Radiation Monitoring at FGUP Atomflot and the Polyarninski Shipyard

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ABSTRACT

The Arctic Military Environmental Cooperation (AMEC) Program is a cooperative effort between military establishments of the Russian Federation, United States and Norway to reduce potential environmental threats from military installations and activities in the Arctic and enhancing the environmental security of all three countries. The goal of this project is to enhance the ability to effectively and safely perform radiological monitoring of objects at selected facilities for dismantlement of nuclear submarines and handling and disposition of spent nuclear fuel. Radiological monitoring is needed to protect workers at the sites engaged in dismantlement of nuclear submarines, the local public and the environment. This is to be accomplished by supply of radiation monitoring equipment and the installation of centralised radiological surveillance, the PICASSO Environmental Monitoring system developed by Institute for Energy Technology, Halden, Norway. The first site selected for the installation of PICASSO will be at the FGUP Atomflot spent nuclear fuel pad site and liquid radioactive waste treatment facility. This will be followed by an installation of PICASSO at the Mobile Processing Facility at Polyarninski Shipyard. The implementation of the PICASSO system will be integrated with the other AMEC projects at both sites. Plans are being developed to implement the use of this system at most Russian Navy sites handling spent nuclear fuel. Dosimeters have been supplied by the US and with funds from Norway. This equipment will be used at the Polyarninski Shipyard.

I. INTRODUCTION

The Arctic Military Environmental Cooperation (AMEC) program is a co-operative effort between military establishments of the Russian Federation, United States and Norway to reduce potential environmental threats from military installations and activities in the Arctic. The collaboration was initiated 26 September 1996, and it encompasses five radioactive waste program areas (spent nuclear fuel, liquid waste, solid waste volume reduction, solid waste storage, radiation monitoring and personnel safety) and two non-radioactive waste program areas (remediation technologies, clean-ship technologies).

This paper presents the results and current status of the cooperative efforts in the area of radiation monitoring (AMEC Program Area 1.5). The goals are to enhance and improve the technical means of the Russian Navy for measuring and controlling radiation exposure of personnel, local population and the environment at sites involved in decommissioning and dismantlement of nuclear submarines and handling and disposition of spent nuclear fuel (SNF) and radioactive waste (RW). This is being accomplished by the supply of radiation monitoring equipment for shipyard personnel, and the development, demonstration and installation of an automated centralised radiological monitoring system based on the software package, Picasso. The system is being installed at the Polyarninski shipyard and FGUP Atomflot, and integrated with other AMEC projects at both sites. Details on the radiation monitoring equipment will be described in the oral presentation and are described elsewhere (1-2).

II. PICASSO-AMEC ENVIRONMENTAL MONITORING SYSTEM

The software package Picasso, developed by the Institute for Energy Technology (IFE), OECD Halden Reactor Project, in Norway, is a data presentation and visualization software which is well suited when large amounts of data are to be stored, transferred to a user interface and presented graphically in real-time in a user-friendly and flexible manner. More information on the Picasso software and its applications can be found at the website http://www.ife.no/picasso.

The Picasso software is used at IFE's research reactor in Halden to monitor radiation parameters in the reactor hall, the storage for SNF and experimental parameters from the reactor core. This application was demonstrated to Russian Naval officers in September 1998. Subsequently, a trilateral decision was made to initiate a project for application of Picasso at Russian facilities that handle military-related SNF and RW. The project was approved in February 1999.

IFE programmers developed a prototype system for presentation of radio-ecological data, called the Picasso-Environmental Monitoring System. Russian Naval officers and programmers from the Nuclear Safety Institute of the Russian Academy of Sciences (IBRAE) received training at IFE, and the software was transferred from Norway to Russia in September 1999.

Russian programmers and technical experts at IBRAE adapted the software to the Russian language and modified the system for use at naval bases. An operating model of a measuring unit, a working model, was developed, which includes terrestrial and underwater gamma detectors, smart controllers, radio-modems for off-site transmission of data, software for data acquisition and processing coupled with the Picasso-Environmental Monitoring System. The sensors are of Russian manufacture; a gross gamma terrestrial sensor based on the gas-discharge counter SI-22G and a submersible underwater Cesium Iodide (CsI) scintillation detector. The system was installed at local computers, workstations and a centralised server at IBRAE and demonstrated to the AMEC principals and senior officials from the Russian and Norwegian Ministries of Defence and the U.S. Department of Defense on 14 August 2000. The overall management of the Project on the Russian side is carried out by ICC Nuklid.

III. RADIATION MONITORING AT FGUP ATOMFLOT

The system will be first installed at FGUP Atomflot, the service base for the nuclear icebreakers north of Murmansk (See Figure 1). FGUP Atomflot is also involved in preparing SNF for transportation by rail and receiving, processing and temporarily storing liquid and solid RW. Picasso will receive data from two facilities at this base: an SNF cask storage pad and a liquid RW treatment facility.

AMEC Project 1.1-1 has successfully completed the design, fabrication, testing and certification of a dual-purpose transport/storage cask for handling SNF from decommissioned Russian Navy submarines, the TUK-108/1 cask. An interim storage pad for up to 19 such casks containing naval SNF is to be commissioned at this site in June 2003. AMEC project 1.1-1 is discussed elsewhere in this conference (3).

The liquid RW treatment facility located at FGUP Atomflot has been modernised and upgraded by a U.S., Norwegian and Russian project, "The Murmansk Initiative". This resulted in an increased capacity to treat liquid waste from about 1200 m^3 per year to 5000 m^3. The existing radiation monitoring system at this site has passed its useful operating lifetime. Development and installation of a new automatic environmental monitoring system is highly needed to detect elevated levels of radiation and decrease the response time if a problem should arise.

The scope of the Picasso monitoring system at this facility includes the SNF storage pad and the liquid RW processing facility. The current plans include terrestrial gross gamma sensors at the SNF pad, the SNF cask trans-shipment point, and the liquid RW treatment facility; aerosol detectors in the ventilation exhaust pipes; and a submersible water activity sensor in the sewage discharge pipe. An important advantage of the system is that it can easily be expanded with additional sensor types and/or locations at a later time.

The conceptual design has been finalised and a Norwegian-Russian contract for development of the detailed technical design and installation was signed in February 2002. The technical design was completed October 2002. An important milestone was reached 11 October 2002, when the contracts for the installation were signed. Norway and the US will jointly fund this installation at a total cost of $ 400,000. The installation is to be completed in the summer of 2003, followed by a six-month trial operation period.

IV. RADIATION MONITORING AT POLYARNINSKI SHIPYARD

The Polyarninski Shipyard is situated in Polyarny, a town of 25,000 inhabitants, north of Murmansk in the Kola Bay. The shipyard carries out maintenance work on laid up submarines as well as service of nuclear submarines that remain in service and has necessary equipment for refueling and dismantling naval reactors. Solid radioactive waste at the shipyard is placed in containers and stored in an open pad area, which is full. Liquid radioactive waste is stored in floating tanks at the quay. The shipyard dismantles first generation nuclear submarines. Plans to dismantle decommissioned submarines in the Northern Region have been delayed due to lack of infrastructure and financing for the management of radioactive waste and spent nuclear fuel.

Leakage of radioactive contaminants to the environment is possible at any of the following main stages of the dismantlement process:

- Floating storage of decommissioned nuclear submarines;
- Defueling, storage, and transportation of SNF and RW;
- Draining of primary coolant waters from reactors;
- Dismantlement of contaminated equipment;
- Dismantlement of nuclear submarines; and,
- Interim storage of three-compartment blocks with reactors afloat (without SNF).

The shipyard has been designated as the recipient of an integrated radioactive waste management installation (abbreviated PPP RAO from the Russian language) as a combination of several AMEC projects. The PPP RAO elements include the Picasso system for radiation monitoring, the mobile pre-treatment facility for solid radioactive waste, a set of hydraulic metal cutting tools, containers for transport and storage of solid waste, and a waste storage facility. The PPP RAO elements are described elsewhere (4,5) and again in this conference (6).

The current radiological control system at this site is primarily limited to field measurements with hand-held detectors. The technical proposal for installation of the automated radiation monitoring system at the Polyarninski Shipyard was completed in the autumn of 2001. The system will provide remote stand-alone radiation monitoring with presentation of the data in real-time with the option of comparison with historical data. Alarm limits will be defined. The computer network will consist of servers, working stations and sensor concentrating units. Eight gross gamma air detectors and one submersible detector are planned, including one gross gamma detector in the City of Polyarny.

The system design includes gross gamma sensors at the open pad for interim storage of solid RW, at the piers where submarines are laid up awaiting dismantlement, at the floating tanks with liquid RW, at the floating docks where submarines are dismantled, at the entrance gate, and at the Radiation Safety Department building. The submersible sensor for water radioactivity is planned in the sewage discharge pipe from the PPP RAO installation. This position is beneficial for the integral assessment of the shipyard's impact on the water environment. The exact placement of the detectors in the vicinity of the PPP RAO installation will be decided when the final design and the exact layout of the installation has been approved. The next step is to initiate U.S. and Norwegian contracts with the Russian contractor for the installation phase.

V. DOSE ASSESSMENT FOR WORKERS AT POLYARNINSKI SHIPYARD

The aim of the project is to improve the Russian Navy's technical capability for radiation control and measurement of doses to personnel directly involved in dismantling nuclear submarines at Polyarninski Shipyard. The project was approved in October 1997, and Russian technical experts in October 1998 provided a prioritised list of equipment. The equipment includes both electronic and TLD-based dosimeters. The US has provided 107 self-reading DD-100 dosimeters, dosimeter batteries and computer for storing and processing the dosimeter readings. Norway and the Russian Navy have co-funded the purchase, installation and test operation of Russian-manufactured TLD-dosimeter system including dosimeters, a calibration- and measuring- unit (KID-08S). The dosimeters use TLD-580T and TLD-400 thermo fluorescent sensors and are designed to measure absorbed gamma and beta radiation by human soft tissue. The manufacture of the dosimeters was completed in May 2002 and the dosimeters are now in the possession of the Polyarninski Shipyard. At the Shipyard the operators have been trained in operation and maintenance of the instruments and a program for test operation has been developed.

VI. CONCLUSION

The increased rate of decommissioning and dismantlement of Russian nuclear submarines has created the need for improved radioactive waste management and radiation monitoring in northwest Russia. The AMEC Program addresses these needs through the development and implementation of the Picasso automated radiation monitoring system, integrated with AMEC radioactive waste management projects at two of the sites for handling and storage of spent nuclear fuel and radioactive waste, the Polyarninski shipyard and FGUP Atomflot. Installation of the Picasso system for automated radiation monitoring will ensure safe operation and early warning if accidents or off-normal situations occur, thereby enabling immediate emergency actions to be taken.

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