CHAPTER 3

A BRIEF COMMENTARY ON "U.S. MILITARY NUCLEAR MATERIAL UNACCOUNTED FOR: MISSING IN ACTION OR JUST SLOPPY PRACTICES?"

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Special nuclear material (SNM) is an integral part of nuclear energy and nuclear weapons, and the primary means for protection of SNM is safeguards. Safeguards address the questions: "Is SNM missing?" and "If SNM is missing, how much is unaccounted for and when did it go missing?" There are two main elements to safeguards: 1) methods of containing and monitoring SNM; and 2) methods of accounting to keep track of SNM quantities and locations. Methods of containing and monitoring SNM are such safeguards as vaults and locks, armed guards, personnel security clearances, and, as we discuss later, the two-person rule. The importance of accounting methods for safeguards is the insider threat to diversion of SNM, where the first category of safeguards could be plausibly bypassed by someone with inside knowledge and access.

Within safeguards, the terms "inventory difference" (ID) and "material unaccounted for" (MUF) are equivalent, and are defined as a "book inventory" of SNM minus the "physical inventory" of SNM, where the book inventory is the quantity of material present at a given time as reflected by accounting records, and the physical inventory is the quantity determined to be on hand by, first, physically ascertaining its pres-

ence, and then using techniques that include measuring, sampling, weighing, and analysis. A central thesis in Chapter 2, "U.S. Military Nuclear Material Unaccounted For: Missing in Action or Just Sloppy Practices?" by Charles D. Ferguson, is that the United States is not currently achieving acceptable standards addressing MUF for defense programs SNM, and if this is true for the United States, then this is likely true for other nuclear weapon states such as Pakistan and Russia.

We agree with the author that in the first decades of the Cold War, inattention to SNM accounting, as well as poor industrial practices, led to large values of MUF in the U.S. nuclear weapons program. Thomas Cochran documented plutonium inventory differences at the Rocky Flats Plant outside of Denver, CO, in a 1996 report:

> It is a shameful legacy of the contractor operations of the Rocky Flats Plant that internal accounting and off-site environmental measurements of plutonium did not receive the attention they demanded from the very start of Rocky Flats operations in 1952. At Rocky Flats the uncertainties in estimated plant releases, reconstructed radiation doses and public health effects, when derived from off-site contamination measurements, are very large. The upper end of these estimates no doubt will be consistent with the very large MUF values at Rocky Flats—that is, with what we do not know about the whereabouts of much of the plutonium. The plutonium release estimates could be increased by orders of magnitude and still be consistent with the MUF.[1]

Today, however, the United States is not producing SNM for nuclear weapons purposes. The U.S. Department of Energy (DOE) site receiving and processing

large quantities of SNM in the form of intact weapons and after disassembly, weapons components, is the Pantex Plant near Amarillo, TX. However, SNM in discrete, countable forms will be amenable to much better accounting than SNM in bulk handling and processing, as was the case during the Cold War where the uncertainties in material accounting were so large that they exceeded the required quantity of material for weapons.

With respect to material accounting at Pantex, little public information exists on the safeguards system used at this site. Two memos from the Defense Nuclear Facilities Safety Board made available on the Board's website[2] described material accountability incidents at Pantex, currently operated by the contractor Babcock and Wilcox (B&W):

> [January 6, 2012]: B&W uses the Pantex Material Move System (PMMS) to authorize all movements of nuclear explosives, nuclear material, certain types of nuclear explosive-like assemblies, and certain types of explosives. A software-based electronic material move system called Move Right serves a critical role in PMMS authorization as it helps to ensure that all moves comply with the material limits specified in the documented safety analysis. B&W recently identified a discrepancy between the quantity of plutonium listed in the Move Right system and the quantity listed in an electronic thermal monitoring system for a particular facility. The discrepancy existed for approximately 1 week before transportation personnel evaluated the physical configuration of the facility and confirmed that the quantity in the thermal monitoring software was correct, and the material was in the correct location. Upon further evaluation, information technology (IT) personnel discovered that a B&W software subroutine that should have updated the Move Right system to reflect the quantities in the thermal monitor-

ing system had not initiated. B&W plans to conduct a cause analysis of the event. IT personnel are performing daily checks to validate the proper function of any software that transfers information between systems that track accountable material.[3]

[September 30, 2011]: This week, technicians were performing nuclear material accountability walkdowns when they discovered a discrepancy between the quantity of nuclear material listed in the electronic material inventory system and the actual quantity of material present in a facility. Manufacturing personnel have identified the facts surrounding the event and determined that a weakness exists in the process that they rely on to ensure that the nuclear material and explosive facility limits specified in the safety basis are not violated. B&W ensures compliance with material limits using a software-based electronic material move system and various independent checks to verify consistency between the material move paperwork, the electronic system, and the actual component. However, once the component has been packaged, technicians are completely reliant on a barcode card (containing the level of assembly, part number, serial number, etc. . . .) as the source of information for the electronic material move system. Several of these cards can be present in a facility at a time since the cards are created and assigned to components and different levels of assembly as a unit transitions through an assembly or disassembly process. This material inventory discrepancy was introduced when technicians inadvertently swapped the barcode cards for different levels of assembly prior to moving an item. The discrepancy has since been resolved. Manufacturing management plans to conduct a formal cause analysis of the event with the objective of identifying corrective actions that would eliminate this vulnerability from the B&W material tracking process.[4]

These examples illustrate that a necessarily complex safeguards system will plausibly have gaps, (i.e., multiple barcode cards), and those gaps could be exploited from an insider threat.

Chapter 2 introduces the reader to the Nuclear Materials Management and Safeguards System (NMMSS), a U.S. safeguards system jointly managed by the Department of Energy (DOE) and the Nuclear Regulatory Commission (NRC). Regarding methods of containing and monitoring SNM, the NRC recently shelved consideration of the "two-person rule," a requirement that "two qualified and authorized individuals are present" when working with SNM. As Dr. Ed Lyman from the Union of Concerned Scientists recently observed, the two-person rule is a "requirement that could greatly reduce the insider threat at U.S. nuclear facilities handling nuclear weapon-usable and other sensitive nuclear materials."[5] Regarding methods of accounting within the NMMSS, the statistical analysis for SNM accounting in material balance areas provides critical information for safeguards; however, based on our information, a statistical analysis for SNM accounting are not required reporting within the NMMSS from individual DOE sites. An NMMSS information circular posted online[6] lists monthly due dates for transactions and inventory, roughly 2 weeks following the "Reporting Month."

In conclusion, while serious problems with MUF have been documented for the U.S. nuclear weapons program during the Cold War, the DOE today is not producing SNM for nuclear weapons purposes, and therefore we do not expect this issue to be as significant as it has been in the past. While anecdotal evidence suggests that challenges to SNM safeguards persist at DOE and at NRC, the information required for a full

picture of the state of safeguards in the United States, or in other nuclear weapon states, is not available to the public due to classification of technical data.

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1. Thomas Cochran, "Plutonium Inventory Differences at the Rocky Flats Plant and Their Relationship to Environmental Releases," Washington, DC: Natural Resources Defense Council, November 22, 1996, available from *docs.nrdc.org/nuclear/files/nuc_11229601a_178.pdf*.

2. Defense Nuclear Facilities Safety Board, Washington, DC, available from *www.dnfsb.gov*.

3. Matthew Duncan and Rory Rauch, "Pantex Plant Report for Week Ending January 6, 2012," Washington, DC: Defense Nuclear Facilities Safety Board, available from *www.dnfsb.gov/sites/default/files/Board%20Activities/Reports/Site%20Rep%20Weekly%20Reports/Pantex/2012/wr_20120106_34.pdf*.

4. Matthew Duncan and Rory Rauch, "Pantex Plant Report for Week Ending September 20, 2011," Washington, DC: Defense Nuclear Facilities Safety Board, available from *www.dnfsb.gov/sites/default/files/Board%20Activities/Reports/Site%20Rep%20Weekly%20Reports/Pantex/2011/wr_20110930_34.pdf*.

5. Ed Lyman, "The NRC and Nuclear Terrorism: Still Out of Step on the Insider Threat," Cambridge, MA: Union of Concerned Scientists, December 5, 2013, available from *allthingsnuclear.org/the-nrc-and-nuclear-terrorism-still-out-of-step-on-the-insider-threat/*.

6. "Nuclear Materials Management & Safeguards System," Washington, DC: National Nuclear Security Administration, available from *nnsa.energy.gov/aboutus/ourprograms/nuclearsecurity/nmmsshome*.