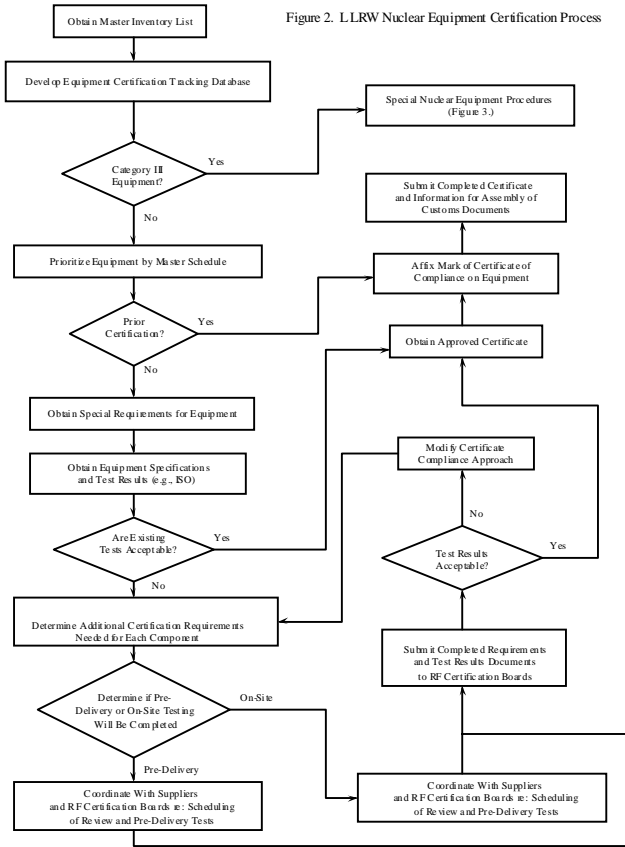


Figure 3. Current GAN Nuclear Certification Process for Category III Equipment

