
SAFETY EVALUATION REPORT

For the U.S. Army's Possession
License for Depleted Uranium from
Davy Crockett M101 Spotting
Rounds – Amendment to Add
Remaining Sites

Docket No. 040-09083

U.S. Army Installation Management Command

U.S. Nuclear Regulatory Commission

Office of Nuclear Material Safety and Safeguards

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Introduction

In a letter dated June 1, 2015, the United States Army Installation Management Command (Army) submitted a license amendment application (Agencywide Document Access and Management System (ADAMS)) Accession No. ML15161A454), as supplemented by submittals on June 1, 2015 (ML15160A509 and ML15161A458); September 30, 2015 (ML15294A276); December 31, 2015 (ML16004A369); January 8, 2016 (dated December 31, 2015) (ML16022A161); January 29, 2016 (ML16041A107); February 9, 2016 (ML16042A232); and February 12, 2016 (ML16048A347) to the U.S. Nuclear Regulatory Commission (NRC or the Commission), requesting that Source Materials License No. SUC-1593 (ML13259A062) be amended to allow the possession of depleted uranium¹ (DU) from Davy Crockett M101 spotting rounds at multiple sites located on multiple Army installations pursuant to License Condition 12 of Source Materials License No. SUC-1593. In the amendment application, the Army refers to each site at the Army installations that have DU from Davy Crockett M101 spotting rounds as a range, a radiation control area (RCA), or an M101 Target Area.

The Army is requesting authorization to possess the DU from Davy Crockett M101 spotting rounds that has been present on specific Army installations for approximately sixty years. The Army requests that the sites that have DU from Davy Crockett M101 spotting rounds located at the 15 installations listed in License Condition 12 be incorporated into Source Materials License No. SUC-1593. The Army also proposes to use a programmatic approach to license these 15 installations.

In addition, the Army proposes to license the two Army installations in Hawaii (HI) (located on the islands of Oahu and Hawaii) which are already licensed under Source Materials License No. SUC-1593, using the same programmatic approach. The 16 Army installations² with sites that have DU from Davy Crockett M101 spotting rounds, are located at: Donnelly Training Area, Fort Wainwright AK (Alaska); Fort Benning, GA (Georgia); Fort Bragg, NC (North Carolina); Fort Campbell, KY (Kentucky); Fort Carson, CO (Colorado); Fort Gordon, GA (Georgia); Fort Hood, TX (Texas); Fort Hunter Liggett, CA (California); Fort Jackson, SC (South Carolina); Fort Knox, KY (Kentucky); Fort Polk, LA (Louisiana); Fort Riley, KS (Kansas); Fort Sill, OK (Oklahoma); Joint Base Lewis-McChord/Yakima Training Center, WA (Washington); Joint Base McGuire-Dix-Lakehurst, NJ (New Jersey); and Schofield Barracks/Pohakuloa Training Area, HI (Hawaii). The Army also proposes that the proposed programmatic radiation safety plan (RSP), programmatic physical security plan (PSP), and programmatic environmental radiation monitoring plan (ERMP) apply to all 16 installations and commits to preparing site-specific ERMPs in accordance with the criteria contained in its programmatic ERMP.

¹ Natural uranium is made up of three isotopes: U-234, U-235, and U-238. "Depleted" uranium or DU has a lower percentage of U-234 and U-235 than natural uranium and is less radioactive. Per 10 CFR 40.4, Definitions, DU means the source material uranium in which the isotope uranium-235 is less than 0.711 weight percent of the total uranium present. DU does not include special nuclear material.

² In the amendment application, the Army identified 16 Army installations with sites where DU from Davy Crockett M101 spotting rounds are located, as opposed to 17 Army installations with sites where DU from the Davy Crockett M101 spotting rounds are located. The Army considers the Schofield Barracks/Pohakuloa Training Area HI, as one Army installation, similar to a joint base (ML16011A373) for this license. Therefore, in this SER, the NRC staff refers to 16 Army installations; however, the NRC considers them as two separate installation-facilities for dose assessment purposes. Refer to footnotes 8 and 11 and information in Section 3.4 of this SER for more detailed information.

The quantities of DU discovered at these sites are subject to licensing and safety requirements found in Title 10 of the *Code of Federal Regulations* (10 CFR) Part 40, "Domestic Licensing of Source Material." This safety evaluation report (SER) summarizes the NRC staff's evaluation of the Army's license amendment application and supporting documents as they pertain to the Army installations that have DU from Davy Crockett M101 spotting rounds.

The regulatory requirements that are applicable to this review are summarized below, followed by a summary of the NRC staff's findings.

Regulatory Requirements

The Atomic Energy Act of 1954 (AEA), as amended, authorizes the NRC to issue licenses for the possession and use of source material and byproduct material. Unless an exemption from the licensing requirements is issued by the NRC, the NRC must license facilities that possess non-exempt quantities of DU in accordance with NRC regulatory requirements to protect the public health and safety from radiological hazards. In accordance with 10 CFR 40.32, "General Requirements for Issuance of Specific Licenses," the NRC is required to make the following safety findings when issuing a source materials license [amendment]:

- The [amendment] application is for a purpose authorized by the [Atomic Energy] Act
- The applicant is qualified by reason of training and experience to use the source material for the purpose requested in such a manner as to protect health and minimize danger to life or property
- The applicant's proposed equipment, facilities, and procedures are adequate to protect health and minimize danger to life or property
- The issuance of the license [amendment] will not be inimical to the common defense and security or to the health and safety of the public

This SER summarizes the NRC staff's review of the amendment application and supporting materials in accordance with the applicable requirements of 10 CFR Part 40, "Domestic Licensing of Source Material" and the applicable guidance in NUREG-1556, Vol. 7, "Consolidated Guidance About Materials Licenses: Program-Specific Guidance About Academic, Research and Development, and Other Licenses of Limited Scope Including Gas Chromatographs and X-Ray Fluorescence Analyzers" [NRC 1999]. This guidance document was used by the NRC staff for the initial licensing of these types of sites (the two Army installations located in Hawaii with Davy Crockett DU present on multiple ranges) because no other guidance document was applicable for the DU in the form of an unsealed source in the environment. NUREG-1556, Vol. 7 was determined to be acceptable for the Davy Crockett DU that is present on active Army ranges because this guidance document addresses Part 20 radiological protection requirements for Part 30 materials licensees. Although this guidance explicitly states that it does not apply to source material (Part 40) licensees, in the absence of guidance for licensing actions such as these Davy Crockett DU licensing actions, the NRC staff determined that this guidance is appropriate for determining whether the applicant meets Part 20 requirements that are germane to Part 30 and Part 40 licensing actions. This evaluation assesses the applicant's compliance with the requirements of 10 CFR Part 40, "Domestic

Licensing of Source Material,” as well as the applicable requirements of 10 CFR Part 20, “Standards for Protection Against Radiation.”

Summary of NRC Staff’s Findings

The NRC staff finds that the Army’s license amendment application for possession of DU from Davy Crockett M101 spotting rounds at the Donnelly Training Area, Fort Wainwright, AK; Fort Benning, GA; Fort Bragg, NC; Fort Campbell, KY; Fort Carson, CO; Fort Gordon, GA; Fort Hood, TX; Fort Hunter Liggett, CA; Fort Jackson, SC; Fort Knox, KY; Fort Polk, LA; Fort Riley, KS; Fort Sill, OK; Joint Base Lewis-McChord/Yakima Training Center, WA; Joint Base McGuire-Dix-Lakehurst, NJ; and the Schofield Barracks/Pohakuloa Training Area, HI, with license conditions implemented with this license amendment, comply with the standards and requirements of the AEA and the Commission’s regulations. Based on its review of the Army’s license amendment application and supporting documents, the NRC staff concludes that these additional license conditions are necessary to ensure that the Army conducts its radiation safety program in compliance with the applicable requirements of 10 CFR Parts 20, “Standards for Protection Against Radiation” and 40, “Domestic Licensing of Source Material”.

Specifically, in accordance with 10 CFR 40.32(b) and (c), the NRC staff finds that the Army is qualified by reason of training and experience to use source material for the purpose it requested, and that the Army’s proposed equipment and procedures in the programmatic RSP are adequate to protect health and safety and minimize danger to life or property.

The license amendment would allow the Army to conduct activities necessary for the possession and management of the DU from Davy Crockett M101 spotting rounds and fragments as a result of previous use of DU at Army installations. The license amendment would not authorize the placement of additional DU on the installations. The license amendment would prohibit the Army from performing decommissioning or ground disturbing activities to collect or remove DU fragments or contaminated soil that is identified during routine range activities without prior authorization from the NRC. Picking up incidental pieces of DU that the Army finds during training exercises would be allowed without further NRC approval, if it does not involve ground disturbing activities.

In addition, the NRC staff determined that, in order to ensure that the Army conducts its operations in accordance with NRC requirements, license conditions are warranted to ensure that: 1) other Army installations, not currently licensed, that are identified by the Army in the future as having DU from Davy Crockett M101 spotting rounds will be added to Source Materials License No. SUC-1593; 2) financial assurance for decommissioning of all the sites located at the Army installations that contain DU from Davy Crockett M101 spotting rounds will be provided; 3) posting and notifications regarding the use of the sites containing DU from Davy Crockett M101 spotting rounds will be implemented; 4) future decommissioning of these sites by the Army will occur under NRC regulatory oversight; and 5) the Army has carefully studied the installation sites and developed and submitted for NRC approval site-specific environmental radiation monitoring plans for each Army installation with sites that have Davy Crockett M101 spotting rounds. These requirements are meant to ensure this DU material will not pose a future health and safety risk. The NRC staff determined that the Army has not provided sufficient justification for site-specific modeling parameters. Thus, the NRC will impose License Condition 19 (which requires the Army to submit for NRC verification, documentation, including

site-specific dose modeling parameters, showing that the approved dose modeling methodology was applied and that the calculated site-specific all pathway dose for each RCA at each installation listed in proposed License Condition 10 does not exceed 1.0E-2 mSv/yr (1.0 mrem/yr) TED. Based on the results of this site-specific modeling, the NRC staff should be able to verify that the Army is in compliance with 10 CFR 20.1301(a) and (d), 20.1302(a) and (b), 20.1501, 20.2001(a), and 20.2103(b) for all RCAs.

The NRC staff concludes that the findings described in the succeeding sections of this SER, including the necessary license conditions, support the issuance of a license amendment authorizing the possession of DU from Davy Crockett M101 spotting rounds at the Donnelly Training Area, Fort Wainwright, AK; Fort Benning, GA; Fort Bragg, NC; Fort Campbell, KY; Fort Carson, CO; Fort Gordon, GA; Fort Hood, TX; Fort Hunter Liggett, CA; Fort Jackson, SC; Fort Knox, KY; Fort Polk, LA; Fort Riley, KS; Fort Sill, OK; Joint Base Lewis-McChord/Yakima Training Center, WA; Joint Base McGuire-Dix-Lakehurst, NJ; and Schofield Barracks/Pohakuloa Training Area, HI. Therefore, in accordance with 10 CFR 40.32(d), the NRC staff finds that issuance of this license amendment will not be inimical to the common defense and security or to the health and safety of the public.

Background

During the 1960s, the Army was authorized to manufacture M101 spotting rounds for the Davy Crockett weapon system under License SUB-307 (ML102430076), issued by the Atomic Energy Commission (AEC), the NRC's predecessor agency, and later under License SUB-459 (ML112521255, ML112521257, and ML112521249). The original license authorized the fabrication, testing, and distribution of the M101 spotting round at two Army Arsenals: Frankford Arsenal located in Philadelphia, PA, and Lake City Arsenal, located in Independence, MO. Later the license was amended to include the Picatinny Arsenal, located in Wharton, NJ.

M101 spotting rounds were fired from a small rifle attached to the underside of the main recoilless rifle and were used to simulate the flight path of the main munition of the Davy Crockett weapon system, which was a low-yield battlefield nuclear device. See Figure 1 for a picture of the Davy Crockett weapon system.

It is important to note that the M101 spotting round was not an atomic explosive. Rather, it consisted of a nosecone, a DU body (containing about 6.2 ounces of DU), and an aluminum tail assembly. The nosecone of the M101 version of the spotting round contained a small amount of explosive that produced a "puff" of smoke to allow the soldier to locate the impact point of the spotting round.

The M101 spotting round had a different composition and was not designed or used like today's DU kinetic energy penetrators. See Figure 2 for pictures of the M101 spotting rounds. See Figure 3 for pictures of M101 fragments.

Unlike modern DU penetrators that upon impact with a hard target generate a cloud of pyrophoric DU dust, use of the M101 spotting round resulted in DU alloy being deposited in large fragments that remain mostly intact, even today.

These licenses allowed specific Army facilities to produce M101 spotting rounds and distribute

them to various Army installations for testing, training, and deployment. In addition, such licenses allowed for export of small arms and artillery ammunition containing uranium components for military purposes from about 1961 to 1965.

Figure 1, Davy Crockett Weapon System



Figure 2, M101 Spotting Rounds

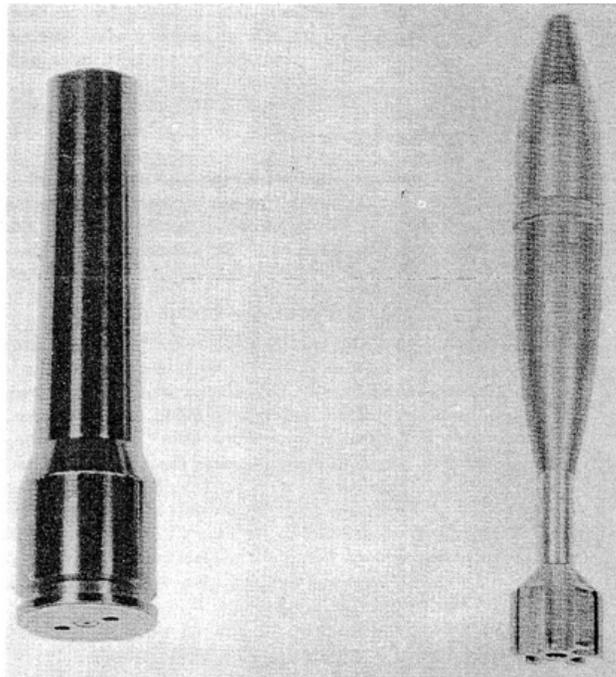


Figure 3, M101 Fragments



Tail Fin Assembly found at Schofield Barracks



Fragment found at Schofield Barracks



Tail Fin Assembly found at Pohakuloa Training Area

Between 1962 and 1968, the Army received and used DU (which the NRC licenses as source material) in the form of Davy Crockett M101 spotting rounds at firing ranges at various installations, including Forts Benning and Gordon, GA, Forts Campbell and Knox, KY, Fort Carson, CO, Fort Hood, TX, Fort Lewis, WA (currently called Joint Base Lewis-McChord/ Yakima Training Center, WA), Fort Bragg, NC, Fort Polk, LA, Fort Sill, OK, Fort Jackson, SC, Fort Hunter Liggett, CA, Fort Greely, AK (currently called Donnelly Training Area, Fort Wainwright, AK), Fort Dix, NJ (currently called Joint Base McGuire-Dix-Lakehurst, NJ) and Fort Riley, KS. As a result, DU was scattered throughout a limited number of ranges used for Davy Crockett weapon system practice and qualification. The Army discontinued firing these spotting rounds at these ranges by 1968.

The conditions of License SUB-459 were modified many times between 1961 and its expiration in 1978 without inquiry from the AEC/NRC regarding the locations where Davy Crockett M101 rounds were distributed, possessed, and used. Once the Army stopped using the Davy Crockett weapon system, the M101 spotting rounds were no longer manufactured and distributed. The Army was not required by license SUB-459 to report where it had distributed

the M101 spotting rounds. Also, collection of the fired Davy Crockett M101 spotting rounds was not part of the Army procedures referenced in its 1961 application (ML091880342), 1968 applications (ML102420515 and ML10241978), 1973 application (ML102430135 and ML102430137), 1974 application (ML102430141), 1978 application (ML111080529) or any amendments (ML102300050, ML102300027, ML102420515, ML102420619, ML102430089, ML111080529, ML112521255, ML112521257, and ML112521249). During its service life, the existence of the Davy Crockett weapon system was a closely held military matter, and little was known about its deployment or the use of Davy Crockett M101 spotting rounds in practice. The Army manufactured about 75,000 M101 spotting rounds; subsequently, approximately 44,000 of these rounds located at Lake City Arsenal, in Independence, MO, were demilitarized (i.e., disposed of). Although records are incomplete, the Army assumes that the majority of the M101 spotting rounds that were not demilitarized were consumed in the U.S. in training on various ranges; in demonstrations; and during research, development, and testing. The Army estimates that approximately 17 percent of the rounds not demilitarized were used in training conducted overseas [NRC 2013b].

At the request of the Army, the NRC allowed License SUB-459 to expire in April 1978 (ML111080529). Parts of License No. SUB-459 superseded license Nos. SUB-307 and SUB-348. License No. SUB-307 authorized the fabrication, testing, and export of DU rounds at the Frankford Arsenal and Lake City Arsenal. License No. SUB-348 authorized the possession of DU artillery component parts at Picatinny Arsenal. The authority to export DU components as part of explosive devices was transferred to License No. SBE-7228 in about 1965, at which time SUB-459 was amended so that it no longer authorized the export of DU rounds. There was a request for termination of License No. SBE-7228 in 1973; the license was due to expire in 1973. DU was never exported under License No. SBE-7228. At the time of license expiration, the NRC thought that the source material held pursuant to SUB-459 was either transferred to other valid license holders or disposed of as radioactive waste (ML111670084). The Frankford Arsenal was decommissioned under NRC authority under SUB-1339. The Picatinny Arsenal is being decommissioned under SUB-348, Docket No. 04006377. The Lake City Arsenal decommissioning is complex in that parts of the facility are being decommissioned under the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 or Superfund (sometimes known as CERCLA) and other parts of the facility are being decommissioned under NRC authority via License No. SUC-1380, Docket No. 04008767. For more details, refer to Staff Requirement Memorandum (SRM)-98-201, "Deferral of Regulatory Oversight of Certain Portions of the Lake City Army Ammunition Plant to the U.S. Environmental Protection Agency," (ML003755439) [NRC 1998a] and SRM-01-0088, "Deferral of Regulatory Oversight of Area 10 (The Sand Pile) of Lake City Army Ammunition Plant to EPA & Request to Remove Site from Site Decommissioning Management Plan," (ML011650107) [NRC 2001].

In 2005, the Army discovered tail assemblies from the M101 spotting round on Schofield Barracks on the Island of Oahu, HI, while clearing former range areas of munitions. Later, during a controlled grass burn of this range in the summer of 2006, the Army discovered several additional DU fragments. In November 2006, the Army notified the NRC that it had discovered the DU fragments at the Army's Schofield Barracks installation (ML070650224).

With the discovery of Davy Crockett M101 spotting rounds at this range, the Army looked into whether DU was present at other Army ranges where the Army fired M101 Davy Crockett spotting rounds. The Army initiated an Archive Search Report (ASR) project [USACE 2011], conducted by the St Louis U.S. Army Corps of Engineers (USACE), to study the issue. In 2006,

the ASR team determined that M101 spotting rounds were used both on the Schofield Barracks and Pohakuloa Training Area ranges located in HI. The ASR team conducted searches for the three-foot piston, a remnant of the Davy Crockett DU M101 spotting round, which provided evidence that the DU from Davy Crockett M101 spotting round could have been fired at each range. The ASR team was able to conduct these searches since the piston fell within 200 yards of the firing point and did not require the team to go onto the impact areas of these ranges.

From November 2006 through February 2007, the NRC and the Army staff discussed the presence of the DU at the Schofield Barracks and next steps in the licensing process (ML070650224). In February 2007, the Army sent a letter to the NRC outlining its investigation of the DU and stated that it may need a license to possess the DU (ML070650679).

The Army also suggested that, before submitting a license application, it needed to determine the total number of installations that might contain DU from the Davy Crockett weapon system. In March 2007, the NRC staff sent a letter to the Army stating that the Army's approach was reasonable (ML070710239).

On November 6, 2008, the Army submitted a license application to the NRC for a possession-only license for DU (ML090070095) at the two Army installations located in HI. Seven other Army installations that were believed to have DU from the Davy Crockett weapon system were identified by the Army by this time. Various radiation safety plans, physical security plans, and environmental radiation plans were submitted by the Army to the NRC between 2009 and 2010, as explained in the SER for the initial licensing of the two Army installations in Hawaii that have Davy Crockett DU (ML13259A081). These submittals overlapped the period of time that the Army was in the process of investigating where Davy Crockett M101 spotting rounds might have been fired at other installations.

On March 11, 2010, the NRC sent a letter (ML100350694) to the Army regarding the need for separate amendment applications for each Army installation where DU from the Davy Crockett weapon system was found.

On November 16, 2010, the NRC held a license application meeting with the Army. At that meeting, the Army informed the NRC of the current status of its investigation into the extent of DU for Davy Crockett M101 spotting rounds at Army installations and indicated that DU may be present at 15 installations other than the two Army installations located in HI. Because the licensing proceedings for the two Army installations with sites containing DU from the Davy Crockett M101 spotting rounds located in HI were well underway, the NRC believed it was prudent to complete the licensing process for the two Hawaiian installations and bring them under NRC regulatory oversight first and then address the licensing of the other Army installations through separate license amendment applications. At that time, the Army and the NRC envisioned that 15 additional separate license amendment applications and 15 separate licensing proceedings or orders, including site-specific considerations and conditions, would be needed. This would have been a resource-intensive undertaking.

The results of the USACE's investigative work under the ASR Project spanned from 2006 to 2011. The result was a report (referred to as the ASR) with annexes for specific installations that described Army efforts to identify Army ranges where the Army fired Davy Crockett M101 spotting rounds. Through the NRC licensing of the sites at the Schofield

Barracks/Pohakuloa Training Area, HI, the NRC agreed that it was reasonable for the Army to use the ASR for the basis for establishing the RCAs [NRC 2013b].

On October 23, 2013, the NRC issued Source Materials License No. SUC-1593 (ML13259A062) to the Army for possession of DU from Davy Crockett M101 spotting rounds at the Army installation sites located at Schofield Barracks/Pohakuloa Training Area, HI. License Condition 12 required the Army to add the remaining 15 sites with Davy Crockett M101 spotting rounds by license amendment.

A PSP, an RSP, and an ERMP were required for the Schofield Barracks and Pohakuloa Training Area RCAs located at the Army facilities in HI. One PSP, one RSP, and one ERMP was applicable to these two Army facilities. The same types of plans would also be needed for the additional RCAs at the 15 additional Army installations that possess DU from Davy Crockett M101 spotting rounds. The NRC staff informed the Army that such plans would also have to be submitted as part of the Army license amendment application.

In a letter dated November 12, 2013 (ML13325A975), the Army submitted a proposed schedule for submitting license amendment requests incorporating the additional sites identified in License Condition 12 of Source Material License No. SUC-1593. The NRC responded in a letter dated December 4, 2013 (ML13329A357), suggesting, among other things, that the NRC and the Army begin site-specific discussions to address how the Army would amend its license for this purpose. Subsequently, beginning in February 2014, the NRC began to explore whether it was possible to streamline the incorporation of the remaining Army installations with sites that contain DU from Davy Crockett M101 spotting rounds into Source Material License No. SUC-1593 using a programmatic approach.

On September 25, 2014 (ML14293A129), the NRC and the Army met to have a discussion regarding a streamlined licensing approach. The objective of this meeting was to obtain a decision from the Army regarding the licensing approach it wanted to pursue for the remaining Army installations with sites that have DU from Davy Crockett M101 spotting rounds. At this meeting, the NRC stated that it examined the matter of streamlining the addition of the remaining sites in question to the Army's license using the programmatic approach and concluded that it is a feasible option. At this meeting, the NRC discussed the key aspects of this approach and identified the types of information that the Army would need to provide in order for a programmatic approach to be viable, as well as the need for license conditions with implementation milestones for site-specific program plan development. The NRC said that the programmatic approach builds on previously approved Army plans and would also require the Army to provide program descriptions (as opposed to submitting actual program plans) that "fully describe" the Army's methodology for developing and implementing installation or site-specific program plans for all of its installations on the license, including the two Army installations located in HI that are already licensed. The NRC communicated that with a programmatic approach, the Army could submit a programmatic PSP, programmatic RSP, and programmatic ERMP with its license amendment application. Details about what a programmatic approach would entail are found in the September 25, 2014 meeting summary (ML14293A129).

Two pre-license-amendment publicly noticed meetings between the NRC and the Army, referred to as readiness reviews, occurred on February 19, 2015 (ML15065A361) and

March 25, 2015 (ML15096A285), respectively, to discuss various topics related to the Army's approach to add the remaining Army installations subject to License Condition 12 of Source Materials License No. SUC-1593. These meeting summaries identify the significant issues and information gaps between the draft applications and the technical content that the NRC staff expected the Army to include in its final application. The NRC staff's expectation was that the Army consider the NRC's observations from the readiness review while the Army finalized its application. The draft applications were not evaluated by the NRC staff as part of this SER.

During the February 19, 2015 meeting, the Army said it was unaware of any specific NRC guidance documents that would be relevant for possession of DU on active munition ranges. At this meeting, the Army requested additional guidance for development of its programmatic ERMP because the sites (RCAs) are unique (not reactors, fuel cycle facilities, etc.). After this meeting, the NRC staff referred to the existing NRC guidance and found that no specific environmental monitoring guidance for these types of sites had been developed. The NRC staff reviewed the guidance in the NRC's risk-informed decisionmaking framework found in Revision 1 of *Risk-Informed Decisionmaking for Nuclear Material and Waste Applications*, dated February 2008 (ML080720238) [NRC, 2008]. The NRC staff found that this guidance was helpful in its efforts in developing a response to the Army's request. On February 27, 2015, the NRC staff provided the Army with the additional environmental guidance (ML15061A177), "*Davy Crockett - Depleted Uranium – Possession Only License Source Materials License No. SUC- 1593 Additional Guidance*," [NRC 2015]. This guidance is specific to the Army installations that have Davy Crockett M101 spotting rounds.

In a letter dated June 1, 2015, the Army submitted its license amendment application (ML15161A454), [as supplemented by submittals on June 1, 2015 (ML15160A509 and ML15161A458); September 30, 2015 (ML15294A276); December 31, 2015 (ML16004A369); January 8, 2016 (dated December 31, 2015) (ML16022A161); January 29, 2016 (ML16041A107); February 9, 2016 (ML16042A232); and February 12, 2016 (ML16048A347), to the NRC requesting that Source Materials License No. SUC-1593 (ML13259A062) be amended pursuant to License Condition 12, including the two Army facilities located in HI.

Based on the Army's amendment application, there are a total of 41 sites (RCAs) that contain Davy Crockett M101 spotting rounds over 15 different States in the U.S and 16 different Army Installations, as summarized in Table 1, "Location and No. of Sites with Depleted Uranium from Davy Crockett Spotting Rounds at Each Army Installation" of this SER.

Table 1. Location and No. of Sites³ with Depleted Uranium from Davy Crockett M101 Spotting Rounds at Each Army Installation

	Army Installation, as described in the license amendment application	Nearest City	Number of Sites and Range Name(s), as license amendment application
1	Donnelly Training Area, Fort Wainwright, AK ⁴	Fairbanks, AK	1 (GEORGIA RANGE)
2	Fort Benning, GA	Columbus, GA	9 (HOOK RANGE, PATTON RANGE, BUCHANAN RANGE, COOLIDGE RANGE, BRANN RANGE, Z-4 (LAE) FIELD RANGE, K-18 RANGE (CACTUS OP), K-15 RANGE (CONCORD OP/DUD AREA), and BURMA HILL RANGE (DEMO AREA))
3	Fort Bragg, NC	Layette, NC	1 (OP 5 RANGE)
4	Fort Campbell, KY ⁵	Clarksville, KY	1 (OP2/OP3)
5	Fort Carson, CO ⁶	Colorado Springs, CO	2 (RANGE 141 and BATTALION FIELD TRAINING AREA)
6	Fort Gordon, GA	Augusta, GA	1 (RANGE E)
7	Fort Hood, TX	Killeen, TX	1 (DAVY CROCKETT RANGE)
8	Fort Hunter Liggett, CA	Monterey, CA	3 (RANGE C8, RANGE B11 and RANGE B13)
9	Fort Jackson, SC	Columbia, SC	1 (RANGE 62)
10	Fort Knox, KY	Fort Knox, KY	3 (ARMS KNOB RANGE (2) and O'BRIEN RANGE ⁷)
11	Fort Polk, LA	Leesburg, LA	2 (RANGE 33 and RANGE 34A)
12	Fort Riley, KS	Junction City, KS	3 (RANGES 27A & 27B, RANGE 18 A, B, & C, and RANGE 19A & 19B)
13	Fort Sill, OK	Lawton, OK	1 (FP 182/WEST RANGE IMPACT AREA)
14	Joint Base Lewis-McChord/Yakima Training Center, WA	Tacoma, WA	At Lewis-McChord area: 3 (52, OP8, and OP9) At Yakima Training Center Area: 3 (#14, #17, and #20)
15	Joint Base McGuire-Dix-Lakehurst, NJ	Trenton, NJ	1 (FRANKFORD ARSENAL RANGE)
16	Schofield Barracks (Oahu)/Pohakuloa Training Area, HI ⁸	Honolulu, HI Between Kailua-Kona, HI and Hilo, HI	At Schofield Barracks 1 (M101 Impact Area) At Pohakuloa Training Area – 4 (Area 1, Area 2, Area 3, and Area 4, located among Ranges 17, 14, 10 and 11T)
		TOTAL	41 sites among 14 States proposed by the Army in its application to amend Source Materials License No. SUC-1593

³ The Army refers to the sites that have DU from Davy Crockett M101 spotting rounds as M101 impact areas, RCAs, M101 Target areas, M101 Target zone/impact areas, active ranges, or sites in its application.

⁴ This RCA was formerly part of Fort Greely, AK, but now this area is under administrative control of Fort Wainwright, AK.

⁵ The M101 target zone/impact area (site or RCA) is located in TN, not KY.

⁶ The Army requested that the 3 sites at Titus and Sergeants Roads (not listed in Table 1, above) be licensed under a General License. Refer to Section 9.0 of this SER for information regarding these 3 sites.

⁷ M101 firing was on the O'Brien (aka O'Brein) Range; also Arms Knob range is depicted as two overlapping ranges of the same name. Lawley and Garvin Ranges shown on the M101 Impact Maps, submitted on January 8, 2016 (ML16022A161), do not contain DU, per the ASR report (ML16041A107).

⁸ The Army considers this as one Army facility located in the State of Hawaii in its amendment application, even though one facility is located on the Island of Oahu and the other is located on the Island of Hawaii. The NRC considers each as an installation-facility for dose assessment purpose. For additional information, refer to Footnote 11 in Section 3.4 of this SER.

The documents that were evaluated by the NRC staff for this SER with respect to the Army's radiation safety program and physical security program for all 16 Army installations are:

- The programmatic RSP, "Radiation Safety Plan for IMCOM [Installation Management Command]⁹ Ranges Affected by M101 Davy Crockett Spotting Round Depleted Uranium," dated December 31, 2015 (ML16004A369)
- The programmatic PSP; "Physical Security Plan for US Army Installation Management Command Ranges Affected by Depleted Uranium in M101 Davy Crockett Spotting Rounds," dated December 31, 2015 (ML16004A369)
- Information in the Army's Form 313, "Application for Materials License," items 1-7, dated June 1, 2015 (ML1516A454)
- Attachment 3, "Calculation of TEDE to Individual Likely to Receive Highest Dose," dated June 1, 2015 (ML1516A454)
- Attachment 4, "How the Army Determined the M101DU RCAs," dated June 1, 2015 (ML1516A454)
- Attachment 5, "Bounding Calculations Using RESRAD 7.0 and RESRAD-OFFSITE 3.1," dated June 1, 2015 (ML1516A454)
- Attachment 8, "Arguments against Air Sampling During HE [High Explosive] Fire into RCAs [Radiation Control Areas]," dated June 1, 2015 (Pkg. ML15161A454)
- Maps of the locations of the RCAs, "M101 Impact Areas," dated December 31, 2015 (but, sent February 12, 2016) (ML16048A358)
- Information in the Army's September 30, 2015, submittal (ML15294A276) that provides the technical basis for its bounding dose assessment modeling, namely:
 - Attachment 8, "Estimating Public Exposure to Airborne Depleted Uranium Outside the U.S. Army Pohakuloa Training Area, Hawaii"
 - Attachment 9, "Examples of Army Range fires"
 - Attachment 10, "Arguments against Air Sampling During HE Fire into RCAs, rev. 1"
 - Attachment 11, "Calculation of Public Dose SOP"

In addition, the programmatic ERMP, "Programmatic Approach for Preparation of Installation-specific Environmental Radiation Monitoring Plans", dated December 31, 2015 (ML16004A369), was used in conjunction with information that was independently identified by the NRC staff to evaluate the types of environmental monitoring that would be necessary at the Army's installations that contain DU from Davy Crockett M101 spotting rounds. Additionally, the "US Army Decommissioning Funding Plan (DFP) for License Number

⁹ IMCOM – US Army Installation Management Command

SUC-1598,” dated February 9, 2016 (ML16042A232); the Army’s emails clarifying the location of the RCAs, dated January 29 and February 12, 2016 (ML16041A107 and ML16048A347, respectively); and the Army’s Statement of Intent (SOI), dated June 1, 2015 (ML15161A458) were evaluated by the NRC staff in this SER. The documents listed above with ML numbers will be the licensing basis and will be jointly referred to as the approved license amendment application.

Safety Evaluation

1.0 Authorized Use

1.1 Regulatory Requirements

10 CFR 40.31 establishes the requirement for NRC to issue a license and states that

[a] person subject to the regulations in this part may not receive title to, own, receive, possess, use, transfer, provide for long-term care, deliver or dispose of byproduct material or residual radioactive material as defined in this part or any source material after removal from its place of deposit in nature, unless authorized in a specific or general license issued by the Commission under the regulations in this part.

1.2 Regulatory Acceptance Criteria

The application was reviewed for compliance with the applicable requirements of 10 CFR 40.31.

1.3 NRC Staff Review and Analysis

The Army’s application for a license amendment to possess DU from Davy Crockett M101 spotting rounds was submitted by the Army, as discussed in the introduction to this SER. The application consists of Items 1-12, as specified in NUREG-1556, Vol. 7, “Consolidated Guidance About Materials Licenses: Program-Specific Guidance About Academic, Research and Development, and Other Licenses of Limited Scope Including Gas Chromatographs and X-Ray Fluorescence Analyzers” [NRC 1999]. The items relating to authorized use are discussed below.

Item 3 of the Army’s submitted NRC Form 313, “Application for Materials License,” lists the address where licensed material will be used (possessed).

Item 5 of the Army’s submitted NRC Form 313, “Application for Materials License,” states that the Army is requesting possession of DU (^{238}U , ^{235}U , and ^{234}U) from Davy Crockett M101 spotting rounds in any chemical form and at a maximum amount of 5,700 kg or 29,622 M101 rounds at any one time. The Army’s test records and demilitarization records account for approximately 46,000 rounds out of a total production of 75,318 rounds. Accordingly, the estimated 29,622 M101 rounds which have not been accounted for contain approximately 5,700 kilograms of DU. Also, Item 5 of the Army’s submitted NRC Form 313, “Application for Materials License,” specifies the number of M101 rounds and the DU mass of these rounds for each installation. The Army’s estimated number of M101 spotting rounds at each installation is footnoted with relevant information from the ASR report [USACE 2011] that the Army used to

develop its estimate. The Army estimated the DU mass at each installation by using the estimated number of M101 spotting rounds assumed to have been delivered to each installation and that each M101 spotting round contains 3,180 (± 25) grains or 0.2061 ($\pm .0015$) kg of molybdenum-DU alloy. The Army also assumed that molybdenum-DU alloy is 92 percent DU, so each M101 spotting round contains about 0.190 kg of DU.

The NRC staff reviewed the assumptions and information that the Army provided to estimate the number of rounds of Davy Crockett M101 spotting rounds and mass of DU at each installation. The NRC selected three of the 16 installations at random and was able to reproduce the estimated DU mass for these installations. However, the NRC staff notes that the total amount of DU, 5628.2 kg, representing the estimated sum total of all DU at all the specified Army installations, does not match the value that the Army requested for the maximum amount of DU (5700 kg) that it would be authorized to possess at any one time. The Army states that this discrepancy is due to rounding. It should be noted that the dose modeling used in this review considered the DU mass corresponding to either 1000 or 9700 M101 rounds. The Army identified that the estimated maximum number of Davy Crockett M101 rounds among the 16 Army installations is found at Fort Benning, GA (9700 rounds distributed over 9 RCAs) that corresponds to an estimated mass of approximately 1843 kg of DU.

Item 6 of the Army's submitted NRC Form 313, "Application for Materials License," provides the purpose for which the licensed material will be used. Authorization was requested for "Activities necessary for the possession and management of depleted uranium (DU) M101 spotting rounds and fragments as a result of previous use of depleted uranium at US Army installations." The Army elaborates by stating that activities include "those that are necessary to maintain the facilities in a safe condition and to prevent the unauthorized removal of licensed material from the authorized places of use; to determine the presence of licensed material at Army facilities; to monitor the radiological and environmental conditions in and around the authorized places of use to determine whether licensed material is being transported in the environment; and for activities that are necessary for the packaging, transport, and disposal of incidentally identified licensed material to a licensed/permitted disposal facility."

Item 7 of the Army's submitted NRC Form 313, "Application for Materials License," describes the individuals responsible for the radiation safety program and their training experience. Items 8, 9, and 10 of the Army's submitted NRC Form 313, "Application for Materials License," discuss training for individuals working in or frequenting restricted areas, facilities and equipment, and the radiation safety program, respectively.

Section 4.0 of the programmatic RSP provides a list of specific activities the Army requests permission to undertake, consistent with item 6 of the Army's submitted NRC Form 313, "Application for Materials License," as well as those that it will not undertake (termed "unauthorized activities") on the ranges (sites or M101 target areas) on each Army installation that contains DU from Davy Crockett M101 spotting rounds. Also, in Section 4.0 of the programmatic RSP, the Army discusses the procedures it will use if DU is present when unexploded ordnance is identified, including what actions the Army will undertake if the unexploded ordnance is exploded in place. It also discusses the use of the Battle Area Complex (BAX) on the RCA at the Schofield Barracks and the controls the Army will use during training exercises.

Attachment 2, "M101 Impact Areas (Radiation Control Areas)," of the June 1, 2015 submittal (ML15161A454), includes maps of each RCA at each Army installation that has DU from Davy Crockett M101 spotting rounds. On December 31, 2015, the Army resubmitted these maps (ML16022A161), along with other documents, to consolidate all responses to RAs into one document because there were extensive changes to some of the documents. Also, the Army had corrected and updated several items in these resubmitted documents on its own. The NRC staff found that in the December 31, 2015 maps, the Army clarified that RCAs at Fort Campbell, KY, are located in TN. However, the NRC staff noted that the Army removed the Garvin Range, Hackett Range, and the Dorret's Run RCAs from the Fort Knox, KY M101 Impact Maps. The Army said that the Army had incorrectly identified them in the Army's June 1, 2015 submittal as ranges that have DU from Davy Crockett M101 spotting rounds. The Army resubmitted all of these maps on January 8, 2016 (ML16022A161). On January 29, 2016 (ML16041A107), the Army further clarified the number of RCAs at Fort Knox, KY, after reexamining the ASR [USACE, 2011] against its January 8, 2016 submittal. Specifically, the Army incorrectly included the Garvin and Lawley Ranges in the M101 Target Area maps. The ASR [USACE, 2011] does not identify these ranges as ranges that contained DU from Davy Crockett spotting rounds.

The NRC staff reviewed the Army's January 8, 2016 and January 29, 2016 submittals against the Army's December 31, 2015 DFP and found that some names of the RCAs at some of the Army installations did not match the names of the RCAs in the Army's January 8, 2016 submittal. In addition, the NRC staff noted that the Army removed a statement about certification of funds. On February 8, 2016 (ML16039A149), the NRC staff requested that the Army resolve these discrepancies. The Army resubmitted its DFP on February 9, 2016 (ML16042A232) and clarified the names and number of the RCAs. The NRC staff confirmed that the number of RCAs at each installation, the names of each RCA at each installation, and the area that each RCA covered, as represented in the February 9, 2016 DFP, were consistent with the January 8, 2016 and January 29, 2016 submittals, and the ASR [USACE, 2011], except for the number of ranges at Fort Riley, KS. The NRC staff requested that the Army clarify, for Fort Riley, KS, the discrepancy and identify and explain any resulting change to its February 9, 2016 DFP. On February 12, 2016, the Army stated that it had changed the DFP after visiting one of the ranges and updated the DFP and the associated M101 maps. The Army indicated that it thought it sent the updated M101 maps with its February 9, 2016 submittal (ML16042A232). The Army resubmitted its M101 maps on February 12, 2016 (ML16048A347). The NRC staff confirmed that the Army's February 9 and 12, 2016 submittals were consistent with the ASR [USACE, 2011].

1.4 Evaluation Findings

The NRC staff concludes that the methods that the Army used to estimate, the type of material, its chemical and physical form, and the mass of DU at each installation are reasonable. The NRC staff concludes that the methods that the Army used to estimate the locations of where the Army used the Davy Crockett M101 spotting ranges is reasonable. The Army undertook an extensive study that involved researching Army historical documents and interviewing Army staff involved in either the use of the material or the maintenance of the current ranges. Because these ranges also contain unexploded ordnances and because the methods to estimate the location of the DU are acceptable to the NRC staff, it is not necessary to identify the exact location of every M101 spotting round at the specified Army installations.

However, the maximum amount of DU mass, 5,700 kg, at any one time among all the specified installations that the Army requests, does not match the sum of the estimated amounts of DU mass, 5628.2 kg, present at these installations. The NRC staff found that, because the estimates of DU are based in large part on the recreation of source documents and interviews, and reported to the tenth decimal place, the level of accuracy reported by the Army is not consistent with the Army's calculation methods. Accuracy to this level is not possible using the Army's methods. Because all the installations are not co-located, the NRC staff found that specifying a mass limit for each installation was appropriate. The NRC staff rounded the Army's individual estimates of the DU mass present at each installation to the nearest tens place to address this discrepancy. The NRC staff reviewed the Army's dose modeling approach and technical basis for the dose modeling and found that rounding up the amount of DU, as described above, at each installation did not impact the bounding all pathway dose value (technical basis for dose modeling). Table 2, "Estimated Amount of DU at Specified Army Installations," of this SER presents the maximum amount of DU estimated to be present at each installation, as indicated in the amendment application, and the maximum amount of DU at each installation that the NRC estimated to be present after performing rounding, as described above.

Table 2. Estimated Amount of DU at Specified Army Installations

Specified Installation	Army's Estimate DU mass (kg)	NRC's Estimate DU mass (kg)
A. Fort Benning, GA	A. 1843.0	A. 1850
B. Fort Bragg, NC	B. 800.3	B. 810
C. Fort Campbell, KY	C. 129.4	C. 130
D. Fort Carson, CO	D. 266.8	D. 270
E. Fort Gordon, GA	E. 25.7	E. 30
F. Fort Hood, TX	F. 767.2	F. 770
G. Fort Hunter Liggett, CA	G. 25.7	G. 30
H. Fort Jackson, SC	H. 25.7	H. 30
I. Fort Knox, KY	I. 751.6	I. 760
J. Fort Polk, LA	J. 365.4	J. 370
K. Fort Riley, KS	K. 20	K. 20
L. Fort Sill, OK	L. 111.2	L. 120
M. Fort Wainwright Donnelly Training Area, AK	M. 20	M. 20
N. Joint Base Lewis-McChord/Yakima Training Center, WA	N. 333.6	N. 340
O. Joint Base McGuire-Dix-Lakehurst, NJ	O. 9.5	O. 10
P. Schofield Barracks/ Pohakuloa Training Area, HI	P. 135.7	P. 140
TOTAL	5628.2 kg	5700 kg

The NRC staff also reviewed the Army's dose modeling approach, which was based on an

estimate of the number of rounds associated with an individual range and not a total mass of DU for an individual installation. NRC staff finds this approach to be acceptable since it provides a more accurate assessment of the exposure to individuals associated with the individual ranges, especially when considering that an individual cannot be located on more than one range at any given time.

1.5 Conclusions/Findings

The NRC staff reviewed the proposed use of DU from Davy Crockett M101 spotting rounds at the Donnelly Training Area, Fort Wainwright, AK; Fort Benning, GA; Fort Bragg NC; Fort Campbell, KY; Fort Carson, CO; Fort Gordon, GA; Fort Hood, TX; Fort Hunter Liggett, CA; Fort Jackson, SC; Fort Knox, KY; Fort Polk, LA; Fort Riley, KS; Fort Sill, OK; Joint Base Lewis-McChord/Yakima Training Center, WA; Joint Base McGuire-Dix-Lakehurst, NJ; and the Schofield Barracks/Pohakuloa Training Area, HI and found that it is in accordance with the applicable requirements of 10 CFR 40.31 and is consistent with the guidance in NUREG-1556, Vol. 7, "Consolidated Guidance About Materials Licenses: Program-Specific Guidance About Academic, Research and Development, and Other Licenses of Limited Scope Including Gas Chromatographs and X-Ray Fluorescence Analyzers" [NRC 1999]. Based on this review, the NRC staff finds that the information in the Army's license application, along with the supporting radiation safety documents and physical security documents discussed herein, represent acceptable documentation to comply with 10 CFR 40.31.

This finding justifies removal of License Condition 12, which requires the addition of specific Army installations that have DU originating from Davy Crockett M101 spotting rounds (as shown below) and replacing it with License Condition 10, upon approval of the license amendment.

License Condition 12:

12. "The licensee will provide the Nuclear Regulatory Commission (NRC) with license amendment requests to incorporate the following list of sites: Forts Benning and Gordon (Georgia); Fort Campbell (Kentucky); Fort Carson (Colorado); Fort Hood (Texas); Fort Knox (Kentucky); Joint Base Lewis-McChord and the Yakima Training Center (Washington); Fort Bragg (North Carolina); Fort Polk (Louisiana); Fort Sill (Oklahoma); Fort Jackson (South Carolina); Fort Hunter Liggett (California); Fort Greeley (Alaska); Fort Dix (New Jersey); and Fort Riley (Kansas) on this license in accordance with a schedule developed by the Army."

Proposed License Condition:

10. "The authorized places of use (possession) shall be at U.S. Army installations at: Donnelly Training Area, Fort Wainwright, AK; Fort Benning, GA; Fort Bragg, NC; Fort Campbell, KY; Fort Carson, CO; Fort Gordon, GA; Fort Hood, TX; Fort Hunter Liggett, CA; Fort Jackson, SC; Fort Knox, KY; Fort Polk, LA; Fort Riley, KS; Fort Sill, OK; Joint Base Lewis-McChord/Yakima Training Center, WA; Joint Base McGuire-Dix-Lakehurst, NJ; and Schofield Barracks/Pohakuloa Training Area, HI."

This finding also justifies including the following information indicated in Table 3, “Amount of DU Proposed for Inclusion in License Amendment,” of this SER in Item 8, “Maximum amount that Licensee May Possess at Any One Time Under This License, “ on Form 374, “Materials License,” for Amendment No.1 to Source Materials License No. SUC-1593:

Table 3. Amount of DU Proposed for Inclusion in License Amendment

Specified Installations	Estimate DU mass (kg)
A. Fort Benning, GA	1850
B. Fort Bragg, NC	810
C. Fort Campbell, KY	130
D. Fort Carson, CO	270
E. Fort Gordon, GA	30
F. Fort Hood, TX	770
G. Fort Hunter Liggett, CA	30
H. Fort Jackson, SC	30
I. Fort Knox, KY	760
J. Fort Polk, LA	370
K. Fort Riley, KS	20
L. Fort Sill, OK	120
M. Fort Wainwright, Donnelly Training Area, AK	20
N. Joint Base Lewis-McChord/Yakima Training Center, WA	340
O. Joint Base McGuire-Dix-Lakehurst, NJ	10
P. Schofield Barracks/ Pohakuloa Training Area, HI	140
TOTAL	5700 kg

2.0 Radiation Safety and Security

2.1 Radiation Safety Program

2.1.1 Regulatory Requirements

The following regulations apply to the applicant's radiation safety program:

- 10 CFR 20.1101(a) requires that each licensee develop, document, and implement a radiation protection program commensurate with the scope and extent of licensed activities and sufficient to comply with the provisions of 10 CFR Part 20, "Standards for Protection Against Radiation"
- 10 CFR 20.1101(c) requires licensees to review their radiation protection program at least annually
- 10 CFR 20.2102 requires licensees to maintain records relevant to the radiation safety program
- 10 CFR 40.32(b) requires that licensees are qualified by training and experience to use the source material for the purpose listed in the license in a manner that protects health and minimizes danger to life or property
- 10 CFR 40.32(c) requires that the licensee's equipment, facilities and procedures are adequate to protect and minimizes danger to life or property
- 10 CFR 40.61 establishes the records relevant to the receipt, transfer and disposal of source material

2.1.2 Regulatory Acceptance Criteria

The application was reviewed for compliance with the applicable requirements of 10 CFR Parts 20, "Standards for Protection Against Radiation," and 40, "Domestic Licensing of Source Material," and with the guidance provided in NUREG-1556, Vol. 7, "Consolidated Guidance About Materials Licenses: Program-Specific Guidance About Academic, Research and Development, and Other Licenses of Limited Scope Including Gas Chromatographs and X-Ray Fluorescence Analyzers" [NRC 1999].

Organization and Administrative Controls

2.1.3 NRC Staff Review and Analysis

The Army's organization structure is presented in Section 2 of the programmatic RSP. The U.S. Army Installation Management Command (IMCOM) Commander has overall responsibility for the radiation safety program. Specific responsibilities of the IMCOM Commander relative to the radiation safety program are described in detail in Section 2.1 of the programmatic RSP. The Army will inform the NRC when the IMCOM Commander changes.

The responsibility for the development, implementation, and overall administration of the programmatic RSP lies with the License RSO. The License RSO reports to the IMCOM Commander and is responsible for assuring and monitoring compliance with NRC regulations and license conditions. The IMCOM Commander will notify the NRC within 30 days of when the current License RSO departs and is replaced. NRC approval for a change of the License RSO is required. The qualifications, duties and authority of the License RSO are described in detail in Sections 2.3.1, 2.3.2 and 2.3.3 of the programmatic RSP.

The Garrison RSO is responsible for day-to-day radiation safety operations and oversight during routine range activities. The Garrison Commander will notify the License RSO as soon as possible when the current Garrison RSO departs and when he or she appoints a new Garrison RSO. The appointment is subject to concurrence of the License RSO, who will verify the Garrison RSO candidate meets the qualification requirements stated in the programmatic RSP. The qualifications, duties and authority of the Garrison RSO are described in detail in Sections 2.4.1, 2.4.2, and 2.4.3 of the programmatic RSP.

The License RSO and Garrison RSO have the authority to immediately stop any operation on these ranges if he or she has any health and safety concerns. Additionally, the License RSO can temporarily suspend individuals from field activities for infractions against the programmatic RSP pending consideration by the Garrison Commander. The Garrison RSO can temporarily suspend individuals from field activities for infractions against the programmatic RSP pending consideration from the License RSO and Garrison Commander.

Section 2.5 of the programmatic RSP discusses the responsibilities and authority of individuals entering the RCAs. Personnel entering an RCA are responsible for understanding and complying with the policies and procedures in the programmatic RSP and have the authority to refuse work and stop work if work conditions are not safe or if the work would not comply with the safety procedures in the programmatic RSP. They also have authority to contact the Garrison RSO, License RSO, Garrison Commander, or NRC to discuss potential safety concerns.

Management Controls

2.1.4 NRC Staff Review and Analysis

Management controls are described in Sections 19 (Program Audits), 21 (Recordkeeping), and 23 (Standard Operating Procedures) of the programmatic RSP. Aspects of these management controls are important to the physical security of the DU. However, to avoid duplication of information and to ensure consistency, the Army references the appropriate sections of the programmatic RSP in the programmatic PSP. Section 5.3 and Section 5.5 of the programmatic PSP references Sections 19 (Program Audits) and 21 (Recordkeeping) of the programmatic RSP for program audits and recordkeeping, respectively.

The Garrison RSO is responsible for monitoring activities in the RCAs. The License RSO will perform annual audits of the radiation safety program to ensure compliance with NRC and license requirements and that occupational and public doses are as low as reasonably achievable (ALARA). A detailed description of the components of an annual audit is included in Section 19.2 of the programmatic RSP.

The Garrison RSO is responsible for maintaining the records relevant to the radiation safety program. Section 21.1 of the programmatic RSP lists the records that will be maintained. Because the maintenance of records is also important to the physical security of the DU and to avoid duplication of information and to ensure consistency, Section 5.5 of the programmatic PSP references Section 21 of the programmatic RSP for recordkeeping. The License RSO will also maintain copies of these records. These records will be made available for review by NRC during inspections.

The License RSO produces and maintains the Standard Operating Procedures (SOPs) associated with the radiation safety program. Section 23 of the programmatic RSP lists the SOPs that will be developed and used in implementing the Army's programmatic RSP.

2.1.5 Evaluation Findings

The NRC staff reviewed the applicant's qualifications for individuals responsible for implementing the Army's radiation safety program with the applicable requirements of 10 CFR Parts 20, "Standards for Protection Against Radiation," and 40, "Domestic Licensing of Source Material," and the guidance in NUREG-1556, Vol. 7, Sections 8.7.1 and 8.7.2 [NRC 1999].

The License RSO position meets the qualifications in Section 8.7.1 of NUREG-1556, Vol. 7 [NRC 1999]. The Garrison RSO position represents both the Garrison Commander and the License RSO in the day-to-day radiation safety operations and oversight at his or her garrison. The Garrison RSO qualification and training requirements are identified and Section 2.4.1. The License RSO must ensure that the Garrison RSO has received this specific training from the License RSO. The License RSO directs the activities of the Garrison RSO. The Garrison RSO has authority to immediately stop any operation involving the use of source material if he or she has any radiological safety concerns. The Garrison RSO may temporarily suspend individuals from field activities for infractions against the programmatic radiation safety plan pending consideration by the Garrison Commander and the License RSO. The Garrison RSO position meets most of the qualifications described in NUREG-1556, Vol. 7, Section 8.7.1 [NRC 1999], for an RSO, and all of the qualifications described for an authorized user (AU) that are described in NUREG-1556, Vol. 7, Section 8.7.2 [NRC 1999]. NUREG-1556, Vol. 7 [NRC 1999] does not include guidance on the qualifications for RSOs below the License RSO level, but includes guidance for AUs that use or directly supervise the use of licensed material. The AU's primary responsibility is to ensure that radioactive materials used in his or her particular lab or area are used safely and according to regulatory requirements. This position is comparable to the Garrison RSO, and as indicated, the Garrison RSO meets all of the requirements for an AU. As explained in NUREG-1556, Vol. 7, Section 8.7.2 [NRC 1999], applicants must provide the name of each proposed AU with the types and quantities of licensed material to be used and information demonstrating that each proposed AU is qualified by training and experience to use the requested licensed materials.

The Army requested that, rather than providing the qualifications of the Garrison RSO when the NRC is notified of the change of the Garrison RSO, the Licensee RSO will ensure that the Garrison RSO meets the minimum qualifications and that the Army will maintain records of the Garrison RSO's qualifications for inspection by the NRC, citing privacy as a rationale for this request (ML12265A173). The issue was discussed during meetings between the NRC and the Army during review of the original license application. The Army stated that the requirement to provide the Garrison RSO qualifications to the NRC each time the Garrison RSO changed could

pose an unnecessary administrative burden due to the large number of installations listed on the license and because the Garrison RSO may change frequently at these installations, due to Army mission requirements. As such, the Army stated it would provide the name of the Garrison RSO to the NRC in a timely manner and ensure that the Garrison RSO meets the minimum qualifications in the programmatic RSP. The Army also committed to maintain records of the Garrison RSO's qualifications for review by the NRC during inspections and provide the NRC with the name of the Garrison RSO within 30 days of the change. The NRC staff found this request to be reasonable for this situation. These commitments are included in the programmatic RSP.

Therefore, based on this review, the NRC staff concludes that the information in the Army's license amendment application, along with the supporting radiation safety documents discussed herein, represent acceptable documentation to comply with the requirements of 10 CFR 40.32(b) and is consistent with the guidance in NUREG-1556, Vol. 7, "Consolidated Guidance About Materials Licenses: Program-Specific Guidance About Academic, Research and Development, and Other Licenses of Limited Scope Including Gas Chromatographs and X-Ray Fluorescence Analyzers" [NRC 1999] for qualifications for individuals responsible for radiation safety programs.

Based on this review, the NRC staff concludes that the information in the Army's amendment application, along with the supporting radiation safety documents discussed herein, represent acceptable documentation to comply with the requirements in 10 CFR Part 20, Subpart L, "Records;" 10 CFR 20.1101(a); 10 CFR 20.1101(c); 10 CFR 40.31 10 CFR 40.32(b); 10 CFR 40.32(c); 10 CFR 40.61 and is consistent with NUREG-1556, Vol. 7, "Consolidated Guidance About Materials Licenses: Program-Specific Guidance About Academic, Research and Development, and Other Licenses of Limited Scope Including Gas Chromatographs and X-Ray Fluorescence Analyzers" [NRC 1999] for organizational, administrative and management controls.

2.2 Radiation Safety Training

2.2.1 Regulatory Requirements

10 CFR 40.32(b) and 10 CFR 19.12 are the regulations that apply to the applicant's radiation safety training program. 10 CFR 40.32(b) requires that licensees are qualified by training and experience to use the source material for the purpose listed in the license in a manner that protects health and minimizes danger to life or property, and 10 CFR 19.12 requires that individuals that are likely to receive an occupational dose in excess of 100 millirem (mrem) in a year be provided training in radiation safety and the applicable provisions of the license conditions and the NRC's regulations.

2.2.2 Regulatory Acceptance Criteria

The application was reviewed for compliance with the applicable requirements of 10 CFR Parts 19, "Notices, Instructions and Reports to Workers: Inspection and Investigations," 20, "Standards for Protection Against Radiation," and 40, "Domestic Licensing of Source Material," and the guidance provided in NUREG-1556, Vol. 7, "Consolidated Guidance About Materials Licenses: Program-Specific Guidance About Academic, Research and Development, and Other

Licenses of Limited Scope Including Gas Chromatographs and X-Ray Fluorescence Analyzers” [NRC 1999].

2.2.3 NRC Staff Review and Analysis

Radiation safety training for individuals entering the RCA is described in Sections 2.5, 2.6, and 20 of the programmatic RSP. All individuals, except one-time visitors, entering the RCA will be trained in the policies and procedures of the programmatic RSP. Visitors requiring entry to the RCA will be briefed by the Garrison RSO and will be escorted at all times in the RCA. Section 20 of the programmatic RSP provides a list of the types of training that will be provided to individuals entering the RCA. The Garrison RSO will provide the training before allowing individuals to enter the RCA and maintain documentation demonstrating that the training has been completed.

2.2.4 Evaluation Findings

The NRC staff reviewed the applicant’s qualifications for individuals responsible for implementing the radiation safety program at each installation and found them to be in accordance with the applicable requirements of 10 CFR 40.32(b) and guidance in NUREG-1556, Vol. 7, Section 8.8 and Appendix J, “Radiation Safety Training Topics” [NRC 1999].

Sections 2.5, 2.6, and 20 of the programmatic RSP describe the general and RCA-specific training topics that will be covered, which individuals will be trained, the training frequency, the individuals conducting the training, and the method that will be used to document the training. The training described in these sections is appropriate for the radionuclides and activity of the source material that is expected to be found on the Army installations and is consistent with 10 CFR 19.12 and the training program described in NUREG-1556, Vol. 7, Section 8.8 and Appendix J, “Radiation Safety Training Topics” [NRC 1999].

Based on this review, the NRC staff concludes that the information in the Army’s license application, along with the supporting radiation safety documents discussed herein, represent acceptable documentation to comply with the requirements of 10 CFR 19.12 and 40.32(b) and the guidance in NUREG-1556, Vol. 7, Section 8.8 and Appendix J, “Radiation Safety Training Topics,” [NRC 1999] for individuals working in or frequenting a restricted area.

2.3 Radiation Control Areas

2.3.1 Regulatory Requirements

The following regulations apply to the applicant’s RCAs:

- 10 CFR 19.11 establishes the requirements for posting notices to workers;
- 10 CFR 20.1101(a) requires that each licensee develop, document and implement a radiation protection program commensurate with the scope and extent of licensed activities and sufficient to comply with the provisions of 10 CFR Part 20, “Standards for Protection Against Radiation;”

- 10 CFR 20.1101(b) requires licensees to use procedures and engineering controls to maintain doses to workers and the public that are ALARA; and
- 10 CFR 40.32(c) requires that the licensee's equipment, facilities and procedures are adequate to protect and minimize danger to life or property.

2.3.2 Regulatory Acceptance Criteria

The amendment application was reviewed for compliance with the applicable requirements of 10 CFR Parts 20, "Standards for Protection Against Radiation," and 40, "Domestic Licensing of Source Material," and was reviewed using the guidance provided in NUREG-1556, Vol. 7, "Consolidated Guidance About Materials Licenses: Program-Specific Guidance About Academic, Research and Development, and Other Licenses of Limited Scope Including Gas Chromatographs and X-Ray Fluorescence Analyzers" [NRC 1999].

2.3.3 NRC Staff Review and Analysis

The Army indicated that the establishment and control of access to RCAs are important aspects to radiation protection and to physical security of the DU from Davy Crockett M101 spotting rounds. These topics are discussed in Sections 3, 4, 14, and 15 of the programmatic RSP. RCAs are also addressed in Section 3 of the programmatic PSP. The Army indicated in its response to the second RAI that the programmatic PSP will refer to the programmatic RSP where there are overlapping topics pertinent to both of these plans. The Army indicated that this was done to ensure consistency and to avoid duplication of information between the programmatic RSP and the programmatic PSP. Therefore, the NRC staff will discuss the content of both the programmatic RSP and the programmatic PSP, as applicable, below.

In the programmatic PSP, the Army identifies that through the St. Louis District of the U.S. Army Corps of Engineers, the ASR Project was conducted from 2006 to 2011. The Army indicates that ASR project resulted in an ASR (report) [USACE 2011] which identifies the Army installations ranges where the Army fired M101 Davy Crockett spotting rounds. The Army used the ASR [USACE 2011] for each installation identified in License Condition 12 of Source Materials License No. SUC-1593 as part of the basis for establishing the RCAs for the sites that have DU from Davy Crockett M101 spotting rounds. The Army applied other criteria, as explained in Attachment 4, "How the Army Determined the M101 DU RCAs," in the Army's first RAI response (ML15294A276), dated September 30, 2015; however, the Army indicated that it most heavily weighted the criterion of an actual finding of Davy Crockett ammunition debris during range inspections.

Section 3 of the programmatic RSP describes the procedures for revising the RCA. These procedures address how the Army would handle a situation if additional M101 spotting rounds are found in an area outside an RCA, and includes provisions for how the NRC will be informed that the M101 spotting rounds has been located. Enlarging the RCA can be done by the License RSO if additional Davy Crockett DU from the M101 spotting rounds are located outside the boundaries of an RCA. The Army will inform the NRC within 30 days, if any additional M101 rounds are found and the RCA is enlarged. Reduction of the approved RCA will require approval by the NRC.

Section 4 of the programmatic RSP describes the activities that may and may not occur within the RCA.

Section 14 of the programmatic RSP describes the posting of the RCA to identify it as an area containing radioactive material. The programmatic RSP states that signs will be posted at a sufficient number of locations around the RCA to ensure that individuals entering the RCA are aware of the presence of DU. The signs may be posted at the perimeter of the range impact area, if posting them at the RCA boundary is unsafe due to the presence of unexploded ordnance. This requirement is included as License Condition 18 and as proposed License Condition 15¹⁰. Also, Section 14 of the programmatic RSP describes how the Army will post the documents and notices to workers that are required by 10 CFR 19.11. Because the Army believes that posting of the RCA is relevant to the physical security of this DU material, in Section 5.1.1 of the programmatic PSP, the Army references Section 14 of the programmatic RSP to address posting requirements in its programmatic PSP.

Section 15 of the programmatic RSP details the access control measures for individuals entering the RCA, including training on the access requirements and the posting requirements for the RCA. The License RSO will review the programmatic RSP annually and update it, as necessary. The Army will inform the NRC of any significant changes to the programmatic RSP, and, if appropriate, the changes will be approved by the NRC before implementation. When access is permitted, access control points will be established for entry to and exit from the RCA and personnel will be required to undergo the training described in Section 20 of the programmatic RSP.

The RCA access control responsibilities are also relevant to physical security of this DU material, Section 2 of the programmatic PSP references the appropriate sections of the programmatic RSP to ensure consistency and to avoid duplication of information. In the programmatic PSP, the Army indicates that access to the RCA is prohibited without the knowledge and approval of the Garrison RSO. Section 4 of the programmatic PSP also addresses the subject of access control of the RCA. In Section 4.1 of the programmatic PSP, the Army provides references that govern access control to the Army installations and ranges. These references are applicable to the sites (ranges) that have Davy Crockett M101 spotting rounds. In Section 4.2 of the programmatic PSP, the Army extracts some "pertinent" references that are listed in Section 4.1 of the programmatic PSP which are specific Army regulations and guidance that prescribe policy for developing effective physical security programs and range management at U.S Army installations. Section 4.3 of the programmatic PSP refers to Section 15 of the programmatic RSP for access control requirements for the RCA.

In Sections 1.1 and 4 (including subsections) of the programmatic RSP, the Army specifically discusses the RCA at the Schofield Barracks on the Island of Oahu, HI. As related to control of the RCA at Schofield Barracks, the Army identifies that the Schofield Barracks RCA contains portions of the Battle Area Complex (BAX). The BAX was cleared of unexploded ordnance and DU by an Army contractor in 2005. Through the licensing process and eventual licensing action that resulted in the issuance of Source Materials License No. SUC-1593, the NRC allowed the Army to use the BAX for training mounted and dismounted troops, with certain restrictions since early 2013 (ML13071A224, ML13016A040). Section 4.4 of the programmatic RSP discusses

¹⁰ License condition renumbering is necessary due to removal of several license conditions based on the NRC staff's technical evaluation of the Army's application and its findings.

the use of the BAX at the Schofield Barracks and discusses how personnel involved in training events on the BAX are exempt from the requirements of the programmatic RSP. The NRC allowed the Army to use the BAX with certain restrictions because the BAX area was surveyed by a licensed decommissioning contractor with extensive experience in site decommissioning and the Army has committed to restrict vehicles and troops only to areas of the BAX that were cleared of DU by the contractor.

2.3.4 Evaluation Findings

The NRC staff reviewed the RCA control and access procedures for the Army ranges affected by Davy Crockett M101 spotting rounds in accordance with the applicable requirements of 10 CFR 19, 20, and 40 and according to guidance in NUREG-1556, Vol. 7, Section 8.10 [NRC 1999]. NUREG-1556, Vol. 7, Section 8.10 [NRC 1999] discusses how licensed materials must be secured from unauthorized access or removal so that individuals who are not knowledgeable about radioactive material are not exposed or contaminated by the material and cannot take the material. The programmatic RSP provides detailed descriptions of how RCAs are established, controlled and maintained, as well as how access is controlled through posting areas and the training of individuals. Access to the ranges where the sites that contain DU from Davy Crockett M101 spotting rounds are located is strictly controlled due to the presence of unexploded ordnance and, thus, these sites are not readily accessible to the public. In addition, the RCAs are located on controlled military reservations with incumbent security restrictions and requirements as identified in Section 4 of the programmatic PSP.

Further, the license amendment, if issued, would prohibit the Army from performing decommissioning or ground disturbing activities to collect or remove DU fragments or contaminated soil that is identified during routine range activities without prior authorization from the NRC. Picking up incidental pieces of DU that the Army finds during training exercises would be allowed without NRC approval, if it does not involve ground disturbing activities.

Under the current license, Source Materials License No. SUC-1593, Army training on the BAX is exempted from the requirements of the approved RSP because the NRC reviewed and approved the final radiological surveys for the BAX (ML13071A224, ML13016A040, and ML13259A081). The NRC staff determined that the type and manner of the Army training in the BAX, and the Army commitments about the conduct of activities there, as described in Sections 4.2, 4.3, and 4.4 of the programmatic RSP, are essentially the same as those in the approved RSP. Also, the radiological surveys of the BAX that the NRC reviewed and approved still stand and do not need to be revisited. Under the programmatic RSP, the Army would be conducting training on the BAX in a manner that ensures that mounted and dismounted troops and vehicles are not entering areas that contain DU, consistent with the current license. Therefore, for this amendment application review, the NRC staff finds that use of the BAX is appropriate for the same reasons as with the initial licensing of this area located at the Schofield Barracks.

For the majority of the installations involved, the areas known or suspected to contain DU from Davy Crockett M101 spotting rounds are within operational range impact areas on which high explosive and other munitions have been routinely used for over 30 years. Given their use and the presence of explosive hazards, access to impact areas is strictly controlled. When access to such areas is authorized, the Army generally limits access to range personnel for range maintenance and similar range-related purposes. Should access be required for other

purposes, range personnel, explosive ordnance disposal personnel or other unexploded ordnance-qualified personnel are required to escort those requiring access. Based on this review, the NRC staff concludes that the information in the Army's license amendment application, along with the supporting radiation safety documents and physical security documents discussed herein, represent acceptable documentation to comply with the requirements of 10 CFR 19.11; 10 CFR 20.1101(a); 10 CFR 20.1101(b); and 10 CFR 40.32(c) and is consistent with the guidance in NUREG-1556, Vol. 7, "Consolidated Guidance About Materials Licenses: Program-Specific Guidance About Academic, Research and Development, and Other Licenses of Limited Scope Including Gas Chromatographs and X-Ray Fluorescence Analyzers" [NRC 1999].

However, in order to ensure that decommissioning will be conducted in accordance with the requirements of 10 CFR 40.42, license conditions pertaining to notification of NRC, the use of decommissioning contractors, and the approval of decommissioning plans are necessary. These requirements are included as License Conditions 19, 20, and 21 in the current license and would be included as License Conditions 16 a. – c. in the amended license.

19. (16 a.) The licensee shall not perform any decommissioning or ground disturbing activities to collect or remove DU fragments or contaminated soil that is identified during routine range activities at the Radiologically Controlled Areas identified in this license without prior authorization from NRC. Picking up incidental pieces of DU that the Army finds during training exercises would be allowed without NRC approval, if it does not involve ground disturbing activities (This last sentence is added to this License Condition);
20. (16 b.) NRC or Agreement State licensed contractors may undertake decommissioning or ground disturbing activities to collect or remove DU fragments or contaminated soil that is identified during routine range activities at the Radiologically Controlled Areas identified in this license consistent with the conditions and commitments of their license(s); and
21. (16 c.) When the licensee engages an NRC or Agreement State licensed contractor to undertake decommissioning or ground disturbing activities to collect or remove DU fragments or contaminated soil that is identified during routine range activities at the Radiological Controlled Areas identified in this license, the licensee will notify NRC in accordance with the requirements of 10 CFR 40.42. The licensee shall provide NRC with the contractor's site-specific decommissioning plans and all other documents associated with radiation safety and environmental monitoring associated with the proposed decommissioning or ground disturbing activities in accordance with the requirements of 10 CFR 40.42 prior to the commencement of the activity. If issues are identified by NRC that could impact radiological health and safety, they will be resolved prior to the commencement of the activity.

2.4 Radiation Safety Controls and Monitoring

2.4.1 Regulatory Requirements

The following regulations apply to the applicant's radiation safety controls and monitoring program:

- 10 CFR Part 20, Subpart C, "Occupational Dose Limits": 20.1201 – 1208 provides occupational dose limits, radiation exposure requirements, and information on dose limits to an embryo/fetus
- 10 CFR Part 20, Subpart D, "Radiation Dose Limits for Individual Members of the Public": 20.1301 provides requirements for dose limits and 20.1302 provides the compliance requirements
- 10 CFR Part 20, Subpart F, "Surveys and Monitoring": 20.1501 and 20.1502 provides survey and monitoring requirements and details on conditions requiring individual monitoring of external and internal occupational dose
- 10 CFR Part 20, Subpart L – "Records": 20.2101 – 20.2110 provides information on the types of radiation safety records that must be kept and the retention requirements
- 10 CFR Part 20, Subpart M – "Reports": 20.2201 – 20.2207 provides information reporting requirements related to incidents, exposure monitoring, theft/loss, and transfer of materials

2.4.2 Regulatory Acceptance Criteria

The application was reviewed for compliance with the applicable requirements of 10 CFR Part 20, "Standards for Protection Against Radiation" and was reviewed in accordance with guidance provided in NUREG-1556, Vol. 7, "Consolidated Guidance About Materials Licenses: Program-Specific Guidance About Academic, Research and Development, and Other Licenses of Limited Scope Including Gas Chromatographs and X-Ray Fluorescence Analyzers" [NRC 1999].

2.4.3 NRC Staff Review and Analysis

2.4.3.1 Radiation Exposure Monitoring Program

The Army has committed to maintaining personnel radiation exposure ALARA, taking technical and socioeconomic factors into account. Section 5 of the programmatic RSP discusses the Army's ALARA program, and notes that it will be implemented through training of personnel in appropriate radiation safety practices and work procedures, good housekeeping practices, engineering controls, and the use of Personal Protective Equipment (PPE) as necessary. Section 5.3 of the programmatic RSP also indicates that, through the implementation the contamination control programs, no one will be allowed to exceed regulatory dose limits. Section 6 of the programmatic RSP further indicates that "Title 10 CFR, Part 20, Subparts C and

D contains the NRC occupational and public dose limits, which will not be exceeded under any circumstances.”

The Army has determined that dosimetry will not be required for entry into an RCA, as it is not expected that unmonitored personnel will receive more than 10 percent of any allowable public limit. The Army has also estimated that the maximum annual total effective dose equivalent (TEDE) to either a worker or a member of the public resulting from exposure to DU associated with Davy Crockett M101 spotting rounds will not exceed the NRC’s public dose limit of 0.1 rem/yr TEDE. The Army notes in Section 8.0 of the programmatic RSP that bioassay is not required for entry into or following exit from an RCA. If it is believed that an uptake of DU may have occurred, the Army has agreed that the Garrison RSO will consult with the License RSO in order to appropriately address the potential intake. Additionally, Section 22.2 of the programmatic RSP indicates that “although unlikely, significant acute ingestion or inhalation of DU-contaminated dust could occur and is the only credible radiological emergency at the RCA,” and that “in such an event, the worker will be evacuated to the local supporting military medical facility for evaluation.”

Section 6.3 of the programmatic RSP describes activities associated with the declared pregnant worker (DPW). For a DPW, the NRC has set a limit of 500 mrem TEDE to the embryo/fetus for the period of gestation. The Army states that even a small percentage of this dose limit could not be exceeded. In the event that a worker informs the Garrison RSO that she is a DPW, the Garrison RSO will acknowledge receipt of the declaration, maintain a record of the declaration, provide the DPW with a copy of NRC Regulatory Guide 8.13 (Instruction Concerning Prenatal Radiation Exposure) and consult with the License RSO.

Attachment 3, “Calculation of TEDE to Individual Likely to Receive Highest Dose,” and Attachment 10, “Arguments against Air Sampling During HE Fire into RCAs,” of the October 2015 submittal, essentially assess the likelihood of exceeding the effluent limits and effluent monitoring requirements of 10 CFR 20, Appendix B, Table 2, “Effluent Concentrations”. Calculations performed in Attachment 3, “Calculation of TEDE to Individual Likely to Receive Highest Dose,” and Attachment 10, “Arguments against Air Sampling During HE Fire into RCAs,” of the October 2015 submittal show that it would require, minimally, the complete aerosolization of 271 rounds of DU per year to exceed the effluent limits, on average. The Army notes that the Fort Benning contains the greatest number of rounds, but it is likely that Fort Bragg’s single RCA contains the greatest number of rounds within a single RCA. The Army notes that the highest number of rounds within a single RCA is likely present at Fort Bragg, NC (4212 rounds is estimated). As these rounds have been present at the site for over 50 years, it is highly unlikely that anything close to the actual limits for effluents has been occurring as that would have fully depleted the DU inventory in the RCA. In Attachment 10 of the October 1, 2010 submittal, this calculation was effectively revised to assess the number of rounds that would have to be aerosolized each year to require “effluent” monitoring (10% of the effluent limit), while the assumptions varied slightly with justification, the Army calculated 68 rounds would have to be completely aerosolized in a year to exceed the monitoring threshold. NRC staff verified the calculations provided by the Army.

The Army asserts there is no reason to believe the DU inventory has significantly varied over the past decades. It states that rounds can remain largely intact after 50 years in the environment, depending on the climate; that corrosion products remain on and in the soil in proximity to where each round landed, and; that any suspension into the atmosphere is short-

lived because of the DU density (i.e., any suspended DU will likely be deposited within several meters of a HE impact). Other points made in these attachments are that the highest external dose from DU-contaminated soil was calculated using the RESRAD code and shown to be less than 0.03 mrem/yr. Also, no DU was detected in air samples taken at Schofield Barracks where it has been performed recently during limited live-fire range activities, during routine contractor survey and construction operations, and during planned controlled range burns.

2.4.3.2 Contamination Control Program

The Army provides details on their contamination control program in Section 11 of the programmatic RSP. Section 11.1 of the programmatic RSP states that control points that will be established as necessary for entry and exit to the RCA. At these control points, the Garrison RSO will assure that instrument scanning will be performed on personnel, vehicles, and equipment as they exit the RCA. The Garrison RSO will normally perform these measurements. However, if the Garrison RSO cannot be present and work must proceed, the Garrison RSO may designate a worker to perform these measurements if the Garrison RSO has trained and verified the worker is able to do so in accordance with the programmatic RSP. All personnel who exit the RCA will be monitored for contamination as they leave the RCA, and decontamination (usually by soap and water) will be performed if DU contamination is detected. The Army will survey all equipment and vehicles for contamination as they leave the RCA. In the event that DU contamination is found, the equipment will be decontaminated to the levels provided in Table 6.1 of the programmatic RSP (including a requirement to decontaminate to ALARA). It is also noted in Section 11.3 of the programmatic RSP that if instrument scanning detects contamination, swipe tests will be performed to verify that decontamination efforts were adequate. Documentation that will be maintained for all contamination surveys of personnel, equipment, and vehicles is listed in Section 11.2 of the programmatic RSP.

Section 9 of the programmatic RSP discusses PPE and states that the Army has determined that normal work clothing will provide adequate protection from DU in the course of authorized range activities. However, disposable gloves will be worn at all times when handling DU. As noted in Section 10 of the programmatic RSP, the Army will not require respiratory protection for entry into the RCA.

2.4.3.3 Instrumentation

An overview of the Army's radiological instrumentation program is provided in Section 17 of the programmatic RSP. A discussion on "essential instruments" is provided in Section 17.1 of the programmatic RSP, where the Army states that "the Garrison RSO will assure that appropriate calibrated instruments are available for use by appropriately trained personnel before allowing personnel access to the RCA." The Army also states in Section 17.1 of the programmatic RSP that the Garrison RSO will possess at least two Geiger-Mueller pancake detectors for alpha-beta-gamma surveys for surface contamination and frisking (e.g., Ludlum Model 44-9 Pancake G-M Detector with appropriate meter; AN/PDR-77 with a pancake probe).

Instrument calibration and maintenance are described in Section 17.2 of the programmatic RSP. The Army has stated that all instruments will be calibrated by qualified calibration/repair facilities at least annually, and the Garrison RSO will retain the calibration records for at least three years. Response checks are required before the first use of an instrument each day in order to verify that the response is within ± 20 percent of the value established by the calibration

laboratory (or the Garrison RSO immediately upon receipt of a newly calibrated instrument). Each item of survey equipment is also required to meet function response checks before, during and at the end of each workday. Instruments requiring repair, other than routine maintenance, will be recalibrated before being returned to use.

Details on the calculations of minimum detectable concentrations (MDCs) are provided in Section 17.3. MDCs will be calculated and documented for each instrument put into use, and the Garrison RSO will make this information available for the License RSO or NRC personnel as requested. The calculation of static minimum detectable concentration is provided in Section 17.3.1, and is consistent with Equation 6-7 of NUREG-1575, Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM) [NRC 2000]. Scan MDC is discussed in Section 17.3.2 of the programmatic RSP, and is consistent with MARSSIM Section 6.7.2.1 and Equation 6-10.

2.4.3.4 Waste Management

The handling, marking and storage of radioactive waste from the Davy Crockett spotting round is discussed in Sections 13, 16, and 18 of the programmatic RSP. Section 5.1.2 of the PSP refers to Section 16 of the programmatic RSP for marking on containers and equipment and Section 5.2 of the programmatic PSP references Section 18 of the programmatic RSP for security of stored materials and waste management. Section 13 of the programmatic RSP describes the Garrison RSO responsibility for maintaining an inventory and control of all check sources associated with instrumentation used at the RCA. No other radioactive sources, other than DU from Davy Crockett M101 spotting rounds, are expected to be at the RCA. The Garrison RSO will maintain a log of all M-101 spotting rounds found on the installation. The log will show the location of each find, an estimate of the amount of DU and whether the DU was left in place or removed for proper disposal. Section 18 of the programmatic RSP describes the waste management and disposal procedures for spotting round fragments if they are discovered during range operations and states that the Garrison RSO, in coordination with explosive ordnance disposal personnel, will double-bag in plastic bags all DU that is picked up and removed from the RCA.

Anyone handling DU will use tools or wear gloves. The bags then will be stored in sturdy containers with appropriate markings. The Garrison RSO will secure these containers in a locked storage facility with access limited to personnel appropriately trained in radiation safety and security. Waste disposal will be coordinated through the Army Low-Level Radioactive Waste Disposal Division, U.S. Army Joint Munitions Command, who will arrange for appropriate disposal of the DU. Section 16 describes the marking of containers used to store spotting round fragments and describes how containers will be labeled with a "CAUTION RADIOACTIVE MATERIALS" sign or label. The label will also provide information, such as the radionuclides present (e.g., DU), an estimate of the quantity of radioactivity, the date for which the activity is estimated, radiation levels, and the kinds of materials.

2.4.3.5 Emergency Planning

Emergency planning for radiological and non-radiological emergencies is discussed in Section 22 of the programmatic RSP. Emergency contact information, as found in the Army's emergency response SOP, is provided in Section 22.1 of the programmatic RSP. In the event that an emergency occurs, the Garrison RSO will provide support to medical personnel as necessary and upon request. It is noted in Section 22.2 of the programmatic RSP that

“although, significant acute ingestion or inhalation of DU-contaminated dust could occur and is the only credible radiological emergency at the RCA”, and that “in such an event, the worker will be evacuated to the local supporting military medical facility for evaluation.” It is further stated in Section 22.3 of the programmatic RSP that life-saving and limb-saving emergencies will always take priority over radiation safety concerns. If there is such an emergency, the Army response will not necessarily wait for the Garrison RSO to allow entrance into the RCA.

2.4.4 Evaluation Findings

The NRC staff reviewed the Army’s regulatory safety controls and monitoring plans in accordance with the applicable requirements of 10 CFR Part 20, “Standards for Protection Against Radiation” and according to guidance in NUREG-1556, Vol. 7, “Consolidated Guidance About Materials Licenses: Program-Specific Guidance About Academic, Research and Development, and Other Licenses of Limited Scope Including Gas Chromatographs and X-Ray Fluorescence Analyzers” [NRC 1999].

2.5 Conclusions/Findings

The NRC staff concludes that the Army’s radiation safety program is consistent with 10 CFR 20.1101, which requires a licensee to “develop, document, and implement a radiation protection program commensurate with the scope and extent of licensed activities and sufficient to ensure compliance with the provisions of this part.” The NRC staff concludes that it has reasonable assurance that the Army’s proposed radiation safety program will operate in such a manner as to protect health and minimize danger to life or property, as is required by 10 CFR 40.32. Specific areas of the radiation protection program, such as As Low As is Reasonably Achievable (ALARA), radiation exposure monitoring, contamination control, instrumentation, waste management, and emergency planning are discussed below.

The NRC staff determined the Army’s commitment that all personnel radiation exposure will be kept ALARA along with the commitment in Section 5 of the programmatic RSP that only essential personnel will be in the RCA at any time provides consistency with the ALARA requirements of 10 CFR 20.1101 and the guidance in NUREG-1556, Vol. 7, “Consolidated Guidance About Materials Licenses: Program-Specific Guidance About Academic, Research and Development, and Other Licenses of Limited Scope Including Gas Chromatographs and X-Ray Fluorescence Analyzers” [NRC 1999]. The NRC staff concludes that the Army’s plan to implement the ALARA program through training, good housekeeping, engineering controls, and PPE is acceptable and in accordance with 10 CFR 20.1101(b), which requires that “the licensee shall use, to the extent practical, procedures and engineering controls based upon sound radiation protection principles to achieve occupational doses and doses to members of the public that are as low as is reasonably achievable (ALARA).”

Based upon the Army’s commitment in Section 6 of the programmatic RSP to not exceed the NRC occupational and public dose limits under any circumstances, the NRC staff concludes that the Army intends to comply with dose limits found in 10 CFR 20.1201 and 1301. This commitment is consistent with NUREG-1556, Vol. 7, Sections 8.10.4 and 8.10.5 [NRC 1999]. The Army’s decision that dosimetry will not be required for entry to the RCA is acceptable based on the Army’s determination that unmonitored personnel will not receive more than 10 percent of the allowable dose limits. This determination is consistent with regulations found in 10 CFR 20.1502, which establish conditions requiring individual monitoring of external and

internal occupational dose. Additionally, the Army's estimation that the NRC's public dose limit of 0.1 rem/yr will not be exceeded by either a worker or a member of the public complies with the requirements of 10 CFR 20.1302, which establish dose limits for individual members of the public. Based upon this estimation, internal and external exposure monitoring would not be required for a DPW, as the regulations in 10 CFR 20.1502 require monitoring when it is likely that a DPW would receive during the entire pregnancy, from radiation sources external to the body, a deep dose equivalent in excess of 0.1 rem or a committed effective dose equivalent in excess of 0.1 rem. This anticipated dose level is also below the occupational exposure limit for an embryo/fetus of a 0.5 rem dose equivalent, as stated in 10 CFR 20.1208. The NRC staff recognizes that dosimetry requirements could change based upon the results of routine surveys and evaluations, or based upon the results of annual program audits.

As shown in Attachments 3 and 10 of the September 30 2015, submittal (ML15294A276), the Army asserts that airborne DU materials leaving an RCA are highly unlikely to exceed 10 CFR Part 20 effluent limits (10 CFR 20.1302(b)(2)(i)) and air pathway dose constraint of 10 mrem/yr (10 CFR 20.1101(d)) based on the level of airborne DU needed to exceed the limits versus the amount of DU potentially present, past experience with the mobility of DU materials, and past experience with air sampling efforts. The NRC staff agrees with the Army's assertion, in their response to RAI 27, that HE ordinance aerosolization of DU materials would bound airborne materials resulting from range fires that may occur within the RCA. Explosions provide much greater motive force to aerosolize materials bound in a soil matrix than a range fire which wouldn't necessarily disturb the soil. The NRC staff finds that the Army's arguments, in total, adequately demonstrate that airborne materials leaving the RCAs/impact areas are highly unlikely to exceed regulatory exposure or monitoring requirements and not pose a danger to the public. As such, existing license conditions 17 and 22, shown below, **will be removed** from the license, upon approval of the amendment application.

17. The licensee shall not fire high-explosive munitions into areas containing depleted uranium without first informing NRC.
22. The licensee shall provide an air sampling plan to the NRC within 90 days of **[effective date of this license]** for review and approval. Until the air sampling results are approved by NRC the licensee will conduct activities on the ranges in accordance with previously approved restrictions and provisions.

In Section 11 of the programmatic RSP, the Army has committed that contamination surveys will be performed when personnel, vehicles, or equipment exit the RCA. The proposed manner and frequency of surveys is acceptable to the NRC staff and is consistent with 10 CFR 20.1501(a), which requires surveys that may be necessary to comply with the regulations in this part, and are reasonable under the circumstances to evaluate the magnitude and extent of radiation levels, the concentrations or quantities of radioactive material, and the potential radiological hazards. In the event that contamination is found during routine surveys, the Army has committed to completely decontaminate personnel, if possible, and to decontaminate materials and equipment to levels that are consistent with Table 6-1, "Acceptable Surface Contamination Levels" of the programmatic RSP and that are also ALARA. The referenced table is based on NRC Regulatory Guide 1.86, "Guidelines for Decontamination of Facilities and Equipment Prior to Release for Unrestricted Use or Termination of Licenses for Byproduct, Source, or Special Nuclear Material," [NRC 1993].

The NRC staff concludes the Army's commitment in Section 17 of the programmatic RSP to provide appropriate calibrated instruments for use by appropriately trained personnel prior to personnel access into the RCA is adequate and consistent with current NRC regulations and guidance in NUREG-1556, Vol. 7, Section 8.10.2 [NRC 1999]. The NRC staff concludes that instrumentation and its usage will comply with requirements of 10 CFR 40.32(c) that "the applicant's proposed equipment, facilities and procedures are adequate to protect health and minimize danger to life or property," and of 10 CFR 20.1501(b) that "instruments and equipment used for quantitative radiation measurements (e.g., dose rate and effluent monitoring) are calibrated periodically for the radiation measured." DU and its progeny include alpha, beta, and photon emissions. The NRC staff believes that the Army intends to maintain instrumentation to measure all of these emissions. However, site-specific environmental conditions and detection efficiencies will ultimately dictate instrument requirements. It should be noted that there may be unique situations which require specialized instruments in addition to those routinely kept on site. As such, the Garrison RSO would be responsible to provide any additionally required instrumentation. Prior to performing contamination surveys of personnel, vehicles, or equipment, appropriate scan and static minimum detectable concentrations (MDC) will need to be calculated and appropriate scan times to detect radioactivity ALARA will need to be determined. The scan and static MDC equations provided by the Army are acceptable to the NRC staff and are consistent with guidance in the Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM) [NRC 2000]. Ultimately, the implementation of radiological surveys will be subject to NRC inspection to ensure that appropriate instrumentation is being used and that surveys are being performed with ALARA concepts in mind.

The NRC staff reviewed the descriptions of how the Army will handle, mark and store radioactive waste from the Davy Crockett spotting round in Sections 13, 16, and 18 of the programmatic RSP and Sections 5 of the programmatic PSP. The NRC staff concludes that the Army's proposed procedures are adequate to ensure that incidentally identified spotting rounds are collected, stored, and disposed of adequately and in compliance with NRC requirements and guidance in NUREG-1556, Vol. 7, Section 8.11 [NRC 1999]. The NRC staff reviewed Section 22 of the programmatic RSP on emergency planning and determined that the Army's plans for radiological and non-radiological events are appropriate for the material expected to be on the ranges and consistent with guidance in NUREG-1556, Vol. 7, Section 8.10.6 [NRC 1999].

Based on this review, the NRC staff concludes that the Army's procedures for dose monitoring will be adequate to comply with 10 CFR Part 20, Subpart C, "Occupational Dose Limits," and 10 CFR 20, Subpart D, "Radiation Dose Limits for Individual Members of the Public." The procedures for contamination control and the instrumentation that will be available for use by the Army will be adequate to comply with 10 CFR Part 20, Subpart F, "Surveys and Monitoring;" waste will be managed in accordance with the requirements of 10 CFR 20, Subpart I, "Storage and Control of Licensed Material" and Subpart K, "Waste Disposal;" and the emergency procedures will be adequate for the radiological hazards posed by the licensed material.

3.0 Dose Assessment

As part of its submittal, the US Army included a dose assessment using overly conservative parameter values and bounding RESRAD calculations. The Army used this approach as a means for demonstrating that there are no plausible conditions under which DU associated with Davy Crockett M101 spotting rounds could produce an annual dose that exceeds NRC standards associated with the multiple sites being considered for inclusion in the license. According to the Army, this process of using conservative parameter values would enable them to use a single suite of RESRAD analyses for the all of the sites being considered for inclusion on the license and avoid the need for individual, site-specific analyses for each of the sites under consideration.

3.1 Regulatory Requirements

- 10 CFR Part 20, Subpart C, “Occupational Dose Limits”: 10 CFR 20.1201 – 1208 provides occupational dose limits, radiation exposure requirements, and information on dose limits to an embryo/fetus
- 10 CFR Part 20, Subpart D, “Radiation Dose Limits for Individual Members of the Public”: 10 CFR 20.1301 – 1302 establishes the dose to the public from licensed material

3.2 NRC Staff Review and Analysis

Included with the license amendment application was a dose assessment that evaluated doses to individuals located on and in the vicinity of the firing ranges who may come into contact with the DU associated with these sites. As part of the license amendment process, these results were provided to demonstrate that expected doses to the public do not exceed the limit of 0.1 mSv/yr (100 mrem/yr) specified in 10 CFR 20.1301(a)(1). These calculations, performed using RESRAD, Version 7, and RESRAD-OFFSITE, Version 3.1, used conservative, probabilistic input parameters in order to evaluate the maximum possible annual dose to anyone on an RCA for all of the sites being added to the license. The Army used conservative input parameters in an effort to use a single set of RESRAD analyses to encompass the characteristics of all of the sites being considered for inclusion on the license. Table 4, “Summary of Individual RESRAD Analyses Performed Using Bounding Parameter Values,” of this SER lists the scenarios considered by the Army to be plausible along with a short description and the average annual dose calculated using RESRAD, Version 7. The peak dose for all of these analyses occurred in the first year and decreases over time.

3.2.1 Bounding Scenario (Resident Farmer Scenario)

The Army used the resident farmer scenario to establish a conservative baseline scenario. The resident farmer, as described in NUREG-1757, Vol. 2, “Characterization, Survey, and Determination of Radiological Criteria, Revision 1” [NRC 2006], is considered to be the most conservative, bounding scenario considered in a RESRAD analysis. The Army assumed that the resident farmer resided on a 1 km² area of land on which 1000 M101 rounds were fired. The only modifications made to the RESRAD parameters were to set the contaminated zone area equal to 1 km² and the contaminated zone thickness to 0.15 m. Although considered a

conservative scenario for this dose assessment, the resident farmer scenario is not considered to be a foreseeable use of the operational ranges in the near future.

3.2.2 Bounding the Source Term

Based on available data, the greatest number of M101 rounds shipped to any individual installation was the 9700 rounds sent to Fort Benning, GA. Since Fort Benning, GA, contains eight M101 firing ranges and was actively used for soldier qualifications training it is unlikely that all 9700 rounds were fired at a single location. Therefore, as a means of bounding the source term, RESRAD analyses were performed assuming 9700 M101 rounds were fired on a single range. All other RESRAD parameters remained the same. As expected, doses associated with this scenario were 9.7 times greater than the doses calculated using the baseline scenario discussed above.

3.2.3 Evaluating Other Bounding Parameter Values

Using the resident farmer scenario and the assumption that 9700 M101 rounds were fired on a single range, the Army performed additional RESRAD analyses that involved modifying individual parameter values and evaluating their impacts on the dose.

3.2.3.1 Decrease Water Table Depth

The initial RESRAD analyses assumed that the contaminated zone is the top 15 cm of soil with no direct contact to the water table. By modifying the “contaminated fraction below the water table” parameter value to 0.5 the Army raised the water table surface to 7.5 cm, halfway into the contaminated zone. This allows half of the contamination to come into direct contact with the water. As a result of this parameter change the dose increased from 0.28 mrem/yr to 0.32 mrem/yr.

3.2.3.2 Increase the Contaminant Zone Erosion Rate

Starting with the “Bounding Source Term” scenario, the Army increased the erosion rate from 0.001 m/yr to 0.01 m/yr. Increasing the erosion rate resulted in a dose of 0.28 mrem/yr, which is the same as the dose calculated with the default erosion rate parameter value.

3.2.3.3 Increase the Contaminant Zone Total Porosity

Total porosity, as defined in the RESRAD manual [Yu et al., 2001], is the fraction of the total volume that is not occupied by solid soil particles. RESRAD uses a default value of 0.4 but, the highest total porosity value listed in Table E.8, “Representative Porosity Values,” of the RESRAD manual [Yu et al., 2001] is 0.57 for both clay and for weathered granite. To bound the parameter the Army elected to use a contaminate zone total porosity value of 0.6. RESRAD analyses using the increased total porosity value resulted in a maximum annual dose of 0.28 mrem/yr.

3.2.3.4 Increase the Contaminant Zone Hydraulic Conductivity

Hydraulic conductivity is a parameter that describes the rate at which water flows through the contaminant zone. The larger the value the faster the flow through the medium. The highest

value listed in Table E.2, “Representative Values of Saturated Hydraulic Conductivity, Saturated Water Content, and the Soil-Specific Exponential Parameter,” of the RESRAD manual (Yu et al., 2001) is 5500 m/yr. To create a bounding scenario the Army increased the RESRAD default value from 10 m/yr to 6000 m/yr. Results from the RESRAD analysis show that this bounding scenario with a high hydraulic conductivity value resulted in a maximum dose of 0.28 mrem/yr. The NRC staff performed an additional analysis to consider the impacts at a site with low contaminant zone hydraulic conductivity. The dose calculated for this scenario was 0.32 mrem/yr.

3.2.3.5 Changes to Annual Wind Speed

Wind speeds are expected to vary among the sites being evaluated for inclusion on the license. The Army performed two bounding analyses to evaluate the impacts from a range wind speeds have on the dose. In the first analysis the Army decreased the wind speed parameter from 2 m/s to 1 m/s, the smallest value included in Table B.2, “Coefficients for the Inhalation Pathway Area Factor for a Particle Size of 1 μm ,” of the RESRAD manual [Yu et al., 2001]. This change resulted in a maximum annual dose of 0.29 mrem/yr. The second analysis used a wind speed value of 10 m/s, the highest value included in Table B.2, “Coefficients for the Inhalation Pathway Area Factor for a Particle Size of 1 μm .” This change resulted in a maximum annual dose of 0.28 mrem/yr.

3.2.3.6 Changes to Annual Precipitation

The average annual precipitation is expected to vary among the sites being evaluated for inclusion on the license. According to the National Oceanic and Atmospheric Administration, HI has the highest average total annual precipitation of 1.6 m/yr (NOAA, 2015). The Army considered an annual precipitation value of 2 m/yr as a bounding value for the RESRAD analysis. Increases in annual precipitation resulted in a dose of 0.28 mrem/yr. The NRC staff performed an additional analysis to consider the impacts at a site with minimal rainfall by setting the precipitation parameter value to 0 m/yr. The dose calculated for this scenario was 0.39 mrem/yr.

3.2.3.7 All Bounding Parameter Values

The previous RESRAD analyses considered above used the RESRAD resident farmer scenario and modifications to individual environmental parameters. Differences in the maximum annual dose associated with these analyses were minimal. The Army then combined all of the bounding parameter values and used RESRAD to evaluate the impact all of the bounding parameter values had on the dose for the resident farmer scenario. The dose from this analysis, 0.33 mrem/yr, is similar to the doses calculated when a single parameter value was modified.

3.2.4 Adjusting the Size of the Range

All of the previous analyses performed by the Army considered a firing range that was 1 km². An additional analysis, using a range size of 0.1 km², was also conducted based on the conservative assumption that efforts were made to avoid firing M101 rounds near the borders of the range. As expected, results of this analysis, which considered the same amount of DU in an area ten times smaller than originally considered, resulted in a dose of 3.2 mrem/yr,

approximately 10 times the dose calculated for the larger area. Results from additional analyses performed by the NRC staff demonstrated that further decreasing the range area had no impact to the doses to individuals occupying the site.

3.2.5 RESRAD-OFFSITE Analysis

The Army also conducted a RESRAD-OFFSITE analysis to calculate the dose to a resident farmer residing one kilometer from the DU impact area. According to the Army one kilometer is a typical minimum distance between training ranges and occupied areas on a site. Since the individual would not be directly involved with the range, this analysis could also be considered to be a method for demonstrating compliance with NRC regulations, including 10 CFR 20.1101, related to evaluating doses to members of the public. The Army's RESRAD-OFFSITE dose calculations resulted in a maximum annual dose to the offsite individual of 0.035 mrem/yr. As with the RESRAD analyses performed for the onsite individual, the peak dose occurs in the first year and decreases over time.

3.2.6 Additional Analyses

Additional analyses using an industrial worker scenario were also considered by the NRC staff to evaluate potential doses associated with workers needed to address various issues such as fires that may occur on the ranges. The RESRAD analyses used the same conservative radionuclide concentrations described above but limited the exposure pathways to external gamma, inhalation, and soil ingestion. Modifications were also made to the inhalation rates and the size of the contaminated area. Doses calculated from these analyses were comparable to the resident farmer scenarios considered by the Army. As a result, the NRC staff concludes that the doses associated with industrial activities that may occur on the firing ranges are also not an issue. In addition, factors such as dispersion and atmospheric settling would result in lower doses to individuals not located directly on the contaminated area.

Table 4. Summary of Individual RESRAD Analyses Performed Using Bounding Parameter Values

Scenario	Description	Peak Dose (mrem/yr) ¹	Army's RESRAD Analyses
Resident Farmer	Baseline scenario with 1000 M101 rounds	0.029	Attachment 1
Bounding Source Term	Increase from 1000 M101 rounds to 9700 M101 rounds	0.28	Attachment 2
High Water Table	Water table surface is 7.5 cm below the surface	0.32	Attachment 3
Increased Erosion Rate	Increased the erosion rate from 0.001 m/yr to 0.01 m/yr	0.28	Attachment 4
Increased Contaminated Zone Total Porosity	Increased the total porosity from 0.4 to 0.6	0.28	Attachment 5
Increased Hydraulic Conductivity	Increased the hydraulic conductivity from 10 m/yr to 6000 m/yr	0.28	Attachment 6
Decrease Wind Speed	Decrease the wind speed from 2 m/s to 1 m/s	0.29	Attachment 7
Increase Wind Speed	Increase the wind speed from 2 m/s to 10 m/s	0.28	Attachment 8
Increase Annual Precipitation	Increase the annual precipitation from 1 m to 2 m	0.28	Attachment 9
Decrease Annual Precipitation	Decrease the annual precipitation from 1 m to 0 m	0.39	NRC-calculated ²
Combining All Bounding Parameter Values	All bounding parameter values (low wind speed)	0.33	Attachment 10
	All bounding parameter values (low wind speed and no precipitation)	0.42	NRC-calculated ²
	All bounding parameter values (high wind speed)	0.35	NRC-calculated ²
	All bounding parameter values (high wind speed and no precipitation)	0.36	NRC-calculated ²
Decrease Range Size	Decrease range size from 1 km ² to 0.1 km ² with bounding parameter values (low wind speed)	3.2	Attachment 11
	Decrease range size from 1 km ² to 0.1 km ² with bounding parameter values (low wind speed and no precipitation)	4.0	NRC-calculated ²
	Decrease range size from 1 km ² to 0.1 km ² with bounding parameter values (high wind speed)	3.5	NRC-calculated ²
	Decrease range size from 1 km ² to 0.1 km ² with bounding parameter values (high wind speed and no precipitation)	3.5	NRC-calculated ²

¹ All peak doses occurred at t=0, which occurred between 1960 and 1968.

² Calculated by the NRC staff using RESRAD, Version 6.5.

3.3 Evaluation Findings

The NRC staff reviewed and independently verified the RESRAD calculations provided by the Army and found the scenarios, parameters, and assumptions to be reasonable and appropriate. Results from the RESRAD analyses demonstrate that doses associated with DU on the firing ranges are minimal and support the NRC staff's decision to not require environmental monitoring of the soil, sediment, surface water, and ground water on a regular basis.

The Army elected to use a programmatic approach to license all the sites (RCAs) at the installations listed in License Condition 12 of the current license (proposed License Condition 10, upon approval of the amendment application). The Army's technical basis for the amendment includes a bounding calculation of 0.42 mrem/yr. This dose, which is for each RCA, is well below the 10 CFR 20.1101(d) 10 mrem/yr TEDE air pathway dose constraint that applies to all types of NRC licensed facilities except those subject to § 50.34a (considered ALARA).

Finally, the Army's bounding dose is well below the additional environmental guidance [NRC 2015] that the NRC staff provided the Army specific for Davy Crockett M101 spotting rounds on such Army ranges.

3.4 Conclusions/Findings

When the Army performs a site-specific dose calculation at the RCA located at each installation listed in proposed License Condition 10, the NRC should be able to verify that each site-specific dose value (each RCA's all pathway dose) is less than the bounding all pathway dose value of 1 mrem/yr that is part of the dose modeling technical basis for the license amendment.

When the Army performs site-specific dose calculations at each installation-facility,¹¹ the NRC should be able to verify that each installation-facility's all pathway dose value (summation of the calculated public dose value for each RCA at that installation-facility) is less than 10 mrem/yr TEDE [less than 10% of 100 mrem/yr TEDE (the public dose limit)]. Note, that the maximum number of RCAs at any one installation listed in License Condition 12 (proposed License Condition 10), is 9 (at Fort Benning, GA).

Proposed License Condition 19 would be included to address the need for the NRC staff to verify that each RCA's all pathway dose is not greater than 1.0 mrem/yr.

Proposed License Condition:

19. Within 6 months of the effective date of this license amendment, the licensee shall provide to the NRC for verification, documentation, including site-specific dose modeling parameters, showing that the approved dose modeling methodology was applied and that the calculated site-specific all pathway dose for each Radiation Control Area at each installation listed in License Condition 10 does not exceed 1.0E-2 mSv/yr (1.0 mrem/yr) TEDE.

¹¹ NRC considers joint bases or Army facilities that are not directly co-located, such as Schofield Barracks on the Island of Oahu and the Pohakuloa Training Area on the Island of Hawaii, to be separate facilities for dose modeling purposes. A calculated dose assessment must be performed for each facility (sum of the all pathway dose for each RCA at each facility) to demonstrate compliance with 10 CFR 20.1302. Therefore, the NRC refers to such facilities as installation-facilities for public dose compliance demonstration purposes.

4.0 Environmental Radiation Monitoring Program

The Army has submitted a programmatic Environmental Radiation Monitoring Program (ERMP) that contains general commitments for environmental monitoring of those transport pathways justified as having potential significance for the transport of DU contamination outside of the designated RCAs. The Army has committed to develop site-specific ERMPs for each Garrison/installation with sites that contain DU from Davy Crockett M101 spotting rounds identified in the Army's license amendment application. The Army indicates in the amendment application that the site-specific ERMPs will be submitted to the NRC within 6 months of NRC's approval of the programmatic ERMP and finalized and implemented the within a year.

For this evaluation, the NRC staff considers an environmental transport pathway significant if it potentially may contribute to exposures/dose at greater than 1% of the public dose limit (i.e., greater than 1 mrem/yr). The Army has performed environmental transport modeling using RESRAD¹² to bound most pathways considered relevant by assuming resident farming land use. In general, the RESRAD modeling is used to demonstrate that no environmental monitoring within the RCA is needed as there is very little dose resulting from the DU that is present (a maximum potential dose of 3.5 mrem/yr was modeled with only the direct exposure pathway exceeding 1 mrem/yr). Exposures outside of the RCA are expected to be of minor consequence as any DU present would be at a lower concentrations than anticipated within the RCAs. The Army's RESRAD-OFFSITE dose calculations resulted in a maximum annual dose to the offsite individual of 0.035 mrem/yr.

Those pathways that are not adequately bounded using RESRAD modeling include off-site transport of contaminants due to surface water erosion/runoff and airborne transport of contaminants aerosolized by high explosive (HE) ordinance or range burns. The Army makes a case based on calculations and experience to show it is highly unlikely that any significant airborne transport of DU has occurred via aerosolization of the DU rounds from HE ordinance strikes in the RCAs. Because the materials being licensed have been present for greater than 50 years, a logical case is made that, if aerosolization occurs due to range activities at levels approaching regulatory limits or monitoring limits, there would be little DU expected in the RCAs at this time. The Army cited past documentation that contamination from DU munitions is typically localized in the immediate vicinity (within 10-100 meters) of the impact area and that airborne particulate sampling conducted during recent live fire events in HI did not find any evidence of DU airborne contamination. The programmatic ERMP does call for surface water and sediment sampling as well as soil sampling of depositions if significant erosion occurs within the RCA.

4.1 Regulatory Requirements

The following regulations apply to the applicant's environmental monitoring program:

- 10 CFR Part 20, Subpart C, "Occupational Dose Limits": 20.1201 – 1208 provides occupational dose limits, radiation exposure requirements, and information on dose limits to an embryo/fetus

¹² RESRAD is a computer model code designed to estimate radiation doses and risks from RESidual RADioactive materials developed by Argonne National Laboratory (ANL). The U.S. Department of Energy (DOE) through ANL currently maintains code and version control (DOE, 2008).

- 10 CFR Part 20, Subpart D, “Radiation Dose Limits to Members of the Public”: 20.1301 – 1302 establishes the dose to the public from licensed material
- 10 CFR Part 20, Subpart F, “Surveys and Monitoring”: 20.1501 and 20.1502 provides survey and monitoring requirements and details on conditions requiring individual monitoring of external and internal occupational dose
- 10 CFR Part 20, Subpart I, “Storage and Control of Licensed Material”: 20.1801 and 20.1802 establishes requirements to maintain control of licensed material
- 10 CFR Part 20, Subpart L, “Records”: 20.2101 – 20.2110 provides information on the types of radiation safety records that must be kept and their retention requirements
- 10 CFR Part 20, Subpart M, “Reports”: 20.2201 – 20.2207 provides information reporting requirements related to incidents, exposure monitoring, and loss/transfer of materials
- 10 CFR Part 20, Appendix B, Table 1, "Occupational Values," provides allowable occupational values of Annual Limits on Intake and Derived Air Concentrations, effluent concentration limits, and allowable concentrations for release to sewers

4.2 Regulatory Acceptance Criteria

The application was reviewed for compliance with the applicable requirements of 10 CFR Part 20, “Standards for Protection Against Radiation.”

4.3 NRC Staff Review and Analysis

The Army relies on results from a modeling analysis as a basis for collecting limited environmental samples. This is because potential land use is generally bounded by the resident farmer scenario that yields doses meeting the regulatory limits for operational or decommissioning activities. Also, most of these areas may contain unexploded ordinance and restricting access to these areas to perform environmental monitoring is a means for balancing risks. Samples that will be collected include surface water flowing from the RCA, sediment in these surface water bodies, and soil deposition areas if the erosion rate in a RCA is excessive. Groundwater samples taken from existing wells that may be influenced by DU in the RCA will also be analyzed for DU.

The modeling analysis, provided as Attachment 5, “Bounding Calculations Using RESRAD 7.0 and RESRAD-OFFSITE 3.1,” of the June 1, 2015 submittal, demonstrate that dispersed DU in the impact areas does not constitute a significant radiological risk to the public or environment through anticipated environmental transport mechanisms. As the Army attests in Section 2 of the ERMP, most RCAs and the areas surrounding them are part of a range or training facility and may contain unexploded ordinance. The risks associated with routinely accessing these unexploded ordinance areas outweigh the value of the information likely to be gathered. The Army makes a case that, most likely, environmental samples will demonstrate either a lack of migration of DU from the RCAs or environmental impacts consistent with modeling results, thereby justifying the limited environmental monitoring activities. Should the DU migrate from

the RCAs, the amount involved is expected to be relatively small and difficult to detect as the environmental transport mechanisms are not anticipated to be conducive to large mass movements of DU oxide/metal. For these reasons, collection of environmental samples will not occur in the RCAs and only limited sampling is anticipated outside of the RCAs. Exceptions will be made only with documented consultation among the license RSO, garrison safety personnel, and range control personnel, who will advise a general officer. The general officer will make the decision on whether to allow additional environmental sample collection.

Installation-specific ERMP's will include criteria for periodic review and potential adjustment to the sampling plan for each RCA to accommodate: Changes in the understanding of risk associated with exposure to DU in the environment; changes in local/regional land use; changes in environmental transport characteristics or environmental conditionals that improves/encroaches on the conservative assumptions of the bounding RESRAD analysis of the programmatic ERMP; trends in sampling results identifying increased/decreased mobilization of DU, but at levels below the bounding RESRAD analysis of the programmatic ERMP or other regulatory thresholds; and any other new information that indicates a need to adjust the site-specific ERMP.

The Army commits that, in terms of sampling frequency and number of samples for environmental media, no installation-specific ERPM will be less conservative than the programmatic ERMP. Adjustments to sampling will reflect improved understanding and identification of the unique conditions and risks associated with each site. If changing site conditions result in environmental transport or exposure hazards that exceed those used in the bounding RESRAD calculations, the Garrison RSO will notify the License RSO who will notify the NRC license program manager within 30 days.

4.3.1 Sampling Inside of the Radiologically Controlled Areas

Section 4 of the programmatic ERMP discusses sampling inside the RCAs. The ERMP states that sampling will not usually be performed inside the RCA. The basis for not sampling inside the RCA for environmental media is because DU is already expected to be present in soil there and the impact of DU in other media has been shown to be of very low impact (i.e., less than 1 mrem/yr). Also, the RCAs are part of a range facility or Army training area so that risks described in the preceding section are expected if routinely accessing the RCAs. In this case, the value of the information likely to be gathered is outweighed by the risks associated with routinely accessing the areas.

4.3.1.1 Soil

The Army states that no conditions require deliberate collection or sampling of soil within the RCA as DU is expected in the soil. The Army cites significant experience with environmental contamination resulting from DU ordinance. In Section 4.e of the programmatic ERMP (ML15294A276), documentation is cited where other locations that DU munitions had been fired did not result in significant migration of the DU and constitute a basis to not monitor DU movement inside of the RCAs. Specifically, the Army cites numerous studies which found limited mobility of the DU away from the DU round fragments or DU penetrators. This provides a basis for the assertion that DU and DU corrosion products are generally not migratory and will remain within a reasonable proximity to the initial impact area (i.e., within 10-100 meters). Given that soil contamination is expected in the RCA, soil sampling in these areas is not considered as having a meaningful contribution to the environmental monitoring program.

4.3.1.2 Plant

Sections 4.f and 4.g of the programmatic ERMP discussed plant sampling for inside the RCAs. The Army does not propose to routinely sample plants for DU. The Army states that, although livestock is allowed to graze at the proposed RCA at Fort Hood, TX, the RESRAD model assuming resident farmer scenario demonstrated consumption of that meat would lead to less than 0.003 mrem/yr. A review of the RESRAD outputs provided with the submittal show that dose from ingestion of meat in a resident farming scenario would be no greater than 0.006 mrem/yr. The NRC staff has confirmed the Army's determination and finds this to be sufficient justification to not perform sampling of flora as human consumption of plants is not a pathway generally needing consideration at the range facilities being licensed.

4.3.1.3 Surface Water

In Section 4.h of the ERMP, the Army states that sampling of static surface water entirely in the RCA is unnecessary as the form of material present in the RCA (DU metal/oxide) is not considered soluble and is unlikely to be detectable in surface water. The NRC staff agrees with this assertion and, as it was demonstrated via RESRAD modeling by the Army and reproduced by the NRC staff, the dose through waterborne pathways is not anticipated to exceed 1 mrem/yr. Therefore, the NRC staff agrees that routine environmental sampling of surface water is not considered necessary.

4.3.2 Sampling Outside of the Radiologically Controlled Areas

4.3.2.1 Air

Section 5.a of the programmatic ERMP discusses air sampling outside the RCA. The Army does not propose to collect air samples. The Army's rationale for not collecting air samples for non-ground disturbing activities is based on the RESRAD bounding calculations. The RESRAD bounding calculation shows that the maximum possible ²³⁸U air concentration for any site is about 1.3×10^{-4} pCi/m³. The NRC effluent standard for air is 0.06 pCi/m³. The RESRAD values would correlate to approximately 0.1 mrem/yr dose due to airborne emissions. The RESRAD bounding calculations assume all DU in the RCA is available for suspension into the atmosphere. However, spotting rounds on RCAs seem to be mostly intact with corrosion products in or on the soil, which means not all DU in the RCA is available for suspension into the atmosphere. Therefore, the expected ²³⁸U air concentration due to resuspended dust is expected to be much less than the maximum value found in the bounding calculations.

Evaluations of HE munitions fire and range burns were presented as Attachments 3, and 7 through 10 of the September 30, 2015 submittal (ML15294A276). In Attachment 10 of the October 1, 2015 submittal, "Arguments against Air Sampling during HE Fire into RCAs," the Army provides 4 arguments against the requirements for air sampling during ground disturbing activities. These arguments include:

- a determination that it would be almost impossible to consistently aerosolize the number of rounds needed to exceed ten percent of the 10 CFR 20 effluent limits due primarily to the total number of rounds available in the RCAs, the volume of air, on average, transiting the RCAs, and the fact that the rounds have been present for over 50 years;

- a comparison of the average calculated DU concentration in RCA soil (maximally estimated at 3 pCi/g) to the soil screening values in NUREG-1757, Vol. 2, "Characterization, Survey, and Determination of Radiological Criteria, Revision 1" [NRC 2006] (14 pCi/g is projected to conservatively result in 25 mrem/yr dose for pathways pertinent to subsistence farming);
- consideration of a previously performed modeling of a Pohakuloa Training Area site-specific plume with receptors on the area boundary projects which demonstrates that less than 3 percent of the effluent limit of 10 CFR 20, Appendix B, Table 2, "Effluent Concentrations," (or less than 2 mrem/yr dose) would be anticipated; and
- that sampling for uranium has a high probability of not being able to detect DU based on historical experience and due to the significant heterogeneity of the distribution of DU in the RCA soil, as well as the random nature of HE strikes.

The Army also states that no air sampling results to date have found evidence of DU during routine contractor survey and construction operations, during planned range burns, and during limited HE fire in training exercises. The Army further maintains that the DU rounds have remained largely intact after 50 years in the environment. The Army concluded that the corrosion products that remain on and in the soil in proximity to the location where each round landed, because of DU density, would deposit within several meters of a HE impact. The NRC staff finds these arguments, in total, to be sufficient justification to alleviate routine air sampling because it is highly unlikely there would be any significant dose (i.e., no more than 1 mrem/yr) from suspended airborne particulates leaving the RCA due to ground disturbing activities in the vicinity of the RCA. For this reason, as previously described in the programmatic RSP evaluation, the NRC staff has elected to remove the existing licensing conditions requiring notification of the NRC before firing HE munitions into the RCAs and requiring an air sampling program.

4.3.2.2 Surface Water and Sediment

Section 5.f of the programmatic ERMP discusses surface water sampling outside the RCA. The Army states that surface water which routinely flows from the RCA will be sampled. The Army states that samples will occur every three months if flow occurs throughout the year and during the flow but no less than three months apart if the flow is intermittent. The Army justifies their sampling plan based on expected uranium chemical forms having low solubility in water and the low concentration of DU, on average, in the soil of the RCA. The Army provides additional justification based on observations at another Army site, Jefferson Proving Ground (JPG), which contains significantly more DU in its RCAs than would be expected on any one installation containing DU from M101 spotting rounds. The concentrations of DU in JPG surface water samples has always been well within NRC effluent limits and USEPA drinking water standards. The Army's programmatic ERMP states it may adjust the sampling frequency from yearly, consistent with Table 4 of the programmatic ERMP, up to an interval of every 5 years if no DU is detected during monitoring over 3 years.

The Army does not propose to sample surface water which does not flow from the RCA. The Army's rationale for not sampling this surface water is in Section 5.d of the programmatic ERMP. The Army's rationale is based on a reference to a USEPA 2006 document which states that "the amount of uranium in air is usually very small and effectively insignificant for remedial

operations.” The Army infers this statement to mean the transfer from the atmosphere to surface water outside the RCA would also be “effectively insignificant.”

Section 5.l of the programmatic ERMP discusses sediment sampling outside the RCA. The Army proposes sampling of sediment when surface water sampling occurs as the Army states water flowing out of the RCA could carry DU-contaminated sediments as small amounts of DU has been found in sediments inside the RCA at JPG. Sediment sampling will occur at the same time/place as surface water sampling.

4.3.2.3 Ground Water

The Army proposes to sample existing wells potentially influenced by DU in the RCA for uranium whenever anyone samples these wells for any purpose. The results will be reported to the Garrison RSO. The Army states that the DU concentration in groundwater coming from soil depends on several factors, which they have not measured for any RCA. The Army states that it is improbable that surface water contributions to DU in groundwater are significant. This is consistent with the NRC staff’s understanding of the chemical forms of DU present (metal and oxide), which are generally considered to be insoluble.

4.3.2.4 Soil

Section 5.k of the programmatic ERMP discusses soil sampling outside the RCA. The primary environmental transport mechanism identified for DU to migrate outside of an RCA would be if significant erosion of soil from the RCA occurs. The Army will annually assess the erosion of soil out of each RCA in a manner to be described in each site-specific ERMP. The Army proposes sampling of deposition areas of soil outside the RCA if a localized erosion rate in an RCA area greater than 25 m² exceeds a volume of 3.75 m³ per year or if the general erosion rate for the RCA is greater than 2 tons per acre per year. The Army proposes to collect two samples per sample site on a semiannual basis from a general location where eroded soils are deposited. If no erosion is identified, the Army proposes to not collect any soil samples. The Army’s rationale for not sampling non-eroded soil is due the unlikelihood of other environmental transport mechanisms depositing significant amounts of DU in the soil.

4.3.2.5 Plants/Biota

Sections 5.n to 5.p of the programmatic ERMP discusses plant sampling outside the RCA. The Army states that “no conditions requires plant sampling.” The Army’s basis for this is that RESRAD modeling shows the dose due to ingestion of plants would be less than 0.1 mrem/yr assuming subsistence farming in the RCA. Lower potential doses would be anticipated outside of the RCA.

Sections 5.q to 5.v of the programmatic ERMP discusses animal sampling outside the RCA. The Army states that “no conditions require animal sampling.” The Army’s rationale for not sampling biota includes:

- DU concentrations in any water that animals consume are orders of magnitude less than the uranium concentration limits under NRC effluent standards (10 CFR 20.1302(b)(2)(i)) and air pathway dose constraint of 10 mrem/yr (10 CFR 20.1101(d)) and the Environmental Protection Agency drinking water regulations of 40 CFR 141, “National

Primary Drinking Water Implementation Regulations” for radionuclides (40 CFR 141.66(e), an Maximum Contaminant Level (MCL) of 30 µg/L for uranium);

- As stated earlier, the average soil concentration inside the RCA is less than the default NRC screening levels for license termination. The DU concentration outside the RCA would be even lower than inside;
- Although plants and animals can bioaccumulate DU, these concentrations do not generally exceed ambient levels; and
- Army sampling of deer that were exposed to DU at JPG did not identify DU in the deer meat.

RESRAD modeling demonstrates that consumption of meat/fish would be less than 0.1 mrem/yr assuming residential farming within an RCA. Consumption of plants for this land use scenario would be less than 0.2 mrem/yr. Lower contributions to dose from this pathway would be expected outside of the RCA.

4.3.3 Laboratory Analysis

Section 6 of the programmatic ERMP discusses the laboratory analysis which will be conducted on the samples collected. The Army states only accredited laboratories will perform radiochemical analysis to demonstrate NRC compliance. These laboratories will use alpha spectroscopy to analyze samples for ^{234}U and ^{238}U concentration. Any samples with a $^{238}\text{U}/^{234}\text{U}$ concentration or activity ratio greater than 3 will be reanalyzed using inductively coupled plasma-mass spectroscopy (ICP-MS) to identify samples with DU content. As stated in Section 3 of the programmatic ERMP, if DU is identified in samples taken outside of the RCA, the Army will notify the NRC within 30 days and collect additional samples within 30 days of the notification of the NRC unless prohibited by the absence of sampling media.

4.3.4 Procedures

Section 7 of the ERMP states that site-specific ERMPs will address all other requirements normally associated with environmental sampling, such as chain of custody, health and safety, and packaging for shipment. In addition, Section 3 of the programmatic ERMP provides a general list of requirements that will be in site-specific ERMP procedures as follows: quality control programs; sample identification; sample custody; how sample locations will be determined; sample collection protocols for each media; and shipment, recordkeeping, and radiochemical analysis for both soil and liquid samples. Each site-specific ERMP will describe sampling in terms of sampling objectives, sampling protocols, analytical methods, and data quality assurance protocols. These descriptions will conform to commonly accepted practices and reliable sources as described in MARSSIM [NRC, 2000].

4.4 Evaluation Findings

The NRC staff finds that, due to the small doses anticipated from environmental transport pathways, a limited environmental monitoring program is justified. Dose from airborne contamination is considered to be highly unlikely to exceed 1 mrem/yr. Dose from all other environmental pathways, as bounded by a resident farmer pathways analysis using RESRAD,

are projected to be less than 4 mrem/yr. Only direct radiation exposure from ground contaminants exceeded a 1 mrem/yr potential, as modeled using RESRAD; however, even that remains far below any monitoring requirements and would be further limited because actual exposure durations are expected to be far less than subsistence farming residence times.

The NRC staff independently verified the RESRAD calculations provided by the Army and finds the use of scenarios, parameters, and assumptions to be reasonable and appropriate. The results from the RESRAD analysis support the NRC staff's decision to not require environmental monitoring within the RCA. It also supports a limited amount of environmental monitoring outside of the RCA (surface water, sediment, soil depositions, and ground water). The proposed frequency, analysis, and actions are sufficient to ensure DU migration outside of the RCA is adequately monitored while not exposing personnel to undue risk due to accessing unexploded ordnance areas.

4.4.1 Air

The NRC staff assessed the Army's programmatic approach with respect to air monitoring. The RESRAD pathways analysis shows that dose from non-ground disturbing activities is anticipated as less than 0.2 mrem/yr. Ground disturbing activities are considered to be bounded by HE ordinance impacts within the RCA. The Army has demonstrated through calculation and modeling, and the NRC staff verified, that it is highly unlikely that the DU in any RCA would be aerosolized sufficiently to result in greater than 1 mrem/yr dose outside of any RCA. For these reasons and as previously described in the programmatic RSP, current license conditions requiring air monitoring and reporting of HE ordinance use will be removed from the license, upon approval of the license amendment application.

4.4.2 Plant/Biota

The NRC staff assessed the Army's programmatic approach with respect to biota monitoring. The NRC staff concludes that the Army has presented sufficient justification that plants and biota do not pose a significant route of exposure to the public. RESRAD modeling shows that ingestion of plants and meat from within the RCA are not expected to exceed 0.3 mrem/yr. As such, the NRC staff finds that current License Condition 23, shown below, **will be removed** from license SUC-1593.

23. The licensee shall provide a plant sampling plan to NRC within 90 days of **[effective date of this license]** for review and approval. Until the plant sampling results are approved by NRC the licensee will conduct activities on the ranges in accordance with previously approved restrictions and provisions.

4.4.3 Surface Water

Limited surface water sampling is proposed for water that runs through a RCA. Standing, or ponded water will not be sampled as there is very limited likelihood that significant deposition of DU will result from airborne activities and the chemical form of the materials (i.e., metal or oxide) is not considered soluble. Running surface water may entrain DU particles in the flow and samples will be taken roughly quarterly, consistent with Table 4 of the programmatic ERMP, unless no evidence of DU is shown, at which point sampling may occur throughout the year but at 5 year intervals. The NRC staff finds this approach adequate for monitoring surface water

bodies for DU.

4.4.4 Sediment

Sediment samples are proposed to be collected at the same time and approximately the same place as surface water samples are collected. Because it is most likely that surface water would only entrain particulate DU, the NRC staff finds this to be an adequate method of monitoring for migration of DU through this pathway.

4.4.5 Ground water

Similar to surface water, there is very little likelihood that DU of metal or oxide form will result in groundwater contamination as it is considered insoluble. However, the Army will sample existing wells that may be impacted by DU and analyze the samples for DU whenever the wells are sampled for any purpose. The NRC staff finds this approach to be adequate because of the low likelihood of groundwater contamination.

4.4.6 Soil

Soil samples are to be obtained at areas of soil deposition if soil erosion from the RCAs is excessive, consistent with Section 5.k of the ERMP. No soil sampling within the RCAs is proposed because DU material is expected to be contained within the RCA borders. Routine soil samples will be obtained semi-annually. The NRC staff finds this to be an adequate method to monitor for transport of DU contamination by erosion mechanisms.

4.4.7 All Pathways

The NRC staff finds the limited environmental monitoring program proposed by the Army to be an adequate method to monitor for migration of significant DU contamination from the RCAs. The low dose potential of the materials (it is highly unlikely that a total dose greater than 5 mrem/yr could occur) and limited environmental mobility of insoluble DU is justification for this approach as is the fact that the RCAs are located within training areas or ranges where unexploded ordinance may be present. As such, the NRC staff finds that the programmatic ERMP proposed by the Army adequately addresses pertinent regulatory requirements for environmental monitoring found in 10 CFR Part 20, "Standards for Protection Against Radiation": 20.1101(d); 20.1301 – 1302; 20.1406; 20.1501; 20.1802; and 20.2107.

4.5 Conclusions/Findings

Each site-specific ERMP for each installation listed in proposed License Condition 10 will have some sampling that is dependent on site-specific environmental conditions, such as the level of erosion occurring within an RCA. For each installation, the Army must appropriately address the criteria for any particular RCA identified in the approved programmatic ERMP. Therefore, for joint base installations (i.e., Joint Base Lewis-McChord/Yakima Training Center, WA; Joint Base McGuire-Dix-Lakehurst, NJ, and the Schofield Barracks/Pohakuloa Training Area, HI), the NRC will not require that a separate ERMP for each installation-facility (for example, a separate site-specific ERMP for Schofield Barracks and a separate site-specific ERMP for the Pohakuloa Training Area) be provided to the NRC for approval.

The NRC staff finds that the limited environmental monitoring program proposed by the Army in the programmatic ERMP will be adequate for the Army installations (16 installations listed in proposed License Condition 10) under consideration. An installation-specific ERMP must reflect the site-specific conditions for each RCA in that installation. In the cases of joint bases, the Army is required to have at least one ERMP that addresses all geographically isolated areas that are encompassed by the joint base or it may elect to provide separate site-specific ERMPs for each geographically isolated RCA or group of RCAs.

This finding is justified due to the small exposure potential associated with the material and other significant hazards associated with the sites on which the material is located. This finding is justification to remove existing license conditions pertaining to environmental monitoring. As such, current License Conditions 17, 22, and 23 will be removed from Source Materials License No. SUC-1593, upon approval of the license amendment application.

To address the need for the Army to develop and then provide, for NRC approval, site-specific ERMPs for each installation listed in License Condition 10 (a proposed license condition), a new proposed license condition, License Conditions 18, as indicated below, would be included in the amendment, upon approval of the amendment application.

Proposed License Condition:

18. Within 6 months of the effective date of the license amendment, the licensee shall provide to the NRC for approval, site-specific environmental radiation monitoring plans for each installation listed in License Condition 10 (a proposed license condition) that address all RCAs at the installations. The licensee shall fully implement each installation's site-specific environmental radiation monitoring plan within 6 months of NRC approval.

5.0 Financial Assurance

5.1 Regulatory Requirements

The following regulations apply to the applicant's financial assurance:

- 10 CFR 40.36 establishes the financial assurance and recordkeeping requirements for source material licensees;
- 10 CFR 40.42 establishes the decommissioning requirements for source material licensees

5.2 Regulatory Acceptance Criteria

The amendment application was reviewed for compliance with the applicable requirements of 10 CFR Parts 20, "Standards for Protection Against Radiation," and 40, "Domestic Licensing of Source Material" and for consistency with guidance in NUREG-1556, Vol. 7, "Consolidated Guidance About Materials Licenses: Program-Specific Guidance About Academic, Research and Development, and Other Licenses of Limited Scope Including Gas Chromatographs and X-Ray Fluorescence Analyzers" [NRC 1999] and NUREG-1757, Vol. 3, "Consolidated NMSS Decommissioning Guidance: Financial Assurance, Recordkeeping and Timeliness, Rev.1" [NRC 2003a].

5.3 NRC Staff Review and Analysis

Decommissioning is not authorized under the license at this time and the license amendment would not authorize decommissioning. If the Army elects to decommission any of the RCAs at any of the installations described in its amendment application in the future, the Army will have to submit a decommissioning plan for each RCA or groups of RCA at each Army installation.

Source Materials License No. SUC-1593, License Condition 16, requires the Army submit to NRC, for review and approval, an updated site-specific decommissioning cost estimate and financial assurance instrument for all Army installations listed in Source Materials License No. SUC-1593, License Condition 12 on a tri-annual basis or in accordance with 10 CFR 40.36(c)5. 40.36(c)5 requires licensees to submit a DFP within one year of completed surveys that detect residual radioactivity in the facility or environment that would prevent unrestricted release of the site.

By letter dated June 1, 2015, the Army submitted its license amendment application (ML15161A454) to add the additional installations that have residual DU from Davy Crockett M101 spotting rounds pursuant to Source Materials License No. SUC-1593, License Condition 12. Attachment 3 of the June 1, 2015 submittal (ML15161A454) includes the Army's updated DFP and its SOI for all Army installations that have DU from Davy Crockett M101 spotting rounds. On December 31, 2015, the Army resubmitted its DFP, along with its programmatic RSP, programmatic PSP, programmatic ERMP, and updated maps of the M101 impact areas (ML16004A369). The Army explained that the purpose of the December 31, 2015 submittal was to consolidate all responses to RAIs into one document since there were extensive changes to some of the documents and the Army had also corrected and updated

several items in these documents on its own. The NRC staff found that in the December 31, 2015 DFP the Army removed the statement that they would provide a certification of financial assurance. Also, the Army reduced the total cost to decommission all the sites by \$1.6 million from its June 1, 2015 DFP submittal (ML15161A458) because, the Army incorrectly included the cost of decommissioning a range at Joint Base Lewis-McChord, WA, Range 53, that does not have DU from Davy Crockett M101 spotting rounds. The NRC asked the Army why it removed the statement to provide a certification of financial assurance. In addition, the NRC staff addressed and the Army resolved the issue of some of the names and number of the RCAs in the DFP and the clarity of the M101 impact area maps (RCAs) in the Army's January 8, 2016 submittal (dated December 31, 2015, ML16022A161), as explained in above. With regard to the certification of financial assurance, the Army resubmitted its DFP on February 9, 2016 (ML16042A232). In the February 9, 2016 submittal, the Army provided a statement that its previously submitted SOI, dated June 1, 2015 (ML15161A458), continues to cover the total decommissioning costs of the latest estimate. The Army's SOI is intended to serve as the certification statement and financial assurance instrument. Additionally, the February 9, 2016, DFP included revisions and removal of several range names and numbers to correct the inconsistencies with the RCAs in the previous DFP, dated December 31, 2015, and the maps of the RCAs, dated January 8, 2016, from the Army. The range corrections led to an additional reduction of \$8.2 million from the December 31, 2015 DFP.

The current license, Source Materials License No. SUC-1593, covers the Schofield Barracks and Pohakuloa Training Area sites (RCAs or M101 impact areas) that have DU from Davy Crockett M101 spotting rounds that are located in HI. The Army has identified 15 additional Army installations, besides those located in HI, which the Army has identified as having DU from Davy Crockett M101 spotting rounds. The former Davy Crockett M101 spotting round impact areas for these Army installations are in Army training ranges, referred to as sites or RCAs or M101 impact areas, as identified in the Army's license amendment application (M101 Impact Areas [ML16004A369]). These are open areas with no habitable structures but, may contain training materials, such as targets associated supporting materials, and unexploded ordnance for other munitions. However, on page 4 of 17 of the DFP, the Army states that "Institutional controls include security fences, signage (UXO, live fire and radioactive material), as well as monitored access control for training range entry."

5.4 Evaluation Findings

The NRC staff reviewed the DFP, dated February 9, 2016 (ML16042A232) and SOI, dated June 1, 2015 (ML, in accordance with requirements in License Condition 16 of Source Materials License No. SUC-1593 and 10 CFR 40.36. The NRC staff also used guidance in NUREG-1757, Vol. 3, Rev. 1, Appendix A, "Standard Format and Content of Financial Assurance Mechanisms for Decommissioning," [NRC 2003a] when conducting its review.

License Condition 16 of Source Materials License No. SUC-1593 states that "[t]he licensee shall submit an updated site/installation specific decommissioning cost estimate and financial assurance instrument for each Army installation listed in License Condition 12 on a triennial basis, by December 31 of each year or, if applicable, in accordance with the requirements of 10 CFR 40.36(c)5."

Furthermore, 10 CFR 40.36(c)5 states that "[i]f, in surveys made under 10 CFR 20.1501(a), residual radioactivity in the facility and environment, including the subsurface, is detected at

levels that would, if left uncorrected, prevent the site from meeting ... criteria for unrestricted use, the licensee must submit a decommissioning funding plan within one year of when the survey is completed.”

5.4.1 Decommissioning Funding Plan

In the decommissioning cost estimate calculations, the licensee includes costs for decommissioning and decontamination, reclamation of sites, structures, and equipment used in conjunction with site operation. The Army estimates the cost to decommission and decontaminate, by an independent party, all 16 Army installations with sites that have DU from Davy Crockett M101 spotting rounds identified in Source Material License No. SUC-1593 is \$339,345,110. The new decommissioning cost estimate represents an increase of approximately \$230,010,718 from the previous estimate (one presented for the current license). The increase to the cost estimate is due in large part to the additional Army installations that would be added to the license, upon approval of the license amendment.

The NRC staff reviewed the submitted DFP for the Army installations that have DU from Davy Crockett M101 spotting rounds to verify that the activities that would be required during decommissioning were included and properly accounted for. The NRC staff also reviewed the unit costs to verify that they represent the costs that would be incurred by a third party to complete decommissioning; that no credit was taken for salvage value; that key assumptions were included; and that an adequate contingency factor of 25 percent was included.

During their review, the NRC staff determined that the cost estimate does include the range of activities necessary to reclaim the individual sites (e.g., removal and remediation of contaminated soil and Davy Crockett rounds and fragments). The NRC staff observed that the Army based its cost estimate primarily on analyses performed using The Remedial Action Cost Engineering and Requirements (RACER[®]) software¹³. The NRC staff determined that the Army has provided adequate justification for the current decommissioning cost estimate for the sixteen Army training area sites.

5.4.2 Statement of Intent

The Army is using an Statement of Intent (SOI) (ML15161A458) to provide financial assurance for decommissioning pursuant to 10 CFR 40.36(e)4. The NRC staff observed that the SOI includes language that indicates sufficient funds will be obtained when necessary for decommissioning. In addition, the SOI describes the qualifications of the issuer and presents a model statement of intent that is acceptable to the NRC per guidance in NUREG-1757, Vol. 3, Rev. 1, Appendix A.11, “Statements of Intent.” Therefore, the NRC staff finds that the SOI financial assurance instrument is acceptable.

5.5 Conclusions/Findings

Based on the information provided in the submission and its technical review of the DFP and

¹³ RACER[®] software is a Windows[®]-based environmental remediation/corrective action cost estimating software. The RACER software estimates costs for all phases of environmental remediation projects – from site investigation through site closeout. This software is licensed and developed by Asset Management Division (AECOM). For more information refer to racer@AECOM.com.

SOI, the NRC staff concludes that the decommissioning cost estimate reasonably includes funds sufficient to cover the estimated costs of site decommissioning. In addition, the SOI is adequate to cover the decommissioning costs. The NRC staff finds that the submission is acceptable. Based on this review, the NRC staff determined that the DFP and the SOI provide reasonable assurance that the estimate and financial assurance instrument will be adequate.

6.0 Consultations with Other Agencies

The NRC staff consulted with other agencies regarding the proposed action in accordance with NUREG-1748, “Environmental Review Guidance for Licensing Actions Associated with NMSS Programs.” These consultations are intended to: (i) ensure that the requirements of Section 7 of the Endangered Species Act of 1973 (ESA), and Section 106 of the National Historic Preservation Act of 1966 (NHPA),¹⁴ are met, and (ii) provide the State liaison agencies with the opportunity to comment on the proposed action.

National Historic Preservation Act of 1966

6.1 Regulations

Section 106 of NHPA requires federal agencies to take into account the effects of their undertakings on historic properties and allow the Advisory Council on Historic Preservation (ACHP) an opportunity to review and comment on the undertaking. The NHPA implementing regulations at 36 CFR Part 800, “Protection of Historic Properties,” define an undertaking as “a project, activity, or program funded in whole or in part under the direct or indirect jurisdiction of a federal agency, including those carried out by or on behalf of a federal agency; those carried out with federal financial assistance; and those requiring a federal permit, license or approval.” Therefore, the NRC’s approval of the Army’s license amendment application for possession of DU from Davy Crockett M101 spotting rounds at the Donnelly Training Area, Fort Wainwright, AK; Fort Benning, GA; Fort Bragg, NC; Fort Campbell, KY; Fort Carson, CO; Fort Gordon, GA; Fort Hood, TX; Fort Hunter Liggett, CA; Fort Jackson, SC; Fort Knox, KY; Fort Polk, LA; Fort Riley, KS; Fort Sill, OK; Joint Base Lewis-McChord/Yakima Training Center, WA; Joint Base McGuire-Dix-Lakehurst, NJ; and Schofield Barracks/Pohakuloa Training Area, HI, constitutes a federal undertaking.

6.2 Regulatory Acceptance Criteria

The NRC carried out its obligations under the Section 106 of the NHPA through consultation with the appropriate State Historic Preservation Officer (SHPO), Tribal Historic Preservation Officer (THPO), and Tribal governments. The NRC staff also followed the guidance in NUREG-1748, “Environmental Review Guidance for Licensing Actions Associated with NMSS Programs,” Appendix D-9, “Section 106 Consultations with the State Historical Preservation Officer,” [NRC 2003b] to conduct Section 106 consultations for this proposed action.

¹⁴ 16 USC 470 et seq.

6.3 NRC Staff Review and Analysis

Consultations with the State Historic Preservation Officers

In the NRC's October 21, 2015, letters to the SHPOs, the NRC stated that "[t]he proposed action is a license amendment that would authorize the possession of the DU. The NRC believes that issuance of this license amendment would not change or affect the current cultural environment because the amendment would only authorize the possession of DU that is already present at these sites." Further, the NRC asked each SHPO's assistance in identifying any Tribal Nations that may have an historical tie to the area. The NRC stated that any information provided would be used to identify historic properties and evaluate potential effects in accordance with 36 CFR 800. Finally NRC noted that after assessing the information provided, the NRC would determine what additional actions would be necessary to comply with the Section 106 consultation process of the NHPA. The NRC requested that each SHPO respond within 30 days of receipt of the NRC's letter. The NRC also included maps of the RCAs that were applicable to each State.

After NHPA, Section 106 consultation letters were sent to the SHPOs, the NRC staff continued to review the amendment application. The NRC staff also consulted with the Advisory Council on Historic Preservation¹⁵ (ACHP), as indicated below. The following is a summary of the NRC's staff independent review and consultation actions.

The ACHP contacted the NRC in November 2015, stating that the ACHP received an inquiry from the California Office of Historic Preservation (CA SHPO) on the Fort Hunter-Liggett, CA Army installation Section 106 consultation and the potential effect on historic properties. The ACHP asked NRC for clarification on the undertaking. The NRC provided the documents it had listed in its October 21, 2015, letter to the SHPOs to the ACHP. The NRC communicated that after further analysis, the NRC believes that a possession only license does not have the potential to impact historic properties or cultural resources.

On December 7, 2015, the ACHP, after evaluating the documents that were provided and doing its own assessment, communicated to the NRC that since the undertaking involves 15 Army installations in 14 states (not including the Army sites in HI because Section 106 consultation has concluded), the ACHP was planning to communicate to the applicable SHPOs through the National Conference of State Historic Preservation Officers¹⁶ (NCSHPO) that it agrees with the NRC that this undertaking does not have the potential to affect historic properties and that the NRC may invoke 36 CFR 800.3(a)(1) of ACHP's section 106 regulations. On December 28, 2015 the ACHP reached out to the NCSHPO with the above information and also requested that the NCSHPO provide the applicable SHPOs the opportunity to voice any concerns or questions through the NCSHPO before the ACHP provides its recommendation to the CA SHPO

¹⁵ The Advisory Council on Historic Preservation (ACHP) is an independent Federal agency responsible for reviewing policies and programs of Federal agencies to ensure their consistency with the policies and programs of the National Historic Preservation Act (NHPA) of 1966, as amended. The ACHP provides guidance on the application of the procedures in the Section 106 process and generally oversees compliance with the Section 106 process.

¹⁶ NCSHPO is a professional association of the State government officials who carry out the national historic preservation program as delegates of the Secretary of the Interior pursuant to the NHPA.

(ML15362A558). On January 15, 2015, the NCSHPO communicated this message to the SHPOs (ML16021A441).

The NRC staff received responses from some of the SHPOs after the SHPOs received the NRC's October 21, 2015 Section 106 of the NHPA consultation letters. A summary of these responses is provided below in Section 6.3.1:

6.3.1 Responses from State Historic Preservation Officers

The Kansas SHPO response letter (ML15309A282) stated that the KS SHPO's understanding is that the NRC is proposing to issue a license amendment allowing Fort Riley, KS to possess DU from spent spotting rounds already on the post property at the locations specified in the NRC's letter. The Kansas SHPO stated that "[s]ince no changes to the existing situation on the ground are planned, our office concurs that a categorical exclusion is appropriate and that the proposed action will have no effect on historic properties as defined in 36 CFR 800. This office has no objection to the license amendment."

The Alaska SHPO response (ML15317A428) conveyed a general understanding or formal acknowledgement of the possession of a licensable quantity of the uranium at the location at the Donnelly Training Area, Fort Wainwright, AK. The Alaska SHPO stated that "Rather than addressing a physical activity such as the recovery of this material it appears to be more of a formal acknowledgement of this possession and licensable quantity of the uranium at these locations. If this is a correct understanding -and there is no associated physical component at this time- we believe that this amendment does not constitute an undertaking with the potential to effect historic properties were they present, and therefore is not subject to further obligations under Section 106 (36 CFR 800.3 [a][1])."

The South Carolina SHPO response letter (ML15310A332) indicated that based on previous identification efforts, the SHPO would concur with an assessment that no properties listed in or eligible for listing in the National Register Historic Places would be affected by this license amendment. Also, the South Carolina SHPO requested to be notified if the boundaries of the affected area changed from that shown on the map for the site at Fort Jackson, SC.

In the Oklahoma SHPO response letter (ML15337A427), the Oklahoma SHPO stated that the proposed action involves two Federal Agencies and that it would provide its comments to whichever agency is determined to be the lead federal agency. The Oklahoma SHPO also suggested that the NRC contact Army personnel at Fort Sill OK regarding questions about historic properties that may be located within the project area and for identification of Tribal Nations to be consulted regarding the project. On March 15, 2016, in a letter (ML16032A544), the NRC responded to the Oklahoma SHPO's comments clarifying that the action is not a joint action and stating the NRC's finding, as explained below.

The Texas SHPO, in reference to the proposed action at Fort Hood, TX, stated that, based on the map provided, there are no historic properties recorded in the proposed target zone/impact area. The Texas SHPO also provided a link for Tribal contacts and indicated that "[i]f buried archeological deposits are discovered during the development phases of this project, work should stop in the immediate area of such finds and the office should be notified immediately."

The Washington SHPO responded (ML15307A382) to NRC's request with regard to the proposed action at Joint Base Lewis-McChord/Yakima Training Center, WA that it believes that further discussion is necessary regarding the proposed area of potential effect (APE) detailed in the NRC letter and illustrated in the attached figures. The Washington SHPO also stated that: 1) the referenced web pages could not be opened; 2) the consideration of DU dispersal and fugitive material needs to be addressed in the definition of the APE; 3) that the State of Washington's Department of Archaeology & Historic Preservation would appreciate receiving any correspondence or comments from concerned tribes or other parties that NRC receives as the Agency consult under the requirements of 36 CFR 800.4(a)(4); and 4) that some of the maps the NRC provided were unreadable. On March 15, 2016, in a letter (ML16032A543), the NRC responded to the Washington SHPO's comments regarding how the NRC staff defined the APE. The NRC stated that as part of the NRC staff's independent analysis of potential environmental effects, the NRC considered dispersal of DU and fugitive emissions from each range's boundaries. The NRC concluded that DU dispersal and DU fugitive emissions from each range's boundaries are anticipated to be well below 10 mrem/yr (10 CFR 20.1101(d)). Because the action is for a possession-only license, the NRC concluded that no areas will be disturbed from the proposed action and that the range boundaries are appropriate to define the APE. The NRC also provided its finding and its basis, as explained in Sections 6.4 and 6.5.

The Colorado SHPO responded (ML15337A442) to the NRC's request with regard to the proposed action at Fort Carson, CO, requesting additional information regarding how the NRC defined the APE and stated that presumably the nature and dispersal of spotting rounds containing uranium may be difficult to accurately demarcate. The Colorado SHPO also suggested that the NRC request a formal record or files search to receive a historic property and inventory. Also, the Colorado SHPO provided instructions on how to make such a request and recommended that the NRC review a listing of Tribes who have a legacy of occupation within the State of Colorado and provided a web link. In addition, the Colorado SHPO suggested that the NRC reach out to Fort Carson directly and provided a specific contact for this purpose. On March 15, 2016, in a letter (ML16032A541), the NRC responded to the Colorado SHPO's comments, addressing how the NRC staff defined the APE, as explained to the Washington SHPO. In the NRC's response letter, the NRC also provided its finding and its basis, as explained in Sections 6.4 and 6.5, below.

The Kentucky SHPO responded (ML16039A155) to the NRC's request with regard to the proposed action at Fort Campbell, KY, stating "Based on the information provided and their review of the license amendment (application), an archaeological or cultural historic survey should not be necessary for the proposed project area. We concur that the proposed undertaking should have No Effect to Historical Resources."

Also, the NRC noticed in the Army's application, as part of a footnote, that one site with licensable quantities of DU, located at Fort Campbell, KY, straddles the KY-TN border. The footnote indicated that the site, identified as OP2/OP, has a Kentucky address but is partly located in TN. On November 12, 2015, the NRC sent a consultation request letter (ML15309A223) to the Tennessee SHPO for this action and a clarification letter to the KY SHPO (ML15309A249) regarding this oversight. On January 8, 2016, in the Army's supplemental application that updated its maps of the RCAs at each installation (dated December 31, 2015, ML16022A161), the Army noted that although Fort Campbell, KY, has a KY address, the M101 impact range (site with the DU) at Fort Campbell, KY, is located in TN.

In January 2016, the NRC staff noticed that a Section 106 NHPA consultation letter was not sent to the North Carolina SHPO. As a result, the NRC staff contacted the NC SHPO by telephone and by email (ML16022A061) explaining this oversight and provided general information about the action at Fort Bragg, North Carolina. The North Carolina SHPO said that it seemed like the action would not impact historic properties and was generally familiar with the activities at Fort Bragg, NC. The North Carolina SHPO asked that a letter be sent with the information and it would respond in a timely manner. The North Carolina SHPO also stated that this communication could be done electronically in the form of an email and requested that a concurrence line be added to the end of the letter for their use. The NRC sent the information to the NC SHPO in a letter, dated March 15, 2016 (ML16032A531), including the NRC's finding and its basis, as explained in Sections 6.4 and 6.5 of this SER.

The NRC received no response from the NJ, GA, TN, and LA SHPOs for the Army installations located at: Joint Base McGuire-Dix-Lakehurst NJ; Fort Benning, GA; Fort Gordon, GA; Fort Campbell, KY (site located in TN); Fort Knox, KY; Fort Bragg, NC; or Fort Polk, LA, respectively. On March 15, 2016, the NRC sent a letter (ML16032A351) to each of these SHPOs, stating the NRC's finding and its basis, as explained in Section 6.4 and 6.5 of this SER.

Tribal Consultations

The NRC performed an analysis to determine which Tribes to contact with regard to this undertaking. The NRC determined the following number of Tribes or Native Lands or Home lands, that were located near one or more Army installations include in this proposed license amendment action:

- Reservation Lands: 10
- Oklahoma Tribal Statistical Areas: 5
- Alaska Native Lands: 1
- Hawaiian Home Land: 18
- State Recognized Tribal Lands: 10

Total: 44

The NRC started by contacting the following seven Tribes because they were closest to the Army installations included in this proposed amendment licensing action:

Tribes Federally Recognized:

- Kiowa Tribe of Oklahoma, OK
- Fort Sill Apache Tribe, OK
- Comanche Nation, OK
- Nisqually Tribe, WA
- Lumbee Tribe, NC
- Coharie Tribe, NC
- Four Winds Cherokee Tribe, Four Winds Tribe, LA

By letters (ML15288A466 [package]) dated October 21, 2015, pursuant to 36 CFR 800, the NRC initiated consultation with seven THPOs on actions to identify historic properties that may

be affected if the NRC grants the proposed license amendment to Sources Materials License No. SUC-1593 that would authorize the possession of DU at Fort Sill, OK, Fort Bragg, NC, Joint Base Lewis McChord/Yakima Training Center, WA; Fort Sill, OK; and Fort Polk, LA. The NRC stated in its letters that any information provided would be used to identify historic properties and evaluate and document potential effects in accordance with 36 CFR 800. The NRC requested a response within 30 days of receipt of this letter, identifying any concerns about historic properties, advising on the identification and evaluation of historic properties, including those of traditional religious and cultural importance, and commenting on the undertaking's effects on such properties.

After further evaluation of the Army's application and examination of relevant public documents the NRC staff determined that no further consultation was necessary based on the reasons described in Section 6.4 and Section 6.5 of this SER.

6.3.2 Responses from Tribal Historic Preservation Officers

The NRC followed up on the October 21, 2015 letters to the THPOs with telephone calls and e-mails to the Federally recognized Tribes on November 17, 2015 and again on January 15, 2016 (ML16022A034) to one of the Federally recognized Tribes, the Kiowa of Oklahoma, because the NRC staff was uncertain that their message was received on November 17, 2015.

The NRC received no THPO responses to any of its communication with these Tribes. On March 9, 2016, the NRC sent a letter (Pkg. ML16062A405) to each of these Tribes stating the NRC's finding and its basis, as explained in Section 6. 4 and 6.5 of this SER.

6.4 Evaluation Findings

The NRC staff determined that this action is a proposed license amendment to Source Materials License No. SUC-1593 for a possession-only license. The Army is requesting authorization to possess the DU from Davy Crockett M101 spotting rounds that is already present on its installations. The DU has been present at these ranges for approximately sixty years. The license amendment, if issued, would not allow the Army to use the DU for any purpose other than activities necessary for the possession and management of DU from Davy Crockett M101 spotting rounds and fragments as a result of previous use of DU at Army installations, nor would it authorize placement of additional DU on the installations. The license amendment would prohibit the Army from performing decommissioning or ground disturbing activities to collect or remove DU fragments or contaminated soil that is identified during routine range activities without prior authorization from the NRC. However, the license would authorize the Army to pick up DU fragments during routine range activities where picking up the fragments does not involve any ground-disturbing activities. Rather than authorizing any physical activity such as the clean-up of this material, the license amendment would bring the possession of this material at these locations under NRC regulatory oversight.

The NRC has determined that issuing the license to the Army will not likely impact historic properties, if present, for the following reasons: (i) the license is for possession only; (ii) no new construction will occur from the proposed action; and (iii) no areas will be significantly disturbed from the proposed action. The NRC also concluded that DU dispersal and DU fugitive emissions from the boundary of these ranges at each of these installations is anticipated to be

well below the NRC maximum dose requirement of 10 mrem/yr (10 CFR 20.1101(d)). Therefore, in accordance with 36 CFR 800.3(a)(1), the undertaking is not the type of activity that has the potential to affect historic properties, and NRC has no further obligations under Section 106 of NHPA.

6.5. Conclusions/Findings

NRC staff has determined that the undertaking is not the type of activity that has potential to cause effects on historic properties. Therefore, no further consultation is required under Section 106 of the NHPA in accordance with 36 CFR 800.3(a)(1).

Endangered Species Consultations

6.6. Regulations

The following regulations apply to the environmental consultations with the U.S. Fish and Wildlife Service (FWS) Regional Offices:

- Section 7 of the Endangered Species Act of 1973 and
- 50 CFR 402, “Interagency Cooperation – Endangered Species,” which require the NRC to meet certain requirements in the protection of endangered and threatened species and critical habitat.

6.7 Regulatory Criteria

In its review of the amendment application, the NRC complied with its obligations under Section 7 of the Endangered Species Act of 1973 and 50 CFR 402, “Interagency Cooperation – Endangered Species.” The NRC staff also used the guidance in Appendix D of NUREG-1748, Appendix D-4, “Section 7 Consultations with the U.S. Fish and Wildlife Service,” for a detailed description for completing the Section 7 consultation requirements [NRC 2003b] to conduct its Section 7 consultations.

6.8 NRC Staff Review and Analysis

As part of NRC’s independent analysis of environmental effects, the NRC staff reviewed available FWS documents that were applicable on the FWS websites regarding endangered or threatened species and critical habitat in the project areas, as well as the Army’s environmental evaluation, dated June 1, 2015 (ML15160A509).

6.8 Evaluation Findings

The NRC staff has determined that Section 7 consultation is not required because the proposed action will not affect listed species or critical habitat. Specifically, the license amendment would authorize possession of DU from the Davy Crockett M101 spotting rounds that is already present on the Army’s installations. The DU has been present at these ranges for approximately sixty years. The license amendment would not allow the Army to use the DU for any purpose other than activities necessary for the possession and management of DU from the

Davy Crockett M101 spotting rounds and fragments as a result of previous use of DU at Army installations, nor would it authorize the placement of additional DU on the installations. The license amendment would prohibit the Army from performing decommissioning or ground disturbing activities to collect or remove DU fragments or contaminated soil that is identified during routine range activities without prior authorization from the NRC. Rather than authorizing any physical activity such as the clean-up of this material, the license amendment would bring the possession of this material at these locations under NRC regulatory oversight. Therefore, issuing the license will not affect the identified species and/or critical habitat because (1) the authorized use under the license is possession only; (2) the license amendment will not authorize any new construction; and (3) the license amendment will not authorize any ground disturbing activities or any other activities that could impact listed species or critical habitats.

Based on the NRC’s assessment, the NRC staff has determined that no additional consultation is necessary for this project because no adverse effects to federally listed species are expected. In letters dated January 28, 2015 (Pkg. ML16022A095), the NRC sent letters to each applicable FWS Regional Office for its endangered or threatened species and critical habitat consultation for the proposed action. The NRC stated its finding and provided maps of the sites that are located under each FWS Regional Office region of control. Table 5, “Endangered Species Consultation Correspondence” of this SER identifies the FSW Region and the associated Army installations for this action.

Table 5. Endangered Species Consultation Correspondence

Name of Army Installation	FWS Region
Joint Base Lewis-McChord/Yakima Training Center, WA**	Region 1 - Pacific
Fort Sill, OK Fort Hood, TX	Region 2 - Southwest
Fort Benning, GA Fort Gordon, GA, Fort Campbell, TN Fort Knox, KY Fort Jackson, SC Fort Bragg, NC Fort Polk, LA	Region 4 - Southeast
Joint Base McGuire-Dix-Lakehurst, NJ	Region 5 - Northeast
Fort Riley, KS Fort Carson, CO	Region 6 - Mountain Prairie
Donnelly Training Area, Fort Wainwright, AK	Region 7 - Alaska
Fort Hunter Liggett, CA	Region 8 – Pacific Southwest

**Note: The consultation for endangered or threatened species and critical habitat specific to the areas of potential effect for the Army sites located at Schofield Barracks, Oahu and Pohakuloa Training Area, HI, have been completed with the initial licensing for possession only of DU from Davy Crockett M101 spotting rounds through correspondence with the FWS, Region 1 (ML13052A656).

6.9 Conclusions/Findings

NRC staff has determined that the proposed action will not affect listed species or critical habitat. Therefore, no further consultation is required under Section 7 of the Endangered Species Act.

7.0 National Environmental Policy Act

7.1 Regulatory Requirements

The National Environmental Policy Act (NEPA) mandates that Federal agencies carefully consider the environmental impacts of their actions prior to making decisions that affect the environment. The NEPA review (also referred to as an environmental review) process is usually initiated by an application for a new license or certification, change to an existing license, or a decommissioning plan submitted to the NRC. The NRC's NEPA implementing regulations are found at 10 CFR Part 51, "Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions."

Pursuant to 10 CFR 51.22(a), categorical exclusions are categories of actions that the NRC, by rule or regulation, has declared to be a categorical exclusion, after first finding that the category of actions does not individually or cumulatively have a significant effect on the human environment. Criteria for identifying a categorical exclusion and a list of actions eligible for categorical exclusions are found in 10 CFR 51.22(c). 10 CFR 51.22(c)(14)(xv) establishes "Possession, manufacturing, processing, shipment, testing, or other use of depleted uranium military munitions" as a categorical exclusion.

NUREG-1748 "Environmental Review Guidance for Licensing Actions Associated with Nuclear Materials Safety and Safeguards Programs" contains the NRC staff's guidance for environmental reviews and includes a process for determining the type of NEPA action the NRC staff must undertake to comply with NEPA.

Appendix B to NUREG-1748 is a checklist and series of basic questions that must be answered by the NRC staff to determine if the proposed action falls under a categorical exclusion in 10 CFR 51.22. The NRC staff's responses to the questions in NUREG-1748 for this proposed action are summarized below.

PROPOSED ACTION

The Army's amendment application requests that the 15 installations listed in License Condition 12 be incorporated into Source Materials License No. SUC-1593. The Army also proposes to use a programmatic approach to license the sites or RCAs, which are located on multiple Army installations throughout the U.S. In addition, the Army proposes to license sites located on the Island of Oahu, HI and the Island of Hawaii, HI which are already licensed under Source Materials License No. SUC-1593, using a programmatic approach. The 16 U.S. Army installations with sites that possess DU from Davy Crockett M101 spotting rounds are located at Donnelly Training Area, Fort Wainwright AK; Fort Benning, GA; Fort Bragg, NC; Fort Campbell, KY; Fort Carson, CO; Fort Gordon, GA; Fort Hood, TX; Fort Hunter Liggett, CA; Fort Jackson, SC; Fort Knox, KY; Fort Polk, LA; Fort Riley, KS; Fort Sill, OK; Joint Base Lewis-

McChord/Yakima Training Center, WA; Joint Base McGuire-Dix-Lakehurst, NJ; and Schofield Barracks/Pohakuloa Training Area, HI. This license amendment application is for possession of DU due to the potential for residual DU to be present at the specified Army installation sites where testing of Davy Crockett M101 spotting rounds has occurred. The Army's application also proposes that its programmatic RSP, programmatic PSP, and programmatic ERMP apply

to all 16 installations and commits to preparing site-specific ERMPs in accordance with the criteria contained in its programmatic ERMP.

It is important to note that the Army is requesting authorization to possess the DU that is already present on the ranges. The Army refers to these areas as RCAs. Therefore, the action evaluated by the NRC staff is to authorize the Army to continue to possess material that it has possessed since the late 1960s. The Army requests authorization for possession of DU and for "[a]ctivities necessary for the possession and management of depleted uranium (DU) M101 spotting rounds and fragments as a result of previous use of depleted uranium at US Army installations." The Army elaborates by stating that activities include those that are necessary to maintain the facilities in a safe condition and to prevent the unauthorized removal of licensed material from the authorized places of use; to determine the presence of licensed material at Army facilities; to monitor the radiological environmental conditions in and around the authorized places of use to determine if licensed material is being transported in the environment; and for activities that are necessary for the packaging, transport and disposal of incidentally identified licensed material to a licensed/permitted disposal facility.

The Army would not be authorized to use the DU and would not be allowed to perform decommissioning on the ranges without additional NRC authorization (incidentally identified DU fragments may be collected, but ground disturbance and large scale removal of DU will require approval from the NRC). The Army will be required to demonstrate that it is in compliance with NRC's effluent emission requirements before these additional sites would be licensed under a programmatic approach. Finally, access to the areas has been and will be limited, due to the presence unexploded ordnance present on the sites. The activities outlined in the Army's programmatic RSP will not involve the use of DU but, will occur in areas that contain DU.

7.2 Regulations and Guidance

The NRC staff evaluated the proposed licensing action in accordance with 10 CFR 51.22 and the guidance in NUREG-1748.

7.3 NRC Staff Review and Analysis

A categorical exclusion (CATX) is a category of actions that the NRC has determined do not individually or cumulatively have a significant effect on the human environment and, therefore, neither an environmental assessment nor an environmental impact statement for the action is required. NRC regulations further describe CATXs in 10 CFR 51.22. A list of current categorical exclusion criteria can be found at 10 CFR 51.22(c). The CATX at 10 CFR 51.22(c)(14)(xv) expressly excludes from the environmental review requirement the issuance of licenses under 10 CFR Part 40, "Domestic Licensing of Source Material," that authorize "[p]ossession, manufacturing, processing, shipment, testing, or other use of depleted uranium military munitions." The Army has requested an NRC license under 10 CFR Part 40, "Domestic Licensing of Source Material" that would authorize its possession of DU from military

munitions, and as such, under 10 CFR 51.22(c)(14)(xv), this licensing action is categorically excluded from the provisions of 10 CFR Part 51, "Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions."

The discussion below presents the NRC staff's analysis of the proposed action with respect to the CATX checklist questions found in NUREG-1748, Appendix B.

- A. Is the action consistent with the Statements of Consideration (SOC) for the CATX chosen?
YES

The SOC for CATX 51.22(c)(14)(xv) states:

Possession, manufacturing, processing, shipment, testing or other use of depleted uranium munitions, e.g., bullets and other projectiles, includes about 10 licenses held by U.S. military organizations and less than 10 licensees involved with the manufacturing process. The military tests involve the use of low specific activity depleted uranium (3.6×10^7 curies/gram) as metal alloy penetrators (rods) which vary in weight from a few grams to less than 10 kilograms. These rods are propelled at high velocities against metal targets such as armor plate. Testing of these munitions is carried out at remote desert locations on military reservations, in constructed enclosures, or over deep ocean waters. Any materials released to the environment are of low radioactive content, are highly dispersed, and are of chemical and physical form which is not readily incorporated into flora or fauna. Thus, radioactive releases to the environment which could affect human, animal or plant life from testing at any of the locations are negligible and occupational exposures from handling depleted uranium are so low that personnel monitoring is not required. Additionally, since the penetrators tested do not explode, cratering or other defacing of the environment is not experienced. The military also transports and stores depleted uranium munitions for war-readiness posture. Because the munitions are transported and stored in sealed containers as solid metal in nondispersible form, there is negligible environmental impact associated with such transportation and storage.

Manufacturers of depleted uranium munitions are also included here for the sake of completeness, although manufacturers are excluded in section (xiii) of Category 14.

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The SOC includes "possession.... of depleted uranium munitions including e.g., bullets and other projectiles." The Army has requested authorization to "possess" the spent spotting rounds and fragments from Davy Crockett M101 spotting rounds. The Davy Crockett M101 spotting round is a military munition and is a projectile. The DU portion of the Davy Crockett projectile is about 190 grams of DU per M101 spotting round. Thus, the "possession" of a "projectile" discussed in the SOC is consistent with the Army's request to possess the DU portion of the spotting round.

The SOC refers to the testing of the DU munition and describes the locations of the testing as remote areas such as deserts on military reservations, oceans and enclosures. In the Army's

license application, the intended “use” by the Army of the DU from Davy Crockett M101 spotting rounds are not for testing. Rather, it is authorization to possess material that is already in the environment, and has been in the environment for many years. Therefore, the discussion of testing of the round is not germane to the proposed action by the NRC staff; i.e., authorization to possess the DU. However, it is important to note that the areas that will contain the spent M101 spotting rounds and fragments are controlled by the Army for unexploded ordnance and other materials and are not occupied without specific authorization from the Army (i.e., they are not open to the public). Thus, while the discussion of the locations of testing is not germane to the intended use by the Army, it is relevant to the concept that the material is not readily accessible to unauthorized individuals or the public and therefore radioactive releases to the environment which could affect human life are negligible.

The SOC discusses the chemical/physical form of the DU and states that the radioactive content is low, highly dispersed (i.e., the locations of the rounds are widely separated) and the DU is not readily incorporated into flora or fauna. This is the rationale for concluding that releases to the environment are negligible and that possible exposures to the DU are so low that personnel monitoring is not necessary. Because the DU from the spent M101 spotting rounds is of a small quantity (less than ½ lb) and will be widely dispersed on the ranges, it is consistent with the SOC.

Finally, the M101 spotting round did not explode on contact and was not fired into a hard target. Rather, the round was fired at a distant target and, while the M101 spotting round did contain a small marking charge in the projectile nose, which could fracture the DU portion of the round, cratering or defacing of the environment of the environment was minimal and the dispersal of the round in the environment was not as extensive as one fired into an armored target (not done at these Army ranges in question).

B. Is the action likely to significantly affect any aspect of the natural environment? NO

The action being undertaken by the NRC staff is to authorize the possession of the DU. It does not include using the DU for any other purpose, nor will it authorize the decommissioning of the ranges in which the DU has been deposited without further NRC authorization (only removal of incidentally identified fragments that does not require ground disturbance will be allowed). Authorizing possession by the issuance of the license amendment will not change or affect the environment because the DU is already present and was deposited in the environment nearly 60 years ago. Thus, the proposed action will have no effect on the environment.

C. Is the action likely to significantly affect any aspect of the cultural environment including those that might be related to environmental justice? NO

The action being undertaken by the NRC staff is to authorize the possession of the DU. It does not include using the DU for any purpose other than for activities necessary for the possession and management of DU M101 spotting rounds and fragments as a result of previous use of DU at Army installations. The Army elaborates by stating that activities include those that are necessary to maintain the facilities in a safe condition and to prevent the unauthorized removal of licensed material from the authorized places of use; to determine the presence of licensed material at Army facilities; to monitor the radiological environmental conditions in and around the authorized places of use to determine if licensed material is being transported in the

environment; and for activities that are necessary for the packaging, transport and disposal of incidentally identified licensed material to a licensed/permitted disposal facility.

The proposed action will not authorize the decommissioning of the ranges in which the DU has been deposited without further NRC authorization (only removal of incidentally identified fragments that does not require ground disturbance will be allowed). Authorizing possession (by the issuance of the license) will not change or affect the current cultural environment because the DU is already present and was deposited in the environment nearly 60 years ago. Thus, the proposed action will have no effect on the cultural environment. Additionally, because no effects to the environment are expected from DU possession, there are no disproportionately high and adverse impacts to minority or low-income populations.

D. Is the action likely to generate a great deal of public interest about any environmental issue?
NO

There is some public interest in the DU at the Schofield Barracks/Pohakuloa Training Area, HI, which was originally licensed in 2013, based on the public's concern about the human health effects of the DU. However, the NRC is not aware of any substantial public interest in the other 15 installations, as identified in License Condition 12 of Source Materials License No. SUC-1593.

E. Is there a high level of uncertainty about the action's environmental effects? NO

Authorizing the continued possession by the Army is not expected to have an effect on the cultural or physical environment. Migration of the DU in the environment is expected to be minimal. Consequently, there is not a high level of uncertainty about the action's environmental effects.

7.4 Evaluation Findings

An environmental assessment for this action is not required, because this action is categorically excluded under 10 CFR 51.22(c)(14)(xv).

7.5 Conclusions/Findings

For the reasons outlined above, the staff has concluded that the issuance of a license to possess DU in the form of fired M101 spotting rounds from the Davy Crockett weapon system falls within the scope of the activities included in 10 CFR 51.22(c)(14)(xv).

8.0 License Conditions

Based on the conclusions discussed above, the NRC staff determined that the following conditions are necessary to ensure that the Army conducts its radiation safety program in accordance with NRC regulations. These proposed conditions were shared with the Army (Pkg. ML15331A129). The Army agreed with all of the conditions, but clarified the representation of the names of the specified installations and noted that it considers the Schofield Barracks and the Pohakuloa Training Area as one Army installation, similar to joint bases, for this license amendment application (ML16011A373).

Proposed License Conditions:

10. The authorized places of use (possession) shall be at U.S. Army installations at Donnelly Training Area, Fort Wainwright, AK; Fort Benning, GA; Fort Bragg, NC; Fort Campbell, KY; Fort Carson, CO; Fort Gordon, GA; Fort Hood, TX; Fort Hunter Liggett, CA; Fort Jackson, SC; Fort Knox, KY; Fort Polk, LA; Fort Riley, KS; Fort Sill, OK; Joint Base Lewis-McChord/Yakima Training Center, WA; Joint Base McGuire-Dix-Lakehurst, NJ; and Schofield Barracks/Pohakuloa Training Area, HI.
11. Except as specifically provided otherwise, the licensee shall conduct operations in accordance with the commitments, representations, and statements contained in the license amendment application:
 - Programmatic RSP, "Radiation Safety Plan for IMCOM Ranges Affected by M101 Davy Crockett Spotting Round Depleted Uranium," dated December 31, 2015 (ML16004A369);
 - Programmatic PSP; "Physical Security Plan for US Army Installation Management Command Ranges Affected by Depleted Uranium in M101 Davy Crockett Spotting Rounds," dated December 31, 2015 (ML16004A369);
 - Army's Form 313, "Application for Materials License," items 1-7, dated June 1, 2015 (Pkg. ML15161A454);
 - Attachment 3, "Calculation of TEDE to Individual Likely to Receive Highest Dose," dated June 1, 2015 (Pkg. ML15161A454);
 - Attachment 4, "Attachment 4. How the Army Determined the M101DU RCAs," dated June 1, 2015 (Pkg. ML15161A454);
 - Attachment 5, "Bounding Calculations Using RESRAD 7.0 and RESRAD-OFFSITE 3.1," dated June 1, 2015 (Pkg. ML15161A454);
 - Attachment 8, "Arguments against Air Sampling During HE [High Explosive] Fire into RCAs [Radiation Control Areas]," dated June 1, 2015 (Pkg. ML15161A454);
 - Email clarifying RCAs at Fort Knox, KY, dated January 29, 2016 (ML16041A107);
 - Attachment 8, "Estimating Public Exposure to Airborne Depleted Uranium Outside the U.S. Army Pohakuloa Training Area, Hawaii," dated September 30, 2015, (ML15294A276);
 - Attachment 9, "Examples of Army Range fires," dated September 30, 2015, (ML15294A276);
 - Attachment 10, "Arguments against Air Sampling During HE Fire into RCAs, rev. 1," dated September 30, 2015, (ML15294A276);

- Attachment 11, “Calculation of Public Dose SOP,” dated September 30, 2015, (ML15294A276);
- Programmatic ERMP, “Programmatic Approach for Preparation of Installation-specific Environmental Radiation Monitoring Plans”, dated December 31, 2015 (ML16004A369);
- “US Army Decommissioning Funding Plan (DFP) for License Number SUC-1598,” dated February 9, 2016 (ML16042A232);
- Maps of the locations of the RCAs, “M101 Impact Areas,” dated December 31, 2015 (but, sent February 12, 2016 (ML16048A358);
- Army’s email clarifying M101 Target Areas (Radiation Control Areas), dated February 12, 2016 (ML16048A347); and
- Army’s Statement of Intent, dated June 1, 2015 (ML15161A458).

The approved license application are hereby incorporated by reference, except where superseded by license condition(s) below:

12. If the licensee identifies information indicating that Davy Crockett-related depleted uranium may be present at a U.S. Army installation not identified in License Condition 10 or included on another NRC license¹⁷, then the licensee will notify the NRC in writing within 15 calendar days of the identification of this information as well as include a schedule for evaluating the presence of depleted uranium. The evaluation schedule should not exceed 90 calendar days from the date of the notification letter.
13. If it is determined that Davy Crockett-related depleted uranium is present at an U.S. Army installation not listed in License Condition 10 or included on another NRC license, the licensee shall submit a request to include the installation in this license within 60 calendar days of the determination. The request will address Radiation Safety, Environmental Radiation Monitoring, Physical Security, Decommissioning Financial Assurance and the name of the Garrison Radiation Safety Officer. Any additional procedures necessary to ensure compliance with License Conditions 9A - 9D that are not included in the licensee’s application referenced in License Condition 11 will also be included in the request.
14. The licensee shall submit an updated site-specific decommissioning cost estimate and financial assurance instrument for each U.S. Army installation listed in License Condition 10 on a triennial basis, by December 31st of each year or, if applicable, in accordance with the requirements of 10 CFR 40.36(c)5.

¹⁷ The words “or included on another NRC license” were added because the Army determined that DU from Davy Crockett M101 spotting rounds are present at Lake City Arsenal. The Lake City Arsenal is being decommissioned. Decommissioning is complex in that parts of the facility are being decommissioning under the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 or Superfund and other parts of the facility are being decommissioned under NRC authority via License No. SUC-1380, Docket No. 04008767. For more details, refer ML003755439 [NRC 1998a] and ML011650107 [NRC 2001]. For a site history summary for portions of this facility, refer to ML11280A336 [NRC 2010]. The NRC staff determined that clarification of this license condition was necessary because it would not be efficient or effective to transfer or combine the requirements of Source Materials License No, SUC-1380 with Source Materials License No. SUC-1593. The intent of this license condition is to ensure that M101 material, if found in the future, comes under NRC authority. Because the Davy Crockett M101 spotting round DU is already under NRC authority, incorporating this material onto Source Materials License No. SUC-1593 from Source Materials License No. SUC-1380 is not necessary.

15. The licensee shall post "Caution - Radioactive Material" signs at a sufficient number of locations around each the Radiation Control Area to ensure that individuals entering the Radiation Control Area are aware of the presence of depleted uranium. The signs may be placed at the perimeter of the range impact areas if posting them at the Radiation Control Area boundary is unsafe due to the presence of unexploded ordnance.
16. Decommissioning is not authorized without NRC approval:
 - a. The licensee shall not perform any decommissioning or ground disturbing activities to collect or remove depleted uranium fragments or contaminated soil that is identified during routine range activities at any of the Radiation Control Areas without prior authorization from the NRC. Picking up incidental pieces of depleted uranium that the Army finds during training exercises would be allowed without NRC approval, if it does not involve ground disturbing activities;
 - b. NRC or Agreement State licensed contractors may undertake decommissioning or ground disturbing activities to collect or remove depleted uranium fragments or contaminated soil that is identified during routine range activities at any Radiation Control Area consistent with the conditions and commitments of their license(s); and
 - c. When the licensee engages an NRC or Agreement State licensed contractor to undertake decommissioning or ground disturbing activities to collect or remove depleted uranium fragments or contaminated soil that is identified during routine range activities at any of the Radiation Control Areas, the licensee will notify NRC in accordance with the requirements of 10 CFR 40.42(g)(1). The licensee shall provide NRC with the contractor's site-specific decommissioning plans and all other documents associated with radiation safety and environmental monitoring associated with the proposed decommissioning or ground disturbing activities in accordance with the requirements of 10 CFR 40.42 prior to the commencement of the activity. If issues are identified by NRC that could impact radiological health and safety, they will be resolved prior to the commencement of the activity.
17. When analytical sampling results from locations outside of the Radiation Control Area indicate that the U-238/U-234 activity ratio exceeds 3, the licensee shall notify NRC within 30 calendar days and collect additional environmental samples within 30 calendar days of the notification of NRC, unless prohibited by the absence of the sampling media (e.g., lack of well water).
18. Within 6 months of the effective date of the license amendment, the licensee shall provide to the NRC for approval, site-specific environmental radiation monitoring plans for each installation listed in License Condition 10 (a proposed license condition) that address all RCAs at the installations. The licensee shall fully implement each installation's site-specific environmental radiation monitoring plan within 6 months of NRC approval.
19. Within 6 months of the effective date of this license amendment, the licensee shall

provide to the NRC for verification, documentation, including site-specific dose modeling parameters, showing that the approved dose modeling methodology was applied and that the calculated site-specific all pathway dose for each Radiation Control Area at each installation listed in License Condition 10 does not exceed 1.0E-2 mSv/yr (1.0 mrem/yr) TEDE.

20. All written notices and reports to USNRC required under this license shall be addressed to: ATTN: Document Control Desk, Deputy Director, Division of Decommissioning, Uranium Recovery, and Waste Programs, Office of Nuclear Material Safety and Safeguards, Mailstop T8 F5, U. S. Nuclear Regulatory Commission, Washington, DC 20555-0001, or by express delivery to 11545 Rockville Pike, Two White Flint North, Rockville, MD 20852-2738. Required telephone notification shall be made to the NRC Operations Center at (301) 816-5100, unless otherwise specified in license conditions.

9.0 General License

In the Army's license amendment application, the Army requests that the three sites that have DU from Davy Crockett M101 spotting rounds located in the Titus and Sergeants Roads Area at the Fort Carson, CO Army installation not be included in the site-specific license, Source Materials License No. SUC-1593. Rather, the Army requests that these 3 sites be licensed under a general license pursuant to 10 CFR 40.22.

9.1 Regulatory Requirements

For small quantities of source material, provisions for a general license under 10 CFR 40.22 may apply. Under 10 CFR 40.22, a general license is limited to thorium and uranium in their natural isotopic concentrations and DU. A 10 CFR 40.22 general licensee is a commercial or industrial firm; research, educational, or medical institution; or Federal, State, or local government agency that receives, possesses, uses, or transfers small quantities of source material in the forms and quantities described in 10 CFR 40.22(a)(1)–(3) for research, development, educational, commercial, or operational purposes.

Under 10 CFR 40.22, a "small quantity" of source material means the following: (1) not more than 1.5 kilograms (kg) (3.3 pounds (lb)) of uranium and thorium in dispersible forms at any one time and not more than a total of 7 kg (15.4 lb) of uranium and thorium in dispersible forms in any one calendar year (any material processed by the general licensee that alters the chemical or physical form of the material containing source material must be accounted for as a dispersible form even after processing is completed); and (2) not more than a total of 7 kg (15.4 lb) of uranium and thorium at one time and not more than a total of 70 kg (154 lb) of uranium and thorium in any one calendar year.

9.2 Regulatory Acceptance Criteria

The NRC staff evaluated the proposed request with respect to 10 CFR 40.22 and using the guidance, "Guidance for Implementation of the Final Rule 'Distribution of Source Material to Exempt Persons and to General Licensee and Revision of General License and Exemptions' 10 CFR Parts 30, 40, 70, 170, and 171," (ML13051A824) [NRC 2013a].

9.3 NRC Staff Review and Analysis

The NRC staff reviewed Attachment 9 of the Army's amendment application, dated June 1, 2015 (ML15161A459), and the Army's response to the second RAI, dated November 30, 2015 (ML15335A123). In the Army's response to the second RAI, the Army provided the "Fort Carson Davy Crockett Phase I, Depleted Uranium Investigation, Fort Carson, Colorado," Baltimore, Maryland Cabrera Services, 2009 report [Cabrera Services 2009] with site-specific analytical data. In these referenced submittals, the Army identifies the area of Titus and Sergeants Roads Area at Fort Carson, CO, as the location of three of the five sites (Titus and Sergeants Roads Area M101 impact area) that contain DU from former testing of Davy Crockett M101 spotting rounds that should be generally licensed.

The Army also quotes various sections of the ASR [USACE 2011] that document the research that was conducted by the USACE to identify areas specific to this impact area. The Army notes that the ASR [USACE 2011] reports that: 1) "No Davy Crockett or munitions debris was found in this area during the project inspection ...;" 2) that on March 14, 2008, "Both the firing points and the probable impact areas ... were inspected.;" and "No Davy Crockett munitions debris or any other munitions debris was found." Also, the Army indicated that Cabrera [Cabrera Services 2009] performed a radiological scoping survey of the area in question where Field Instrument for Detecting Low Energy Radiation (FIDLER) instruments and dose rate meters were used and soil samples were collected in March 2008. The scoping survey report [Cabrera Services 2009] concluded that there was no evidence of Davy Crockett debris; no DU was observed within the cantonment area, and if the Davy Crockett weapon system were used in this area, the DU was likely either removed or has since been covered by existing construction or fill. Further, the scoping survey report [Cabrera Services 2009] concluded that "[g]iven the low usage of the area as a DC [Davy Crockett] demonstration range, the risks presented in the area are extremely low. No further action is recommended in this area."

From the research that was performed by the USACE and as documented in the ASR [USACE 2011], the Army found that there were only three documented instances that the Davy Crockett weapon system was fired in this area: 1) on January 22, 1965; 2) on February 5, 1965; and 3) on June 6, 1966. The Army states that it believes that probably two but not more than three M101 spotting rounds (up to 3 bullets, in layman's terms) were fired in this area for demonstration purposes. The Army states that the total DU mass, if the M101 spotting rounds remain in the area, is probably 0.38 kg, but no more than 0.57 kg. The Army assumes that each M101 spotting round contains 0.190 kg of DU and using a specific activity of DU of 3.7×10^{-7} Ci/g, the Army estimates that the total DU activity is probably about 140 μ Ci, but no more than 210 μ Ci. Per 10 CFR 20.1902(e), an area must be posted with "CAUTION, RADIOACTIVE MATERIAL" signs if the area contains more than 1000 micro Ci of DU. The Army concludes that this area does not require posting.

The Army notes that the possession of this DU meets the requirements for a general license under the provisions of 10 CFR 40.22(a)(1). Although the Army does not know the exact location of this DU, the Army states that it can meet the conditions for a General License in 10 CFR 40.22(b) through (e).

9.4 Evaluation Findings

The NRC staff independently analyzed the Army's estimate and reproduced the same results for the Army's estimate of the amount of DU that could be present in this area. The NRC staff found that the Army's calculation was technically correct and the assumption of the specific activity for DU is appropriate. The NRC staff reviewed the Army's research notes and laboratory analyses [Cabrera Services 2009] and concluded that there is no evidence of significant contamination as the Army presented facts on visual inspection, as well as through a review of historical information about the quantities of DU believed to be present at this site. The NRC staff found that the analytical data and conclusions [Cabrera Services 2009] were reasonable.

Also, the NRC staff examined the maps of the areas in question where construction had taken place. The NRC staff found that the statement that these areas were likely covered by existing construction or fill" was reasonable given that buildings and a golf course are now located about 1000 yards away and given the amount of time that has passed since the estimated three M101 spotting rounds were fired at this location.

The NRC staff performed an independent dose assessment using the industrial worker scenario to evaluate potential doses to workers who are needed to address various issues, such as fires, that may occur on the ranges. Doses calculated were comparable to the resident farmer scenario considered by the Army. NRC staff concluded that doses associated with industrial activities that may occur on the ranges are not an issue and that factors such as dispersion and settling of atmospheric debris would result in lower doses to individuals not located directly on the contaminated area.

The Army has provided factual information that would lead a reasonable person to conclude that any remaining DU that may be present is not significant.

9.5 Conclusions/Findings

The NRC staff finds that the three sites that contain DU from the three Davy Crockett M101 spotting rounds located in the Titus and Sergeant Roads Area at the Fort Carson, CO meet the criteria in 10 CFR 40.22(a) for a general license for the possession of the DU. Therefore, the terms of 10 CFR 40.22(e) would apply for the three sites located in the Titus and Sergeant Roads area at Fort Carson, CO. The applicable requirements that would apply to these three sites include all applicable requirements of Parts 19, "Notices, Instructions and Reports to Workers: Inspection and Investigations," 20, "Standards for Protection Against Radiation," and 21 "Reporting of Defects and Noncompliance," requirements. The guidance, "Guidance for Implementation of the Final Rule 'Distribution of Source Material to Exempt Persons and to General Licensee and Revision of General License and Exemptions' 10 CFR Parts 30, 40, 70, 170, and 171," [NRC 2013a] explains the requirements that apply to 10 CFR 40.22 General Licensees that would be applicable to the three sites located at the Titus and Sergeants Road area at Fort Carson, CO.

Because the sites located in the Titus and Sergeants Road area at Fort Carson, CO would be covered by a general license, the Army is not required to provide anything in its SUC-1593 specific license amendment application with respect to this area. Neither the Army, nor the

NRC staff, are required to address the matter of a general license for the proposed amendment action for Source Materials License No. SUC-1593. For transparency, the NRC's staff evaluation of these sites is included in this SER.

The license amendment would add the Fort Carson CO, Army installation to the license, in accordance with License Condition 12 of Source Materials License No SUC-1593 (the current license). License Condition 12 of Source Materials License No. SUC-1593 identifies the list of Army installations that the Army must request be added to the specific-license, Source Materials License No. SUC-1593, by amendment. There are a total of 5 sites at the Army installation Fort Carson CO that contain DU from Davy Crockett M101 spotting rounds. The license amendment would include the Fort Carson, CO Army installation but would not include the two sites located in the Titus and Sergeant Roads Area.

10.0 Acronyms and Initialisms

AAP	Army Alternate Procedures
ACHP	Advisory Council on Historic Preservation
ADAMS	Agency Document Access and Management System
AEA	Atomic Energy Act of 1954, as amended
ALARA	As Low As is Reasonably Achievable
ANL	Argonne National Laboratory
APE	Area of Potential Effect
AR	Army Regulation
ASR	Archive Search Report
AU	Authorized User
BAX	Battle Area Complex
CATEX	Categorical Exclusion
CFR	<i>Code of Federal Regulations</i>
CRM	Cultural Resources Manager
DCP	Declared Pregnant Worker
DFP	Decommissioning Funding Plan
DOE	U.S. Department of Energy
DU	Depleted Uranium
ERMP	Environmental Radiation Monitoring Plan
FR	<i>Federal Register</i>
FIDLER	Field Instrument for Detecting Low Energy Radiation
FWS	U.S. Fish and Wildlife Service
HE	High Explosive
HPO	Historic Preservation Officer
IMCOM	U.S. Army Installation Management Command
ICRMP	Integrated Cultural Resource Management Plan
JPG	Jefferson Proving Ground
MARSSIM	Multi-Agency Radiation Survey and Site Investigation Manual
MDCs	Minimum Detectable Concentrations
NHPA	National Historic Preservation Act of 1980
NCSHPO	National Conference of State Historic Preservation Officers
NEPA	National Environmental Policy Act
NOAA	National Oceanic and Atmospheric Administration
NUREG	NRC technical report designation (<u>N</u> uclear <u>R</u> egulatory Commission)
PSP	Physical Security Plan
PPE	Personal Protective Equipment
QHG	Quantitative Health Guidelines
RACER	Remedial Action Cost Engineering and Requirements
RAI	Request for Additional Information
RCA	Radiation Control Area
REM	roentgen equivalent man
RESRAD	dose assessment code for RESidual RADioactive materials
RSO	Radiation Safety Officer
RSP	Radiation Safety Plan
SOC	Statements of Consideration
SER	Safety Evaluation Report

SHPO	State Historic Preservation Officer
SOI	Statement of Intent
SOP	Standard Operating Procedures
SRM	Staff Requirement Memorandum
TEDE	Total Effective Dose Equivalent
THPO	Tribal Historic Preservation Officer
USACE	U.S. Army Corps of Engineers

11.0 References

[AEA] Atomic Energy Act of 1954, as amended, 42 U.S.C. § 2011 et seq., Pub. L. 83-703.

[DOE, 2008] *RESRAD Home Page*. [Online] Available at: <http://web.ead.anl.gov/resrad/home2/index.cfm> [Accessed 19 November 2012].

[Cabrera Services, 2009] "Fort Carson Davy Crockett Phase I, Depleted Uranium Investigation, Fort Carson, Colorado," Baltimore, Maryland.

[NOAA 2015] *National Climatic Data Center*. 2015 (www.ncdc.noaa.gov/, accessed April 17, 2015).

[NRC 1993] Regulatory Guide 1.86, "Guidelines for Decontamination of Facilities and Equipment Prior to Release for Unrestricted Use or Termination of Licenses for Byproduct, Source, or Special Nuclear Material," dated April 1993.

[NRC 1998a] "Commission Staff Requirements Memorandum (SRM) - SECY-98-201 – Deferral of Regulatory Oversight of Certain Portions of the Lake City Army Ammunition Plant to the U.S. Environmental Protection Agency," dated October 15, 1998 (ML003755439).

[NRC 1998b] "NRC Collection of Abbreviations, Rev. 4," July 1998.

[NRC 1999] NUREG-1556, Vol. 7, "Consolidated Guidance About Materials Licenses: Program-Specific Guidance About Academic, Research and Development, and Other Licenses of Limited Scope Including Gas Chromatographs and X-Ray Fluorescence Analyzers," 1999.

[NRC 2000] NUREG-1575, "Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM), Rev. 1," August 2000 (ML003761445).

[NRC 2003a] NUREG-1757, Vol. 3, "Consolidated NMSS Decommissioning Guidance: Financial Assurance, Recordkeeping and Timeliness, Rev. 1," September 2003 (ML12048A683).

[NRC 2003b] NUREG-1748, "Environmental Review Guidance for Licensing Actions Associated with NMSS Programs" July 2003 (ML032450279).

[NRC 2006] NUREG-1757, Vol. 2, "Characterization, Survey, and Determination of Radiological Criteria, Revision 1", September 2006 (ML063000252).

[NRC 2008] "*Risk-Informed Decisionmaking Guidance for Nuclear Material and Waste Applications, Revision 1*," 2008 (ML080720238).

[NRC 2001] SRM-SECY-01-0088 - "Deferral of Regulatory Oversight of Area 10 (The Sand Pile) of Lake City Army Ammunition Plant to EPA & Request to Remove Site from Site Decommissioning Management Plan", June 13, 2001 (ML011650107).

[NRC 2011] "August 2011 Lake City Army Ammunition Plant Area 10 Sand Remediation Project

Summary,” dated August 22, 2010 (ML11280A336).

[NRC 2013a] ‘Guidance for Implementation of the Final Rule “Distribution of Source Material to Exempt Persons and to General Licensee and Revision of General License and Exemptions” 10 CFR Parts 30, 40, 70, 170, and 171,’ dated May 29, 2013 (ML13051A824).

[NRC 2013b] Safety Evaluation Report for the U.S. Army's Possession License for Depleted Uranium from the M101 Spotting Round, October 23, 2013 (ML13259A081).

[NRC 2015] *Davy Crockett - Depleted Uranium – Possession Only License Source Materials License No. SUC- 1593 Additional Guidance*, February 27, 2015 (ML15061A177).

[USACE 2011] St Louis. Project Archive Search Report. Use of Cartridge, 20mm Spotting M101. St Louis, Missouri: US Army Corps of Engineers, St Louis District, 2011.

[USARMY 2007] AR 200-4, “Environmental Protection and Enhancement,” December 13, 2007 (http://www.apd.army.mil/pdf/files/r200_1.pdf).

[Yu, C., et al., 2001] *User's Manual for RESRAD Version 6*. Argonne, Illinois: Department of Energy Argonne National Laboratory, 2001.