Warhead Monitoring – Technical Challenges to Maintaining a Chain of Custody

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Introduction

With the New START Treaty entry into force, there are discussions within the administration and the arms control community of continuing negotiations for further nuclear warhead reductions. One of the key elements of the next treaty may be to include both strategic and tactical nuclear warheads as treaty limited items. Such an approach would likely constrain the total stockpile numbers, the number of warheads by type, the numbers by operational status, or even the locations where warheads would be authorized. To support those types of limits on the nuclear stockpile, the treaty may require an extensive warhead monitoring regime to verify data declarations and augment both on-site inspections and National Technical Means. This regime, cooperative in nature, would allow each party to track warheads throughout their life cycle - a process often called maintaining a "chain of custody".

As one investigates the warhead life cycle and associated operational environments, it quickly becomes apparent that warhead sustainment is not a static process. Warheads are not just put under lock and key and left unattended for many years. They are deployed on launchers, transported between Department of Defense (DoD) and Department of Energy (DOE) sites and within those sites, receive periodic maintenance at both DoD and DOE, under go extensive refurbishment for life extensions, are withdrawn from the stockpile to support surveillance and flight test programs, and dismantled when no longer needed for military purposes. All of these conditions will have direct impacts on the design and implementation of a warhead monitoring regime and the ability of that regime to sustain a chain of custody over the warheads put under that regime. This paper explores how the operational environment and the warhead life cycle pose technical challenges to a future monitoring regime that may require maintaining a warhead chain of custody.

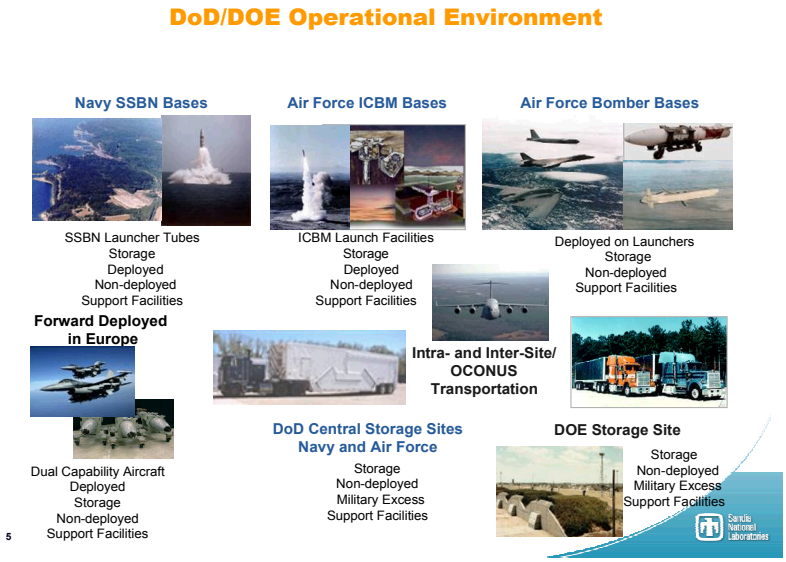

Figure 1 – DoD/DOE Operational Environment

Technical Challenges of the DoD/DOE Operational Environment

The operational environment as illustrated in Figure 1 can be broken down into DoD and DOE elements. Delivery systems within the DoD include Navy ballistic missile submarines, Air Force ballistic missiles and heavy bomber aircraft as well as forward deployed dual capable tactical aircraft in Europe. These forces are located throughout the United States and Europe, and at least for the foreseeable future, many of these bases will maintain forces in "deployed" configurations - missiles and warheads at sea, in their silos at the missile fields, or stored in their designated bunkers. Other non-deployed warheads would also be present at these sites.

Significant infrastructure is needed to support the DoD operations. In addition to numerous storage and maintenance facilities, there are a variety of transportation elements for the specific weapons systems. DoD also provides the transportation for those warheads forward deployed to Europe. Operational bases have warheads associated with the specific weapons system; however at DoD central storage facilities there is likely to be a mix of non-deployed or reserve warheads as well as those that have been declared excess to military requirements. Additionally for those warheads in storage, each has its own unique storage container or configuration. To complicate the process further, DoD utilizes two different types of storage facilities.

DOE only has one site that supports warhead operations, including storage, maintenance and dismantlement. At this site, one would find non-deployed warheads and those awaiting dismantlement. To support its mission, this site possesses a large storage area and unique facilities to conduct maintenance and dismantlement. However, the list of DOE sites subjected to monitoring could be expanded greatly if warhead trainers or other test assemblies become accountable under the treaty, and those items are not moved to a central location. DOE also provides the transportation fleet for the movement of

warheads between the DoD and DOE sites. These vehicles are also utilized to move components and materials within the DOE complex.

Figure 2 – Warhead Life Cycle

Looking at the size and diversity of the operational environment, one gets a sense of the challenges that lay ahead as we begin to consider where and how one might employ a warhead monitoring regime to support treaty objectives. The system must deal with multiple locations, varying storage modes and configurations, diverse transportation elements, multi-use transportation vehicles and multi use facilities. But there are additional considerations that need to be addressed as well – classification issues and monitoring equipment certification.

As one might suspect, much of the information related to the nuclear stockpile and its operations is very sensitive. For example, the location and numbers of warheads at a specific location are classified information under today's rules. The same is true regarding information about movement of those warheads either locally or between sites. As the technical community begins to think about how to monitor warheads at each site and movement between sites, as well as managing the data associated with those processes, it may be required to contend with and protect classified data.

Monitoring equipment certification presents an equally challenging problem set. All of the equipment designed for a warhead monitoring regime would need to pass very stringent safety and security evaluations before it could be operated on or near a warhead, in the supporting facilities or used during transportation shipments. By no means is this a trivial task; however, understanding that requirement exists should help the system designers approach the problem. For example if an item monitor becomes a part of the monitoring regime, and it must be attached to the warhead container, then the designer must determine where the item monitor could be mounted on the container and what type of mounting fixture is needed. Some issues that need to be considered include: Are modifications required to the warhead container to attach the item monitor? Is the item monitor attached in such a way so that it will not impede current handling operations? Will the item monitor design impact the container tie-down configuration during transportation? Can the mounting

fixtures meet safety certification for use during transportation? To address such issues and understand key design requirements, the monitoring system designers will need a very active engagement and collaboration with the nuclear weapons community.

As we have seen, the nuclear operational environment will have significant impact on how the monitoring regime will be designed and the chain of custody is established. However, the elements and activities of the warhead lifecycle will have an equally important impact. The next section of the paper will discuss some of those impacts.

Technical Challenges of the Warhead Life Cycle

As we stated earlier and can be seen in the Warhead Life Cycle graphic (Figure 2), warheads are not just placed in storage for some number of years and then sent to DOE for dismantlement. To understand how the warhead life cycle also complicates our ability to monitor all warheads and sustain a viable chain of custody, we need to discuss six activities conducted within the life cycle. These activities are:

1. Deployment preparations
2. Stockpile inventory verification
3. Warhead maintenance
4. Stockpile Life Extension Programs
5. Surveillance program
6. Flight test program

Preparing warheads for actual deployment on their associated launchers is a very complex operation and one that will create an anomaly in the monitoring regime. For illustration purposes, let us assume that a warhead on a deployed ICBM needs to be replaced. To do that a warhead that is currently in storage will be moved from its storage location to the maintenance facility. At that facility, it will be removed from its storage container and prepared for operational deployment. It will then be loaded into the transportation vehicle that will move it to the missile silo. At the silo, it will then be loaded onto the missile as a replacement for the current warhead. The replaced warhead will be returned to the maintenance facility where corrective maintenance will be performed if the site is authorized to conduct that activity. If so the warhead would be repaired and then returned to storage waiting for redeployment to the missile force. If not, it will then be returned to storage waiting shipment to DOE for repair. As can be seen by this scenario, one warhead has actually been removed from the monitoring regime and moved to a deployment location. Another warhead has been moved from its deployed location to a storage location either associated with the deployment base or DOE. And this warhead, although accounted for in the data base, will not likely be "captured" under a monitoring regime until the next inspection. That process would likely include some type of warhead verification/authentication and then "tagging" the warhead container and placing it into the monitoring regime. Here the assumption is that the bilateral partner would be present for such treaty activity. This scenario will play out a few times each year so there will be a small number of warheads outside of the monitoring regime for some period of time.

Another activity that has a similar impact as noted above is that of stockpile inventory verification. There are a number of reasons for inventory verification: direction by the national leadership, change of site custodian, preparation for inspections, and actual headquarter inspections. Depending on the reason for the inventory verification, it may include only a few warheads or it may include all warheads at a given location. This type of accountability is a requirement for both DoD and DOE. Depending on the access requirements for the inventory and the design of a warhead monitoring regime, this process could break the chain of custody. This possibility needs to be well understood and addressed as the technical experts design a reliable monitoring regime.

Warhead maintenance presents additional cases where warheads in monitored storage will need to be removed from that environment. This activity could take place at the operational base, in central storage, or at the DOE facility. For example, if through the surveillance program, it was discovered that some system component on a deployed warhead needed replaced because of reliability issues. As a result, DOE would design and produce the new component, and replaced it on a schedule agreed to by DoD and DOE. To replace the component, each warhead in storage would need to be brought to the maintenance facility where it is removed from the storage container. Next the components are swapped out and the warhead returned to a storage container. Then it will be moved to a monitored storage location. For deployed warheads, the replacement warheads would be drawn from those in storage. As one can see, a maintenance process such as described above would disrupt the chain of custody for a whole warhead type over the given maintenance schedule.

This kind of disruption is greatly amplified when one considers a warhead life extension program. Here the entire inventory of a specific type would undergo system sustainment upgrades. All of the work would be done at the DOE facility and in many cases require that the warhead be disassembled so that new components could be installed. In addition this maintenance would take considerably longer to complete than what has been noted before. The life extension program complicates the chain of custody because all of the warheads would be moved to the DOE site on a specific schedule. Therefore, warheads monitored at one location would be removed from that location, transported to another location (perhaps monitored en route), placed into monitored storage at DOE, and then ultimately removed from that storage. Then the warheads will be moved to the dismantlement facilities for the required maintenance. In this scenario, there may be some elements of portal monitoring but no monitoring of the actual disassembly/assembly process. At some later date, the warheads will return to the active stockpile; however, they may not be placed under any monitoring regime until the next inspection by the treaty partner. Depending up on the frequency of follow on inspections, it could be many months before some of these warheads are reentered into the designated monitoring regime.

Two other processes in the life cycle will create technical challenges to the chain of custody – the warhead surveillance and flight test programs. Both of these programs draw a very small number of warheads from the active stockpile for analysis and testing. So they present the same issues as noted above on removal from deployment/storage at a

DoD site and movement to the DOE facility. But these two program bring an additional issues not noted before. Some of these warheads will not return to the stockpile. During surveillance, some of the warheads are completely disassembled and some of the components sent to other DOE sites for analysis. They are not returned for reassembly. So through this process, the aggregate stockpile number would be reduced. The same holds true for the flight test program. Here some of these selected warheads minus their nuclear components are destroyed during the flight test. Again there may be a reduction in the aggregate warhead count, and the monitoring regime will need to account for those losses.

Proposed Next Steps

To summarize our discussions, it is evident that the operational environment of our nuclear and dual capable forces and the life cycle of our warheads create technical challenges to a designer of warhead monitoring systems. The designers must clearly understand that environment and the multiple activities within the life cycle that will invariably stress the integrity of the monitoring regime and chain of custody. However, today's system designers are in a state of speculation since there are no stated requirements for a future monitoring system. The policy community has not yet agreed on a definition of warhead monitoring or what is meant by a warhead chain of custody; therefore, each designer is left to his own devices on what needs to be done. Such a design process is flawed and needs corrected.

A first step would be to conduct a detail analysis of the operational environment and the warhead life cycle to determine what operations or information related to warheads are off limits, what information we may be willing to share, and under what conditions. The same analysis needs to be applied to facilities – what must be exempt from inspection or monitoring, what might be monitored externally only, and what would we allow access to and be monitored. Finally, the transportation elements need to be included in this analysis as well. Once this analysis is completed, its results should be used to prepare an operational scenario for use by the system designers. This document would serve as the general concept and requirements basis for design activity.

However, we shouldn't leave the designers in isolation. There needs to be an active interface with the military end users, the DOE weapons community, and arms control experts throughout the design, development, testing, and evaluation process to ensure the system meets requirements.