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Title: KrasMAS: IMPLEMENTATION OF A NUCLEAR MATERIAL COMPUTERIZED ACCOUNTING SYSTEM AT THE MINING AND CHEMICAL COMBINE THROUGH THE RUSSIAN/US COOPERATIVE MPC&A PROGRAM

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KrasMAS: Implementation of a Nuclear Material Computerized Accounting System at the Mining and Chemical Combine Through the Russian/US Cooperative MPC&A Program

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Abstract

The Russian/US Mining and Chemical Combine (Gorno-Kimichesky Kombinat, GKhK, also referred to as Krasnoyarsk-26) Material Protection, Control and Accounting (MPC&A) project was initiated in June 1996. A critical component of the ongoing cooperative MPC&A enhancements at the GKhK is the implementation of a computerized nuclear material control and accountability (MC&A) system. This system must meet the MC&A requirements of the GKhK by integrating the information generated by numerous existing and new MC&A components in place at the GKhK (e.g., scales, bar-code equipment, NDA measurement systems). During the first phase of this effort, the GKhK adapted CoreMAS (developed at Los Alamos National Laboratory) for use in the PuO_2 storage facility. This included formulation of Web-based user interfaces for plant personnel, Russification of the existing user interface, and at the functional level, modification of the CoreMAS stored procedures. The modified system is referred to as KrasMAS and builds upon completed work on CoreMAS. Ongoing efforts include adding GKhK specific report forms and expanding the functionality of the system for implementation at the radiochemical processing and reactor plants of the GKhK. Collaborations with other Russian facilities for appropriate parts of these efforts will be pursued.

Introduction

The Mining and Chemical Combine (Gorno-Khimichesky Kombinat, GKhK, also referred to as Krasnoyarsk-26) is located within the closed city of Zheleznogorsk, Krasnoyarsk Region, Russia, and is a production facility of the Ministry of Atomic Energy of the Russian Federation (MINATOM). A unique underground site[1] at the GKhK, located on the east side of the Yenisey River, includes one operating dual-purpose reactor, of three original reactors, and plutonium dioxide and highly enriched uranium (HEU) storage areas. The underground site chosen was the point where the Atamanov Ridge (a spur of the Sayan Mountains) intersects with the Yenisey River. The purpose of the combine was to assure that production of weapons-grade plutonium continued even if this capability was lost at other production facilities in the country. Because of this important role, the facility has been referred to as "The Shield of the Country."[2] Zheleznogorsk, a closed city of 100,000, is located approximately 10 km from the underground site.[1] The remaining reactor is scheduled to be decommissioned by 2000; however, it still provides the essential electricity and steam to Zheleznogorsk.

Prior to 1994, the GKhK shipped weapons-grade PuO_2 to other weapons manufacturing facilities throughout Russia. However, in October 1994, the GKhK was notified by MINATOM that the state

order for PuO_2 had been eliminated, effective November 1, 1994.[3] Because the GKhK was still operating the dual-purpose reactor ADE-2, it was necessary to address the storage of the PuO_2 that continued to be produced. This led to the implementation of a temporary PuO_2 storage area. A long-term storage area has been designed and construction initiated so that it would be ready for use by 1998.

In cooperation with the U.S. national laboratories, MPC&A efforts were begun in June 1996. One of the key elements of the MPC&A plan was the implementation of a computerized MC&A system at GKhK. In the course of introducing a computerized system for nuclear materials control and accounting, a number of difficulties were encountered. The first difficulty was that the old accounting system was based on paper technology. The second major difficulty was that the new computerized control and accounting system had to integrate several other new technologies that have been or will be implemented as part of the scope of the MPC&A project. This paper describes the implementation of the computerized material control and accounting (CMC&A) system at the GkHK.

Computerized Material Control and Accounting System at the GkHK

The CMC&A system at GKhK will determine the quantity of nuclear materials, describe their location, and detect their losses and unauthorized use. Prior to the installation of the computerized system, specific CMC&A requirements were developed. The most important of these requirements are noted below:

- simple-to-use graphical interface;
- simple access to the database;
- access to database through stored procedures;
- use of technologies that support integration of MC&A systems measuring equipment (electronic balance, volume measurement, spectrometry); and
- support of remote workstations.

Support of remote workstations is required because a distance of some 10 km separates areas of data entry and data processing. In practice, this means that data is acquired and entered directly at the production site in the mountains, while reports are generated and data are analyzed at the main office of the combine in Zheleznogorsk.

In view of these requirements a Draft Network Plan for Computerized Control and Accounting was initiated. This plan is shown in Figure 1. Note that four main areas are connected through the system. These are the Radiochemical Plant, Reactor Plant, GKhK Main Office, and the Information and Analytical Center. The Draft Network Plan called for the use of CoreMAS or another automated nuclear material accounting system. CoreMAS characteristics are discussed in the next section. It was found that for Russian needs, certain changes were required, which led to the implementation of a system, based on CoreMAS, named KrasMAS.

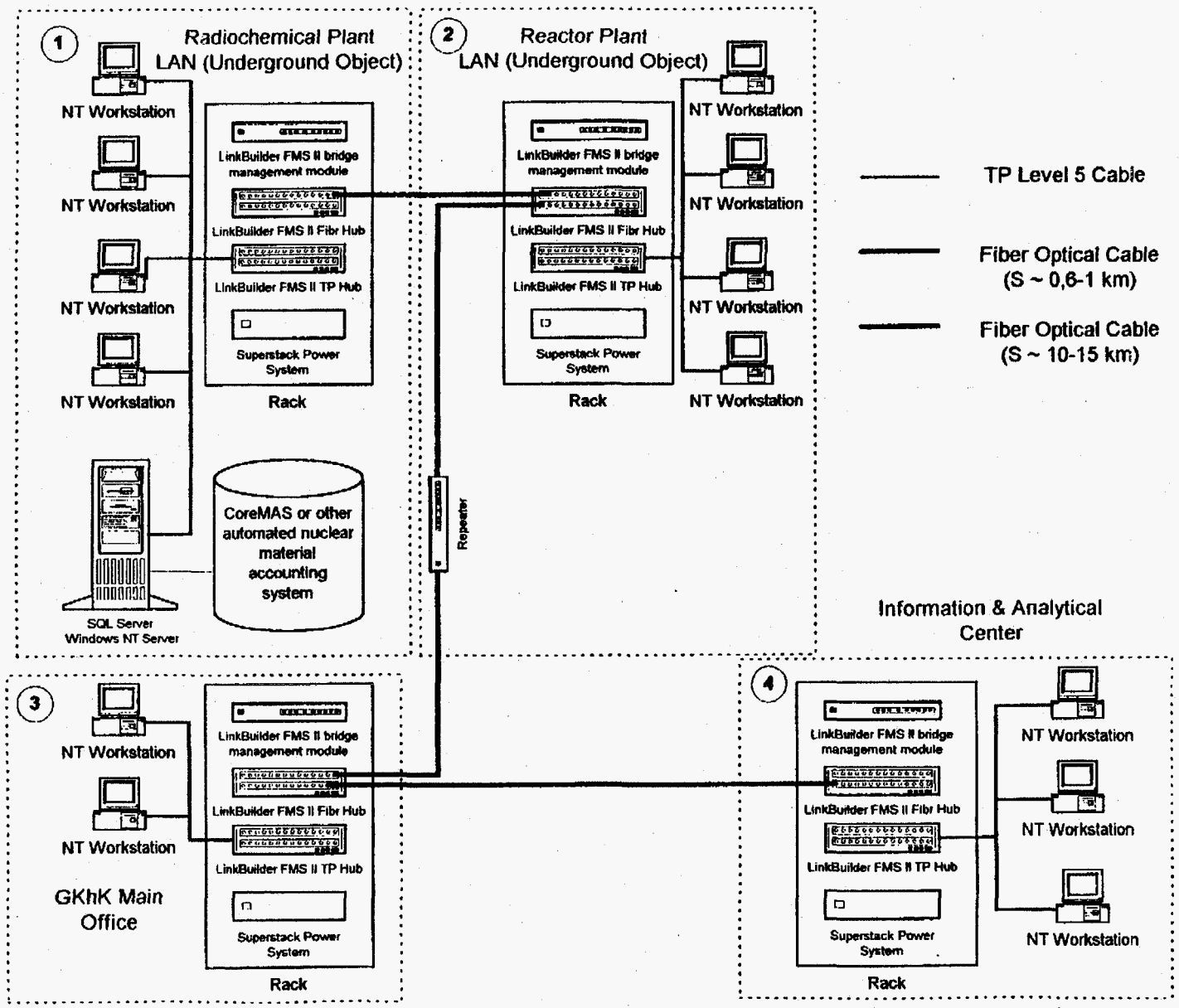

Figure 1. Draft network plan for computerized control and accounting system.

Characteristics of CoreMAS

CoreMAS is a computerized accounting system that appeared to meet the fundamental requirements developed for the system. The advantages and disadvantages of the CoreMAS computerized accounting system are noted below:

Advantages:

- Allowed for a detailed examination of the database,
- Stored procedures for interaction with the database, and
- Mechanisms for controlling authorizations for material control and movement.

Disadvantages:

- No documentation on procedures,
- Procedures are not categorized into functional levels, and
- Stringent limitations on data that can be entered into the system.

The disadvantages associated with CoreMAS required certain adaptations before it could be used at the GKhK. The adaptations are discussed in the next section.

Adaptation of CoreMAS

Following the installation of CoreMAS at the GKhK, work was started on its adaptation for use at the site. At the fundamental level, the CoreMAS database structure was left unchanged but certain stored procedures of CoreMAS were modified. At the user interface level, two different approaches were tried. The first approach was the Russification of the existing interface. The second approach was the implementation of a new interface.

In addition during the course of adaptation, the following additional problems were discovered:

- There are no computer-aided software engineering tools,
- The CoreMAS interface is too complicated for the requirements of GKhK users, and
- CoreMAS is designed for the US reporting system.

In light of the foregoing problems, it was decided to adapt and implement a system referred to as KrasMAS, using the experience and completed work on CoreMAS. In doing so, the chosen approach was to create a system of individual small modules that perform a specific task. The purpose of this approach is to accelerate the actual implementation of the system at priority areas with the GKhK.

Characteristics and Implementation of KrasMAS

A specific feature of KrasMAS is the use of Java and Internet technologies in adaptation. This solves several problems. In particular, it simplifies the job of integrating the system with measuring equipment. The components of the system are the following:

Basic components of KrasMAS:

- Java - Programming language used to develop WEB applications.
- JDBC - Java Database Connectivity used to connect/transact with databases.
- JavaScript - Programming language used on client side programming for browsers.
- HTML - HyperText Markup Language used to display information on WEB browsers.
- Netscape Navigator 4 - Used on client workstations to interpret and display HTML data.

Basic components of the inventory module:

- Java - Programming language used to develop WEB applications
- JDBC - Java Database Connectivity used to connect/transact with databases.
- IFC - Internet Foundation Classes, Netscape library of Internet functions
- Netscape Navigator 4 - Used on client workstations to interpret and display HTML.

The following steps are planned next for expanded adaptation and implementation of KrasMAS:

- adding specific GKhK report forms,
- integrating with computerized scales and barcode and nondestructive assay equipment,
- enlisting a team from Kurchatov Institute as collaborators in adaptation of the system,
- expanding the system to other GKhK sites, and
- installing a fiber-optics communication line between the main production facilities and the administrative buildings of GKhK.

Summary of Accomplishments

The project is progressing well and the following significant tasks have been completed:

- GKhK system requirements were met, December 1966,
- GKhK specialists were familiarized with existing systems of control and accounting, December 1996–January 1997,
- A team of GKhK specialists dealing with CMC&A problems went through special training at LANL, January 1997,
- Accessible systems were analyzed and evaluated; a special technique was implemented for the analysis and evaluation, February 1997,
- CoreMAS was selected for introduction at the GKhK PuO_2 storage facility, March 1997,
- CoreMAS was installed at GKhK with the assistance of a LANL expert, May 1997,
- Work was completed on adaptation of CoreMAS, June–August 1997,
- System prototypes were enhanced by alternative software, September 1997–March 1998,
- A module for support of physical inventory was used for a physical inventory, March 1998, and
- A lab-to-lab seminar on issues related to CMC&A specific to GKhK was held.

Conclusion

The Mining-Chemical Combine is adapting and implementing a computerized MC&A system, KrasMAS, based on CoreMAS. The system is specifically tailored for applications at a Russian nuclear facility. Successful completion of the initial objectives of the project has been accomplished. As the adaptation and installation of the system proceeds, system certification, integration with the federal control and accounting system, and complete integration with the existing production process and financial accounting of the project are being pursued.

This project is an example of a truly successful safeguards collaboration. The Russian facility acquired the American technology, learned from it, and then modified to meet the Russian needs.

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