The Computer Modeling System for Arms Control and Non-Proliferation (CMSAC) for Warhead Dismantlement and Transparency

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Abstract

This project represents the development of a state of the art tool that provides a suite of applications which graphically displays and links to a tabular database complex treaty/agreement information. This tool also stores, analyzes and presents data to enable efficient and accurate assessment of the status, impacts and conditions associated with inspection scenarios for monitored warhead dismantlement under a bilateral regime. This tool will also have the capability to test and evaluate the effectiveness of transparency/verification measures as applied to hypothetical warhead dismantlement scenarios. The Computer Modeling System for Arms Control and Non-Proliferation (CMSAC) is being developed, by VNIITF, under a Sandia National Laboratory contract as part of the U.S. Department of Energy (DOE) Russian Lab to Lab Program. This tool will have state of the art capability and flexibility to model and assess numerous treaty related scenarios. The unclassified modeling of the Russian warhead dismantlement process and the potential verification/transparency measures that could be integrated into that process will be the first application of the tool.

Introduction

Within the context of the Helsinki Summit Agreements, both the United States and the Russian Federation committed to "measures relating to the transparency of strategic nuclear warhead inventories and the destruction of strategic nuclear warheads .... ". To help achieve a better understanding of those objectives within the Russian Federation, Sandia National Laboratories under the auspices of the DOE's Office of Arms Control and Non-Proliferation (NN-42) Russian Lab to Lab Program, initiated a series of contracts with the Russian Nuclear Institutes to examine the topic of Warhead Dismantlement and Transparency. The primary contributor to the unclassified Computer Modeling System for Arms Control and Non-Proliferation is the Zababakhin Russian Federal Nuclear Center of Technical Physics (VNIITF).

Sandia and the Zababakhin Russian Federal Nuclear Center (VNIITF) are conducting extensive studies of technical issues related to arms control and are developing associated hardware through the unclassified Russian Lab to Lab Warhead Dismantlement and Transarpency Program. This program has many key areas of investigation such as:
- The Russian nuclear warhead dismantlement process
- The concept of irreversibility in warhead dismantlement
- Scenarios for monitoring nuclear warhead dismantlement

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- Potential monitoring technology to enhance transparency
- And a computer modeling tool for scenario and transparency evaluation and training - CMSAC

CMSAC is a powerful concept that can be used for a wide variety of intricate Arms Control policy making and negotiating activities; warhead dismantlement monitoring and assessment is its first application. The Computer Modeling System for Arms Control and Non-Proliferation employs the concept of systems engineering by linking three major types of complex information to support multi-user applications for technical assessments, arms control evaluation and negotiating purposes. The tool's use of visual illustration, data collection, and analytical capability enables the rapid and accurate graphic assessment of the interrelationships and interdependencies that are created when arms control requirements are placed on a facility, an operation or a set of processes.

The graphic's capability offers a 3-D view of facilities, processes, transparency or verification measures and technologies, equipment, work stations, components and sites. The data collection capability is a comprehensive inter-linked database that collects all the data from objects that are viewed in the graphic's segment. The analytical capability analyzes and assesses data and graphics both statistically and against criteria selected by the user.

Study Results

The unclassified Computer Model System for Arms Control and Non-proliferation can be used by:
- Policy makers to perform assessments of monitoring U.S. and Russian options and implementation issues
- Negotiators to familiarize themselves with technical issues associated with warhead dismantlement and transparency
- Weapons inspectors, facility and operations personnel to train and prepare for inspections
- Technical personnel to train and prepare to support implementation of a warhead dismantlement regime
- Collect and access treaty or agreement data to increase confidence in compliance.

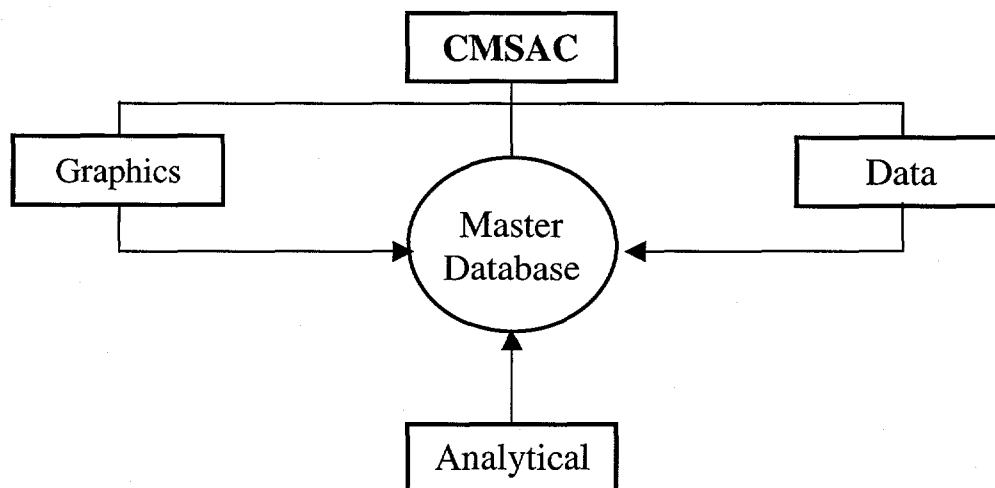A simplified structure of CMSAC is provided in Figure 1.

Figure 1. – CMSAC Structure

Graphic's Capability

The graphic's capability is the most developed module of the CMSAC. It allows users to interact with 3D models of facilities, equipment, and processes to be used during dismantlement of nuclear weapons.

Data Collection Capability

VNIITF is currently working on developing a data collection capability that can be used to track dismantlement activities and transparency data. This data can be then be stored in a master database and analyzed against treaty requirements.

Analytical Capability

As CMSAC develops it will eventually be used by facility inspectors as a tool to conduct inspections as well as a reference source for facility information and/or treaty requirements. CMSAC could then be used to analyze data collected during the process of dismantlement and automatically provide various reports for inspectors and facility owners. Inspectors will then be able to review activity logs, remote camera pictures as well as computer reports which can assist in validating dismantlement activities have occurred in compliance with treaty requirements.

Future Work

In October 1999 VNIITF began phase 2 of development for the CMSAC. As depicted in Figure 1 the Master Database is at the core of the CMSAC and will require the most effort to make the CMSAC a truly useful tool. CMSAC will soon become more interactive with the ability to query areas of a room or move between different levels of the facility using virtual reality tools. The development of the CMSAC provides the US and Russia a unique tool to discuss various aspects of monitored warhead dismantlement. The unclassified Computer Model for Arms Control and Nonproliferation is a unique confidence building and engineering tool. It is being designed to meet the requirements of Arms Control activities and serve as a 21st century resource for bi-lateral policy applications.