
SAFETY EVALUATION REPORT

For the U.S. Army's Possession License for Depleted Uranium from the M101 Spotting Round

Docket No. 040-09083

U.S. Army Installation Management Command

U.S. Nuclear Regulatory Commission

**Office of Federal and State Materials and Environmental
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Introduction

In a letter dated November 6, 2008, the U.S. Army Installation Management Command (Army or the applicant) submitted a license application (application) to the U.S. Nuclear Regulatory Commission (NRC or the Commission) requesting a source material license to allow the possession of depleted uranium (DU) from the M101 Davy Crockett spotting round (Agency Document Access and Management System (ADAMS) Accession No. ML090070095). The application states that “the initial discovery of depleted uranium from the M101 spotting round was at locations within Hawaii and at Fort Hood, TX,” and that the “presence of depleted uranium may be determined to exist at additional installations.” Several additional sites were noted in the license application and in subsequent submittals to the application. 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 license application, and supporting documents, as they pertain to the U.S. Army facilities in Hawaii, specifically, the Schofield Barracks and Pohakuloa Training Area (PTA). The Army will request amendments to the license, once it is issued, to incorporate additional Army installations that contain DU from the M101 spotting round.

The Atomic Energy Act of 1954, as amended, (AEA) 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, 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 material license:

- The 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 application and supporting materials in accordance with the applicable requirements of 10 CFR Part 40 and licensing guidance in NUREG-1556, Volume 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 evaluation assesses the applicant’s compliance with the requirements of 10 CFR Part 40 as well as the applicable requirements of 10 CFR Part 20, “Standards for Protection against Radiation.”

Summary and Conclusions

The staff finds that the Army's application for possession of depleted uranium at the Schofield Barracks and PTA, as currently written, generally complies with the standards and requirements of the Atomic Energy Act of 1954, as amended, and the Commission's regulations. However, based on its review of the Army's license application and supporting documents, the staff concludes that 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 and 40.

More specifically, in accordance with 10 CFR 40.32(b) and (c), the 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 Radiation Safety Plan (RSP) are adequate to protect public health and minimize danger to life or property.

However, the staff has determined that the Army has not provided sufficient justification that air and plant monitoring is not warranted on the Hawaiian installations. With the license conditions identified in the SER, the Army should be able to determine if further air and plant monitoring is necessary. Based on the results of this additional monitoring the staff will be able to determine if 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) or if additional monitoring is warranted.

In addition, the staff determined that, in order to ensure that the Army conducts its operations in accordance with NRC requirements, license conditions are warranted regarding: 1) other sites that contain depleted uranium from the Davy Crockett spotting round that will be added to the license in the future, 2) financial assurance for decommissioning the Hawaiian installations, 3) posting and notifications regarding the use of the ranges containing DU, and 4) future decommissioning of the Hawaiian installations.

The staff concludes that the findings described in the succeeding sections of this SER, including the necessary license conditions, support the issuance of a license authorizing the possession of depleted uranium associated with the M101 spotting round at Schofield Barracks and PTA. Therefore, in accordance with 10 CFR 40.32(d), the staff finds that issuance of a license to the Army for the possession of depleted uranium at the Schofield Barracks and PTA 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 manufactured spotting rounds for the Davy Crockett Weapon System at the Frankford Arsenal in Philadelphia, PA under license SUB-307 issued by the Atomic Energy Commission (AEC), the NRC's predecessor agency, and AEC/NRC License SUB-459. These licenses allowed the Frankford Arsenal to produce the spotting rounds and distribute them to various Army installations for testing, training and deployment. The spotting round was fired from a small rifle attached to the underside of the main recoilless rifle and was used to simulate the flight path of the main munitions of the Davy Crockett Weapon, which was a low-yield battlefield nuclear device. It is important to note that the spotting round was not an atomic explosive. Rather it consisted of a nosecone, a DU body (containing about 6.2 ounces of depleted uranium), 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. Other versions, such as the XM106, did not have an exploding nosecone. M101 rounds were distributed to various Army installations for training purposes. At the request of the Army, License SUB-459 was allowed to expire in April 1978 (ML111080529).

Between 1962 and 1968, the Army received and used DU (which the NRC licenses as source material) in spotting rounds, at firing ranges at various installations, including Forts Benning and Gordon (Georgia), Forts Campbell and Knox (Kentucky), Fort Carson (Colorado), Fort Hood (Texas), Fort Lewis (currently called 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). As a result, DU was scattered throughout a limited number of ranges used for Davy Crockett Weapon system practice/qualification. According to information provided by the U.S. Army, the Army discontinued firing these spotting rounds in Hawaii in 1968.

In August 2005, the Army identified the remnants of a DU round at the Schofield Barracks, HI installation (ML070650224). During a controlled grass burn of the 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, HI installation (ML070650224). From November 2006 through February 2007, NRC and Army staffs discussed the presence of the DU at the Schofield Barracks (ML070650224). In February 2007, the Army sent a letter to 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, they determine the total number of installations that might contain DU from the Davy Crockett weapons system. In March 2007, 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).

On July 8, 2009, the Army provided two generic plans (applicable to all sites where DU has been found) to NRC for review (ML091950282) entitled, “Physical Security Plan for Depleted Uranium from the M101 Spotting Round” (ML091950286) and “Environmental Radiation Monitoring Plan for Depleted Uranium From the M101 Spotting Round” (ML091950291). Two site-specific Environmental Radiation Monitoring plans (ERMPs) were also provided for Schofield Barracks (ML091950292) and the PTA (ML091950297). On August 3, 2009, the NRC notified the Army that the plans were accepted for detailed technical and environmental review (ML092150316). On September 13, 2010, the U.S. Army submitted a letter to the NRC containing an ERMP for the Fort Benning installation and discussed the submission of the site-specific ERMPs for other U.S. Army installations (ML103130113).

On November 16, 2010, NRC staff held a license application meeting with Army staff at NRC headquarters. At that meeting, the Army informed NRC staff of the current status of their investigation into the extent of Davy Crockett DU at Army installations and indicated that DU may be present at 17 installations. On November 30, 2010, NRC staff issued a letter to the Army containing technical comments on the Army’s license application submittals (generic physical security and ERMPs) and detailed guidance on the scope and content of an acceptable

ERMP, to aid Army staff in its development of the site-specific ERMPs for its installations (ML103160239, ML102770230, and ML102790074). On February 9, 2011, the Army provided a "Radiation Safety Plan for US Army Garrison Hawaii Ranges Affected by Depleted Uranium in M101 Davy Crockett Spotting Rounds" (RSP) (ML110610529). On February 17, 2011, the Army responded to the NRC staff's November 30, 2010, comments and provided revised RSPs and Physical Security Plans (PSPs) (ML110830582), the qualifications of the Garrison Radiation Safety Officer (RSO) for the Hawaiian installations, a decommissioning cost estimate, and a list of facilities with Davy Crockett ranges. On March 31, 2011, the NRC staff held a technical meeting with the Army to discuss the NRC staff's review of the Army's RSP for the HI sites. On May 17, 2011, the NRC staff provided comments on the RSP to the Army (ML111360082). The Army responded to the staff's comments and provided a revised RSP on June 22, 2011 (ML11193A228, ML11193A227, and ML11193A226).

On November 1, 2011, and November 15, 2011, the Army submitted ERMPs for the Schofield Barracks and PTA (ML11312A143 and ML11326A258, respectively) to the NRC staff for review. On December 16, 2011, the NRC staff provided comments on the Army's revised ERMPs indicating that they would not meet the intent of an ERMP, namely, detecting the migration of DU from the ranges to the surrounding environs, nor did they include the type of information discussed in the NRC staff guidance (ML113420145). On February 3, 2012, the Army responded to the staff's comments and provided revised ERMPs for the Schofield Barracks and PTA (ML120470139, ML120470165, ML12053A391, and ML12046A506).

On June 28, 2012, NRC staff provided a draft license to the Army incorporating license conditions that the NRC staff determined were necessary to ensure that the Army complied with NRC's regulations and requirements for the possession of the DU (ML12179A321). The principal documents that were used by the NRC staff to evaluate the Army's request for a license to possess DU at the Schofield Barracks and PTA and develop the draft license were the application dated November 6, 2008, the PSP dated February 17, 2011, the RSP dated June 22, 2011, and the ERMPs dated February 3, 2012.

On July 12, 2012, NRC staff met with Army staff to discuss the draft license. At the meeting, the Army requested that the NRC staff delay issuing the license until the Army was able to comment on the draft license conditions. The NRC staff agreed to the Army's request on July 23, 2012 (ML12201A257).

On September 10, 2012, the Army provided comments on the draft license. In its response, the Army requested that the NRC exempt the Army from licensing DU from the Davy Crockett under the provisions of 10 CFR 40.13(c)(5) or 10 CFR 40.14(a) (ML12265A173). The Army also requested that, if an exemption from licensing was not justifiable, that NRC issue the license without any license conditions or, failing that, issue the license without any conditions pertaining to environmental radiation monitoring.

On December 12, 2012, the NRC staff met with Army staff to discuss the NRC staff's review of the Army's comments on the draft license and request for an exemption from licensing. The staff developed a meeting summary and assessment of the Army's comments on December 27, 2012 (ML12354A165). On February 6, 2013, the Army provided its comments on the meeting summary and staff assessment (ML13046A176).

On May 9, 2013, the NRC staff provided proposed resolutions to the license conditions that had not been resolved during previous meetings (ML13126A298). On May 30, 2013, the NRC staff met with Army staff to resolve the remaining issues surrounding the license conditions (ML13157A286).

On June 21, 2013, the Army provided a revised RSP for the Hawaiian sites (ML13190A264). On August 14, 2013 the NRC staff provided comments on the revised RSP (ML13218A229). On August 23, 2013, the Army provided a revised RSP that addressed the NRC staff's outstanding comments (ML13242A281).

In summary, the documents that are evaluated in this SER and are considered to be the documents that describe the Army's radiation safety program for the Hawaiian installations are the RSP¹, dated August 23, 2013 (ML13242A281), and the Physical Security Plan for US Army Garrison Hawaii Ranges Affected by Depleted Uranium in M101 Davy Crockett Spotting Rounds (ML110830582). In addition, the information supplied in the Army ERMPs was used in conjunction with information that was independently identified by the NRC staff to evaluate the environmental monitoring necessary at the Army's Hawaiian installations.

Safety Evaluation

1.0 Authorized Use

1.1 Regulatory Requirements

10 CFR 40.3 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 and was reviewed in accordance with guidance provided in NUREG-1556, Volume 7.

1.3 Staff Review and Analysis

The Army's application for a license to possess depleted uranium associated with the M101 spotting round was submitted by the Army on November 6, 2008 (ML090070095). The application consists of Items 1-12, as specified in NUREG-1556. The items relating to authorized use are discussed below. The Army submitted revised RSPs to support the application on June 21, 2011 (ML11193A228) and June 21, 2013 (ML13190A264). The revised RSPs revised much of the information contained in the original application and included changes due to ongoing correspondence and discussions between the Army and NRC staff.

¹ For this SER the "RSP" refers to the final version of the RSP dated 08/23/2013 (ML13242A281).

On August 23, 2013, the Army submitted the final RSP that incorporated revisions agreed upon by Army and NRC staff (ML13242A281).

Item 3 of the application lists the address where licensed material will be used or possessed. The Army's application states that "the initial discovery of depleted uranium from the M101 spotting round was at locations within Hawaii and at Fort Hood, TX," and that the "presence of depleted uranium may be determined to exist at additional installations." The application identified the following installations where the M101 spotting round has been found: Fort Benning, Georgia; Fort Campbell, Kentucky; Fort Carson, Colorado; Fort Hood, Texas; Fort Knox, Kentucky; Fort Lewis, Washington; Fort Riley, Kansas; Schofield Barracks, Hawaii; and PTA, Hawaii. The application also indicated that "the NRC will be notified upon confirmation that depleted uranium is present at a given installation and that installation will then be incorporated into this permit."

Subsequent to the original application submittal, the Army provided notification that the following sites contain depleted uranium from the M101 spotting round: Schofield Barracks and PTA, (Hawaii), 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), and Fort Riley (Kansas)(ML110830582). However, authorization for possession of DU at each facility will require a site-specific license amendment, including site-specific considerations and conditions. Therefore, review and approval of the Army's application will only authorize possession at the Schofield Barracks and PTA.

Item 5 of the application states that the Army is requesting possession of depleted uranium (^{238}U , ^{235}U , and ^{234}U) from the M101 spotting round in any chemical form and at a maximum amount of 8,000 kilograms (17,637 pounds). 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 29,318 rounds which have not been accounted for contain approximately 5,200 kilograms of DU.

Subsequent to the original application submittal, the Army provided additional documentation (ML111670084) indicating that a total of about 32,000 M101 spotting rounds had been shipped or fired at Army ranges, including those that were licensed by NRC.

On February 6, 2013, the Army requested that the authorized possession limit be revised from 8,000 kg to 125 kg, as this is the amount of DU that will be present on the Army's Hawaiian installations (ML13046A176).

Item 6 of the application provides the purpose for which the licensed material will be used. Authorization was requested "to possess and manage depleted uranium present at US Army installations as a result of previous use of depleted uranium." It also states that "[s]pecific functions to be performed under the license will be limited to radiological surveys as necessary to fully characterize the nature and extent of contamination and, when appropriate, to obtain information necessary to support development of decommissioning plans," and that "depleted uranium possessed pursuant to this license may also be subjected to disposal by transfer to a properly permitted/licensed disposal facility."

Subsequent to the original application, the Army submitted revised RSPs that included the specific activities that the Army wished to conduct at the Hawaiian installations. Section 4 of the RSP provided a list of specific activities the Army requests permission to undertake on the ranges at its Hawaiian installations. The RSP also states that “[h]igh explosive (HE) munitions will not be fired into an RCA [Radiation Control Area] until the Licensee RSO has informed the NRC.” In addition, Section 4 of the RSP discusses the procedures the Army 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 and the controls the Army will use during training exercises.

Item 7 of the application describes the individuals responsible for the radiation safety program and their training experience. Here it states that the Army’s executive management and Radiation Safety Staff Officer (RSSO) will work as a team to oversee the radiation safety program for the license. The Army radiation safety program is directed by the Army RSO on behalf of the Director of Army Safety. It also states that in accordance with paragraph 1-4i, Department of the Army Pamphlet (DA Pam) 385-24, Commanders will ensure command compliance with conditions of the NRC license. A trained Health Physicist/RSSO will be appointed, who is responsible for day-to-day operation of the radiation safety program. According to the license application, the RSSO will have, as a minimum, a college degree at the bachelor level in a physical or biological science, mathematics or engineering and training and experience commensurate with the scope of the license to include specific training involving depleted uranium. To be consistent with NUREG-1556, this training will be from "a formal course designed for RSOs presented by an academic institution, commercial radiation safety consulting company, or a professional organization of radiation protection experts." The application also states that in addition to the RSSO, the Garrison Commander will designate a trained RSO who would establish and direct the garrison radiation safety program.

Subsequent to the original application, the Army provided revised information on the individuals that will be responsible for the radiation safety program (Section 2 of the RSP).

Items 8, 9, and 10 of the application discuss training for individuals working in or frequenting restricted areas, facilities and equipment, and the radiation safety program, respectively.

Subsequent to the original application, the Army provided additional information regarding the training of individuals working in or frequenting restricted areas, facilities and equipment, and the radiation safety program (Sections 2, 5, 17 and 20 of the RSP).

1.4 Evaluation Findings

The staff reviewed the proposed use of depleted uranium at the Schofield Barracks and PTA in accordance with the applicable requirements of 10 CFR 40.31 and guidance in NUREG-1556, Volume 7. 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 10 CFR 40.31 which describes the general requirements for the issuance of a specific license.

However, the staff has concluded that the Army should develop a schedule for the submission of license amendments to include its remaining installations on the license and a commitment to provide a Radiation Safety Plan along with the license amendment request. In addition, the

Army must inform NRC if DU from the Davy Crockett is identified on additional Army installations. These requirements are included as License Conditions 12, 13, and 14.

In addition, the staff has concluded that the Army must first inform the NRC when it intends to fire high explosives into areas containing DU. This requirement is included as License Condition 17 and is discussed in Section 4 of the RSP.

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;

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; and

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 and 40 and was reviewed in accordance with guidance provided in NUREG-1556, Volume 7.

Organization and Administrative Controls

2.1.3 Staff Review and Analysis

The Army's organizational structure is presented in Section 2 of the RSP. The Commanding General, U.S. Army Installation Management Command (IMCOM), 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 final RSP. The Army will

inform the NRC whenever the IMCOM Commander is changed.

The responsibility for the development, implementation, and overall administration of the RSP lies with the License RSO. The License RSO reports to the IMCOM Commander and is responsible to the NRC 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 and the NRC will approve the appointment (via license amendment). 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 RSP.

Responsibility for DU associated with the M101 spotting round at the Schofield Barracks and PTA ranges lies with the U.S. Army Garrison Hawaii Commander. A Garrison RSO will be chosen by the Garrison Commander. 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 RSP.

Both the License RSO and the Garrison RSO have the authority to immediately stop any operation involving the use of DU in which the health and safety may be compromised or may result in non-compliance with NRC requirements and to suspend individuals from field activities for infractions against the RSP.

Section 2.5 of the RSP discusses the responsibilities and authority of individuals entering the RCAs on the Hawaiian installations. Individuals entering the RCA are responsible for understanding and complying with the policies and procedures in the 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 RSP. They also have authority to contact the Garrison RSO, License RSO, Garrison Commander or NRC to discuss safety concerns.

Management Controls

2.1.4 Staff Review and Analysis

Management controls are described in Sections 19 (Program Audits), 21 (Record Keeping) and 23 (Standard Operating Procedures) of the RSP. The Garrison RSO is responsible for monitoring activities in the RCAs of the installations and maintaining records demonstrating compliance with the NRC's regulations and the license requirements. The License RSO performs 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 RSP.

The Garrison RSO is responsible for maintaining the records relevant to the radiation safety program. Section 21.1 lists the records that the Garrison RSO is responsible for maintaining. The License RSO also maintains copies of the 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 lists the SOPs that will be developed and used in implementing the radiation safety program.

2.1.5 Evaluation Findings

The staff reviewed the applicant's radiation safety organization, and the administrative and management controls for implementing the radiation safety program at the Schofield Barracks and PTA in accordance with the applicable requirements of 10 CFR Parts 19, 20 and 40 and according to guidance provided in NUREG-1556, Volume 7, Sections 8.7, 8.10, and Appendices I and L.

The Army's proposed organizational structure is hierarchical in nature, with ultimate responsibility for ensuring compliance with NRC regulations and the Radiation Safety Program resting with the Commander of IMCOM. This responsibility is passed to a License RSO responsible for implementing the radiation safety program at the Army's installations. Day-to-day activities at each installation are overseen by a Garrison RSO that is located at the installation. The duties and authority of each of the positions in the radiation safety program are described and are appropriate for the respective positions. Appropriate stop work authority is given to all individuals responsible for implementing the Radiation Safety Program. The License RSO position meets the qualifications in Section 8.7.1 of NUREG-1556, Volume 7. The Garrison RSO position meets most of the qualifications in NUREG-1556, Volume 7, Section 8.7.1 for an RSO and all of the qualifications for an authorized user in NUREG-1556, Volume 7, Section 8.7.2. The adequacy of the Garrison RSO's qualifications and correlation to an authorized user (as defined in NUREG-1556, Volume 7) are addressed in Section 2.2.4 of the SER, below. The License RSO and the Garrison RSO are responsible for maintaining the records required by NRC regulations and the radiation safety program includes an audit program that is consistent with that described in NUREG-1556, Volume 7, Section 8.10.1 and Appendix L. The License RSO produces and maintains written procedures commensurate with the types of activities in the RCAs that are consistent with the NUREG-1556, Volume 7, Section 8.10.6.

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 in 10 CFR Part 20, Subpart L; 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 NUREG-1556, Volume 7 for Organizational, Administrative and Management Controls.

2.2 Qualifications for Personnel Conducting the Radiation Safety Program

2.2.1 Regulatory Requirements

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

2.2.2 Regulatory Acceptance Criteria

The application was reviewed for compliance with the applicable requirements of 10 CFR Parts 20 and 40, and was reviewed in accordance with guidance provided in NUREG-1556, Volume 7.

2.2.3 Staff Review and Analysis

Qualification requirements for the principal radiation safety program personnel are described in Sections 2.3.1 (License RSO) and 2.4.1 (Garrison RSO) of the final RSP. Section 2.3.1 provides the minimum qualifications for the License RSO. In a letter dated February 24, 2010, the Army replaced Mr. Mario Owens as the individual to be contacted about the license application (Item 4) and Mr. Greg Komp as the License RSO (Item 7) with Dr. Robert Cherry (ML120950352). The February 24th letter included Dr. Cherry's resume outlining his training and experience. Section 2.4.1 describes the qualifications of the Garrison RSO and provides the training on both general radiation physics and training specific to the possession of DU that will be provided to meet these qualifications. In a letter dated February 17, 2011, the Army provided documentation of the qualifications of the Garrison RSO for the Hawaiian installations (ML110830582). The Army will notify NRC within 30 days of the change of a Garrison RSO. Documentation of the Garrison RSO's qualifications will be maintained by the Army and will be available for inspection by the NRC (Section 2.4.4).

2.2.4 Evaluation Findings

The staff reviewed the applicant's qualifications for individuals responsible for implementing the radiation safety program at the Schofield Barracks and PTA in accordance with the applicable requirements of 10 CFR Parts 20 and 40 and according to guidance in NUREG-1556, Volume 7, Sections 8.7.1 and 8.7.2.

The License RSO position meets the qualifications in Section 8.7.1 of NUREG-1556, Volume 7, Section 8.7.1. The Garrison RSO position meets most of the qualifications described in NUREG-1556, Volume 7, Section 8.7.1 for an RSO and all of the qualifications described for an authorized user (AU) in NUREG-1556, Volume 7, Section 8.7.2. NUREG-1556 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, Volume 7 Section 8.7.2, 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 ensure that the Garrison RSO meets the minimum qualifications and Army maintain records of the Garrison RSO's qualifications for inspection by NRC, citing privacy as a rationale for this request. (ML12265A173). The issue was also discussed during meetings between the NRC and Army staff. The Army will eventually have as many as 18 different installations listed on the license and the Garrison RSO may change frequently at these installations, due to Army mission requirements. As such, the Army indicated that the requirement to provide the Garrison RSO qualifications to NRC each time the Garrison RSO changed could pose an unnecessary administrative burden. In that the Army will provide the name of the Garrison RSO to NRC in a timely manner, ensure that the Garrison RSO meets the minimum qualifications in the RSP and maintain records of the Garrison RSO's qualifications, the NRC staff found this request to be reasonable. Because the Garrison RSO and an AU are comparable positions within the radiation safety organization, the NRC staff has concluded that the Army should provide the

NRC with the name of the Garrison RSO within 30 days of the change and maintain the qualifications of the Garrison RSO for review by NRC during inspections. This condition has been included in the RSP.

Therefore, 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 40.32(b) and the guidance in NUREG-1556, Volume 7 for qualifications for individuals responsible for radiation safety programs.

2.3 Radiation Safety Training

2.3.1 Regulatory Requirements

The following regulations 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.

2.3.2 Regulatory Acceptance Criteria

The application was reviewed for compliance with the applicable requirements of 10 CFR Parts 19, 20, and 40 and was reviewed in accordance with guidance provided in NUREG-1556, Volume 7.

2.3.3 Staff Review and Analysis

Radiation safety training for individuals entering an RCA is described in Sections 2.5, 2.6, and 20 of the final RSP. All individuals entering the RCA will be trained in the policies and procedures of the final RSP. Section 20 of the final 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.

2.3.4 Evaluation Findings

The staff reviewed the applicant's qualifications for individuals responsible for implementing the radiation safety program at the Schofield Barracks and PTA in accordance with the applicable requirements of 10 CFR 40.32(b) and according to guidance in NUREG-1556, Volume 7, Section 8.8 and Appendix J.

Sections 2.5, 2.6, and 20 of the 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 radionuclide and activity of the source material that is expected to be found on the Hawaiian installations and is consistent with 10 CFR 19.12 and the training program described in NUREG-1556, Volume 7, Section 8.8 and Appendix J.

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, Volume 7, Section 8.8 and Appendix J for individuals working in or frequenting a restricted area.

2.4 Radiation Control Areas

2.4.1 Regulatory Requirements

The following regulations apply to the applicant's radiation control areas:

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;

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.

2.4.2 Regulatory Acceptance Criteria

The application was reviewed for compliance with the applicable requirements of 10 CFR Parts 20 and 40 and was reviewed in accordance with guidance provided in NUREG-1556, Volume 7.

2.4.3 Staff Review and Analysis

Establishment and control of access to RCAs is discussed in Sections 3, 14 and 15 of the RSP and in the "Physical Security Plan for US Army Garrison Hawaii Ranges Affected by Depleted Uranium in M101 Davy Crockett Spotting Rounds" (ML110830582). The Army conducted an evaluation of the use of the Davy Crockett weapon system from 2006 through 2011 to determine which Army installations had used the Davy Crockett and where on the installations the weapon was fired. The Army used the Archive Search Report for the Hawaiian installations as the basis for establishing the RCA for the Schofield Barracks and PTA. Section 1 of the RSP includes diagrams showing the proposed RCAs for the Schofield Barracks and PTA. Section 3 of the RSP discusses the procedures for revising an RCA, if additional spotting rounds are found in an area not on the RCA, and states how the NRC will be informed that the round has been located. Enlarging an RCA can be done by the License RSO if additional DU rounds are

located. NRC will be informed within 30 days if additional rounds are found and the RCA is enlarged. Reduction of an approved RCA will require approval by NRC.

Section 3 also discusses the removal of incidentally identified DU fragments and states that decommissioning or ground disturbing activities shall not be performed without prior NRC authorization.

Section 14 describes the posting of the RCA to identify it as an area containing radioactive material. It 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. Section 14 also describes how the Army will post the documents and notices to workers required by 10 CFR 19.11.

Access control of RCAs is discussed in Section 15. It is also described in detail in "Physical Security Plan for US Army Garrison Hawaii Ranges Affected by Depleted Uranium in M101 Davy Crockett Spotting Rounds." Access to RCAs is prohibited without the knowledge and approval of the Garrison RSO. When access is permitted, access control points will be established for entry and exit to the RCA and personnel will be required to undergo the training described in Section 20 of the final RSP.

The PSP describes the responsibilities for ensuring the security and access control of the RCAs of the IMCOM Commander, the Garrison Commander, the License RSO and the Garrison RSO. It also details the access control measures for individuals entering the RCA, including training on the requirements of the PSP, and the posting requirements for the RCA. The License RSO will review the PSP annually and update it as necessary. NRC will be informed of any significant changes to the PSP, and if appropriate, they will be approved before implementation.

The RCA contains portions of the Battle Area Complex (BAX). The BAX was cleared of unexploded ordnance and DU by an Army contractor, and NRC has 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 final RSP discusses the use of the BAX and discusses how personnel involved in training events on the BAX are exempt from the requirements of the RSP. NRC has allowed the Army to use the BAX with certain restrictions because the Army's contractor is a licensed decommissioning contractor that has extensive experience in the decommissioning of sites and the Army will restrict vehicles and troops to areas of the BAX that were cleared of DU by the contractor.

Section 4.4.3 of the RSP outlines the controls that will be established for the BAX. They include restricting troops and vehicles to cleared areas and not firing high explosives into the RCA.

2.4.4 Evaluation Findings

The staff reviewed the RCA control and access procedures at the Schofield Barracks and PTA in accordance with the applicable requirements of 10 CFR 19, 20, and 40 and according to guidance in NUREG-1556, Volume 7, Section 8.10.

NUREG-1556, Volume 7, Section 8.10.6 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 RSP provides detailed descriptions of how RCA's are established, controlled and maintained as well as how access is controlled through posting areas and the training of individuals. Access to the ranges, including the RCAs, is strictly controlled due to the presence of unexploded ordnance and, thus, the ranges are not readily accessible to the public. In addition, they are located on controlled military reservations with incumbent security restrictions and requirements. Decommissioning and ground disturbing activities are not permitted without prior NRC authorization.

Because the Army will conduct training on the BAX in a manner that ensures that mounted and dismounted troops and vehicles are not entering areas that contain DU, training activities on the BAX can be exempted from the requirements of the RSP once NRC has reviewed and concurred on the final radiological surveys for the BAX.

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 19.11; 10 CFR 20.1101(a); 10 CFR 20.1101(b) 10 CFR 40.32(c), and the guidance in NUREG-1556, Volume 7.

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.

2.5 Radiation Safety Controls and Monitoring

2.5.1 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 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;

2.5.2 Regulatory Acceptance Criteria

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

20 and was reviewed in accordance with guidance provided in NUREG-1556, Volume 7.

2.5.3 Staff Review and Analysis

2.5.3.1 Radiation Exposure Monitoring Program

The Army has committed to maintaining personnel radiation exposure as ALARA, taking technical and socioeconomic factors into account. Section 5 of the 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 final RSP also indicates that, through the implementation of the ALARA and contamination control programs, no one will be allowed to exceed regulatory dose limits. Section 6 of the RSP further indicates that "Title 10 CFR, Part 20, Subpart C 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 the RCA, as it is not expected that unmonitored personnel will receive more than 10 percent of the allowable limits. 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 the M101 spotting round will not exceed the NRC's public dose limit of 0.1 rem. The Army noted in Section 8.0 of the RSP that bioassay is not required for entry into or following exit from the 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 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 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 does limit could not be exceeded; therefore, a written declaration of pregnancy is not expected to be necessary. However, in the event that a worker informs the Garrison RSO that she is a declared pregnant worker, 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.

2.5.3.2 Contamination Control Program

The Army provides details on their contamination control program in Section 11 of the RSP. Section 11.1 of the RSP states that control points that will be established as necessary for entry and exit to the RCA (as discussed above, control points will not be established when troops are using the BAX contained in the RCA). At these control points, instrument scanning will be performed by the Garrison RSO on personnel, vehicles, and equipment as they exit the RCA. Non-exempt 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, except those using the BAX, 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 final RSP (including a requirement to decontaminate to ALARA). It is also noted in Section 11.3 of the final 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 RSP.

Section 9 of the RSP discusses Personnel Protective Equipment (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 RSP, the Army will not require respiratory protection for entry into the RCA.

2.5.3.3 Instrumentation

An overview of the Army's radiological instrumentation program is provided in Section 17 of the RSP. A discussion on "essential instruments" is provided in Section 17.1 of the final 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 RSP that the Garrison RSO will possess at least two Geiger-Mueller pancake detectors for alpha-beta-gamma surveys for surface contamination and frisking (examples: 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 final 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 re-calibrated 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 RSP, and is consistent with MARSSIM Section 6.7.2.1 and Equation 6-10.

2.5.3.4 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 RSP and Sections 6 and 7 of the PSP. Section 13 describes the Garrison RSO responsibilities for maintaining an inventory of all check sources and spotting round fragments on the Army's Hawaiian installations and states that the Garrison RSO will inventory and control all check sources associated with instrumentation used at the

RCA. No other radioactive sources, other than DU from the 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 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 EOD personnel, will double-bag in plastic bags all M101 spotting round 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.

2.5.3.5 Emergency Planning

Emergency planning for radiological and non-radiological emergencies is discussed in Section 22 of the RSP. Emergency contact information, as found in the Army's emergency response SOP, is provided in Section 22.1 of the final 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 final 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 final RSP that life-saving and limb-saving emergencies will always take priority over radiation safety concerns.

2.5.4 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 and according to guidance in NUREG-1556, Volume 7.

The staff concluded 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 staff concluded 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 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 final 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 NUREG-1556, Volume 7. The staff concluded 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 final RSP to not exceed the NRC occupational and public dose limits under any circumstances, the NRC staff concluded that the Army intends to comply with dose limits found in 10 CFR 20.1201 and 1301. This commitment also provides consistency with NUREG-1556, Volume 7, Sections 8.10.4 and 8.10.5. 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/year 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.

In Section 11 of the RSP, the Army committed that contamination surveys will be performed when non-exempt personnel, vehicles, or equipment exit the RCA, except when training is conducted on the BAX. 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 RSP and that are also ALARA. The referenced table is based on NRC Regulatory Guide 1.86, and is consistent with the current NRC guidance, "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 1993].

The NRC staff concluded the Army's commitment in Section 17 of the 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, Volume 7, Section 8.10.2. The staff concluded 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 staff finds it reasonable 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, and 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 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.

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 RSP and Sections 6 and 7 of the PSP. 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, Volume 7, Section 8.11.

NRC staff reviewed Section 22 of the 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, Volume 7, Section 8.10.6.

Based on this review the staff has concluded that the Army’s procedures for dose monitoring complies with 10 CFR Part 20 Subpart C; the procedures for contamination control and the instrumentation that will be available for use by the Army comply with 10 CFR Part 20 Subpart F, waste will be managed in accordance with the requirements of 10 CFR 20, Subpart L and the emergency procedures will comply with 10 CFR 20 Subpart M.

3.0 Environmental Monitoring Program

As discussed above, the Army has provided several ERMPs and revisions to the NRC staff to support the licensing of the Hawaiian sites. The Army provided site-specific ERMPs or revised ERMPs for the Schofield Barracks and the PTA on July 8, 2009, November 1 and 15, 2011, and February 3, 2012. The NRC staff reviewed and provided comments to the Army on these ERMPs and revisions. In addition, the Army provided information on the environment at its Hawaiian installations in its responses to the draft license conditions (ML12265A173).

The ERMPs provide information that the NRC staff has used in evaluating the environmental conditions at the Army’s Hawaiian installations. In addition, the staff reviewed the Army’s responses to the draft license conditions and other publicly available information to evaluate the environmental conditions at the Army’s Hawaiian installations and the manner in which depleted uranium behaves in the environment. The staff’s analysis below focuses on evaluating the

Army's rationale for including or excluding a particular environmental pathway and the supporting information in the ERMPs to establish what environmental monitoring is necessary and what monitoring may be excluded.

3.1 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;

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; and

10 CFR Part 20, Appendix B, Table 1 provides allowable occupational values of Annual Limits on Intake and Derived Air Concentrations, effluent concentration limits, and allowable concentrations for release to sewers.

3.2 Regulatory Acceptance Criteria

The application was reviewed for compliance with the applicable requirements of 10 CFR Part 20.

3.3 Staff Review and Analysis

The Army relies on results from a modeling analysis as a basis for not routinely collecting environmental samples. In its response to the proposed license conditions, the Army used RESRAD computer code² to estimate doses for two scenarios: Resident Farmer and Current Worker (ML12265A173). The Army assumes the RESRAD default values for most parameters. The site-specific inputs are the area of the contaminated zone and the concentration of DU,

² 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).

which is based on the contents of one thousand M101 rounds distributed evenly across the contaminated zone area. As defined in *NUREG-1757, Consolidated Decommissioning Guidance, Vol. 2, Rev. 3* (NRC 2006), the Resident Farmer scenario assumes that a farmer moves onto the site and grows some of his or her diet onsite and uses water tapped from the aquifer under the site. Pathways include external exposure from soil, inhalation to (re)suspended soil, ingestion of soil, ingestion of drinking water from the aquifer, ingestion of plant products grown in contaminated soil (using aquifer water for irrigation), ingestion of animal products grown onsite (using feed and water derived from potentially contaminated sources), and ingestion of fish from a pond filled with water from the aquifer. The Army calculated the peak dose for the Resident Farmer scenario to be 3.3×10^{-4} mSv/yr (0.033 mrem/yr). The Current Worker scenario assumes that a worker is in the contaminated area for 160 hours out of the year. Also, the pathways are limited to external gamma, inhalation, and soil ingestion. The Army calculated a dose of 1.1×10^{-5} mSv/yr (1.1×10^{-3} mrem/yr) for the Current Worker. The Army states that the low risk resulting from these scenarios does not justify the cost of implementing several of the proposed license conditions pertaining to environmental monitoring.

3.3.1 Air

Section 3.3.5 of the PTA ERMP discusses air sampling at the PTA. The Army does not propose to collect air samples at PTA routinely but proposes to collect and analyze air samples if range burns to remove vegetation occur and provides its reasoning for not collecting routine air samples in Section 3.3.5.1. The Army's rationale for not collecting routine air samples at the PTA includes the following:

- Substantially more DU was found at Schofield Barracks than at PTA and air sampling conducted during a prescribed burn in a DU-contaminated area at Schofield Barracks did not indicate the presence of DU.
- Air sampling conducted during BAX construction in 2010 at the PTA Range did not indicate any DU.
- Spotting rounds remained intact upon firing but were subject to processes that could cause airborne particulates to be formed such as: (1) weathering from exposure to the atmosphere and water from rainfall or overland flow, (2) impacts from subsequent high-explosive (HE) range firing, (3) mechanical shearing and grinding by heavy tactical equipment, and (4) prescribed or accidental range fires.
- The most probable recognized situation to produce transportable particles of DU with an activity median aerodynamic diameter (AMAD) less than $5 \mu\text{m}$ is range fires because the Army has prohibited firing HE on ranges contaminated with DU since 2004 and DU must undergo physical exposure to grinding or heat to temperatures above uranium's melting point of 700-1,000 degrees Celsius.

Section 3.3.5 of the Schofield Barracks ERMP discusses air sampling at Schofield Barracks. The Army does not propose to collect air samples at Schofield Barracks routinely but proposes to collect and analyze air samples if range burns to remove vegetation occur and provides its reasoning for not collecting routine air samples in Section 3.3.5.1. The Army's rationale for not collecting routine air samples at Schofield Barracks is, as described in the PTA ERMP, that the spotting rounds remained intact and the most probable situation to produce airborne particles of DU with an AMAD less than $5 \mu\text{m}$ is range fires. To further support this rationale, the Army states that air sampling conducted during a prescribed burn in a DU contaminated area of the

RCA at Schofield Barracks did not indicate the presence of DU.

3.3.2 Plant/Biota

Section 3.3.6 of the PTA ERMP discusses biota sampling at the PTA. The Army does not propose to routinely collect plants, vegetables, wild or farm meat, fish, or milk for DU analysis because DU is poorly adsorbed, rapidly excreted, and does not bioaccumulate. The Army states that if DU concentrations in other environmental media indicate a substantial release of DU from the RCAs, the Army will include plant, animal, and aquatic life tissue sampling in any subsequent analyses that are undertaken. The Army indicates in Section 3.3.6.1 that although the pathway to man includes consumers of meat or milk from farm animals grazing on PTA and vegetables or fruit off the military installation that is contaminated by water or airborne DU, potential for uptake in the pathway is unlikely. The Army presents its rationale for not collecting routine biota samples at the PTA as the following:

- The potential for uranium uptake, transport through, and bioaccumulation in the human food chain is small to nonexistent.
- Uptake by plants is typically low, restricted to adsorption in the outer root membranes (USEPA 2006).
- Uranium concentrations in higher trophic levels of aquatic organisms decline due to low assimilation efficiency (ATSDR 2011).
- Low level organisms tend to excrete both soluble and insoluble uranium species quickly, so uranium is not effectively transported through the food chain (USEPA 2006).
- Army sampling of deer that were exposed to DU at Jefferson Proving Ground (JPG) did not find DU in the deer

Section 3.3.6 of the Schofield Barracks ERMP discusses biota sampling at Schofield Barracks. As stated in the PTA ERMP, the Army does not propose to collect biota samples at Schofield Barracks routinely but proposes to collect and analyze biota samples if other environmental media sampling indicates considerable substantiation of extensive release of DU from the RCA. The Army provided the same rationale for not sampling biota at PTA for not sampling biota at Schofield Barracks in Section 3.3.6.1 of the Schofield Barracks ERMP.

3.3.3 Ground water

Section 3.3.1 of the PTA ERMP discusses ground water sampling at the PTA. The Army does not propose to sample ground water at PTA. Section 3.3.1.1 provides the Army's rationale for not sampling the ground water. The Army's rationale for not sampling ground water at the PTA includes the following:

- Exploratory drilling in the RCA to a depth of over a thousand feet at the PTA site did not reveal the presence of any ground water;
- Calculations utilizing the transport characteristics of uranium, the depth to ground water and other site specific situations would result in uranium not reaching the ground water for 51,000 years;
- Annual precipitation rate 25.4 - 40.64 cm per year (10-16 inches per year); and
- Lack of any potable water sources on the PTA Training Area or in springs which occur in the PTA Gulch or associated with Lake Waiau.

Section 3.3.1 of the Schofield Barracks ERMP discusses ground water sampling. Section 3.3.1.1 provides the Army's rationale for not sampling ground water. The Army's rationale includes the following:

- Depth to ground water underneath the RCA is approximately 550 feet below the surface;
- RESRAD calculations based upon the transport characteristics of uranium, depth to ground water and other site specific situations would result in uranium not reaching the ground water for 12,500 years;
- Annual precipitation rate of approximately 44 inches per year;
- Uranium concentration levels; and
- Uranium distribution coefficient.

3.3.4 Surface Water

Section 3.3.2 of the PTA ERMP discusses surface water sampling at the PTA. The Army does not propose to sample surface water at PTA. Section 3.3.2.1 provides the Army's rationale for not sampling the surface water. The Army's rationale for not sampling surface water at the PTA includes:

- There are no surface streams, lakes or other bodies of water within the boundaries of PTA; and
- There are no perennial streams within 15 miles of PTA.

The nearest known surface water body to PTA is Lake Waiau, which is near the summit of Mauna Kea, approximately 8 miles away. There are seven intermittent streams that drain surface water from the southwest flank of Mauna Kea and lie within the same drainage area as PTA. Popo's Gulch is the closest stream to PTA and it converges with Auwaiakeakua Gulch to drain surface water toward the Waikoloa community located west of PTA. A perennial stream that runs downstream of PTA, the Waikoloa Stream, flows towards the Kohala Mountains, runs north and discharges into Kawaihae Bay through the Waiulaula Gulch.

Section 3.3.2 of the Schofield Barracks ERMP discusses surface water sampling. The Army proposed in the ERMP to collect surface water grab samples at three locations on a quarterly basis but subsequently, in a letter dated September 10, 2012 (ML12256A173), provided information as a basis for requiring sampling of surface waters. The Army's basis for sampling surface water was:

- Once deposited within the soil or surface water, there are several different processes which could potentially cause DU to be released and transported through the environment;
- Weathering of DU may result in increased solubility and transportability; and
- Potential physical movement of DU along surface water drainage ways due to erosion, flooding and/or high water conditions.

The Army stated in Section 3.3.2.1 of the Schofield Barracks ERMP that the intermittent nature of some the surface water bodies at Schofield Barrack may sometimes preclude collection of surface water samples at all locations during every quarter. Section 3.3.2.1 also cites a study

conducted by the Army in 2008 in which the Army collected 75 surface water samples. The isotopic uranium ratios did not indicate the presence of DU.

Although the Army originally proposed to sample surface water in the Schofield Barracks 2009 ERMP, the Army subsequently provided rationale for why the NRC should not require surface water sampling (ML12265A173).

- The Army cites an EPA study from 2006 that shows uranium oxides have low solubility in water.
- The Army also refers to the United Nations Environmental Programme reports summarizing the impacts in Kosovo, where the highest DU activity concentration was 300 times less than the NRC effluent limit for DU in water.
- The Army refers to environmental data from JPG, where DU has not been detected in surface or ground water samples.
- The Army states that results at Aberdeen Proving Ground (APG) show no transport of DU into the surrounding surface waters of the Chesapeake Bay. (See section on Evaluation Findings below for the NRC staff comments on the APG data.)

3.3.5 Soil

Although the Army stated it would collect soil samples in the 2009 version of the ERMP, the Army subsequently provided reasons as to why the NRC should not require soil sampling (ML12265A173). The Army cites the RESRAD analysis as a basis for not requiring soil sampling.

The Army also provides comparisons to multiple other locations where DU had been fired. Specifically, the Army cites that studies at JPG and Yuma Proving Ground did not find DU migration outside of the impact areas. Environmental monitoring at JPG, which has significantly more DU than the Hawaii sites, has not detected DU in soil or sediment samples outside of the impact area. The Army states that “the NRC source materials license number SUB-1435 allows JPG to possess up to 80,000 kg of DU at a single site, which is more than ten times greater than the estimated total of all rounds of DU fired at 16 Army installations.” The Army has stated that 714 rounds were fired at the Hawaii sites and each of the rounds contains approximately 6.2 ounces of DU, equating to about 125 kg of DU at the Hawaii sites (714 rounds X 6.2 ounces of DU per round X 1pound/16 ounces X 1kilogram/2.2 pounds).

3.3.6 Sediment

The Army does not propose sampling and analysis of any sediment. Section 3.3.4.1 of the PTA ERMP provides the Army’s rationale for not sampling sediment at the PTA. The Army’s rationale is that there are no surface streams, lakes or other bodies of water within the boundaries of PTA and no perennial streams within 15 miles.

Section 3.3.4 of the Schofield Barracks ERMP discusses sediment sampling. In the 2009 ERMP, the Army proposed to collect sediment samples. However, the Army provided subsequent reasons as to why the NRC should not require sediment sampling in its response to the proposed license conditions (ML12265A173).

3.4 Evaluation Findings

The NRC staff concludes that the Army's RESRAD analysis described in Section 3.3 is conservative for the following reasons: (1) the Army uses RESRAD defaults for most of the parameters, which are conservative for a generic site; (2) the Army assumes one thousand M101 spotting rounds were fired as opposed to 714 rounds; (3) the Army assumes the rounds are concentrated within a smaller area than is the likely case; and (4) the Resident Farmer scenario is a conservative scenario. The Army assumes that 1000 rounds are contained in a single target area of 1 square km (10^6m^2). The ERMPs describe three target areas for Schofield, and three for PTA - each being 1 km^2 . By assuming a smaller contaminated zone area than what is likely the case (1 target zone in total as opposed to 6 target zones), the concentration is biased higher so is therefore a conservative assumption. The NRC staff notes that RESRAD accounts for the dose due to the in-growth of the progeny such as Th-230, Ra-226, and Pb-210.

The NRC staff has 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 staff's decision to not require environmental monitoring of the soil, sediment, surface water or ground water.

3.4.1 Air

The staff has assessed the sites with respect to air monitoring. The staff has concluded the Army has not presented sufficient justification for not performing air sampling at the sites during "ground disturbing" activities, such as firing high explosives (HE) or using heavy ground moving equipment.

Although RESRAD assumes some portion of the contamination is available for inhalation, the code does not attempt to simulate the environmental conditions present during ground disturbing activities such as a fire or use of high impact explosives and therefore is not relevant to the requirements for air monitoring during such activities. RESRAD by default assumes a mass loading for inhalation of $2.0 \times 10^{-4}\text{ g/m}^3$, which is the air/soil concentration ratio of airborne contaminated soil particles, taking into account short periods of high mass loading and sustained periods of normal activity on a typical farm (DOE 2008).

Additionally, the NRC evaluated data collected by Army contractors (US ARMY 2008) at the PTA and Schofield Barracks and a health consultation provided by the Agency for Toxic Substances and Disease Registry (ATSDR 2008). The Army contractor performed air, vegetation, and soil sampling during prescribed burns in a background area, an area known not to contain DU (i.e., a reference area) and on the Schofield Barracks training range containing visible DU fragments and oxidation products from the M101 Davy Crockett spotting round. The contractor used four large area (8-inch by 10-inch) particulate Whatman-41[®], or equivalent, paper filters in high volume air samplers at a collection rate of approximately 50 cubic feet per minute (cfm) around each study area. The contractor concluded that all burn air sampling data results were less than 10 percent of the 10 CFR 20, Appendix B, Table 2 airborne effluent limit for any of the U isotopes and that these data that range burn activities do not risk the health and safety of Schofield Barracks personnel or the general public (US ARMY 2008). The ATSDR stated in its health consultation of the DU at the Army's Hawaiian ranges that no additional air sampling is suggested if conditions remain unchanged because there was no evidence of DU in

the airborne particulates generated by the controlled burns at the Schofield Barracks training range (ATSDR 2008).

The NRC staff finds that the contractor's air sampling data collected during the prescribed burns at Schofield Barracks had large uncertainties. NRC staff agrees with the Army, as stated in its second response to the NRC's draft license (ML13046A176), that large relative uncertainties occur when uranium concentrations in air are near or below the minimum detection concentrations of laboratory instrumentation. The NRC staff notes that the Army contractor used paper filters rather than glass fiber filters typically used at Army DU ranges (US ARMY 2008). Paper filters do not collect particles as small as glass fiber filters. Also, analytical uncertainties increase with the less volume of air measured. A review of Army burn data collected at APG (Oxenberg 1997) observed that extended sampling time lowered the uncertainties and that the isotopic ratio of sample with a large volume of air (e.g., 4800 cubic meters (m³)) collected during a burn a range fire at APG detected DU, whereas air samples with less volume (e.g., less than 600 milliliters (ml)) had larger uncertainties and indicated natural U (Oxenberg 1997). Additionally, the staff found that DU was detected in air samples surrounding the catchboxes at APG indicating that DU oxidation products from DU fragments in the catchbox sand are resuspended as DU ammunition is fired in catchbox sands. The NRC notes that the impact area and catchboxes at APG contained much more DU, greater than 70,000 kg, than the Hawaiian ranges; the APG data indicates that resuspension is possible from ground disturbing activities.

The Army proposes to collect a one-time air sample during high explosive (HE) firing on the ranges, and other ground disturbing activities, at the Schofield Barracks BAX (ML13046A176). The Army states that if DU is not detected during this exercise, the Army expects that the NRC will not require additional air sampling at any license-allowed operation on all Army ranges. The NRC staff concludes that an additional sample collected during ground disturbing activities at Schofield Barracks will provide the data needed to demonstrate that the small amount of DU on the PTA and Schofield Barracks ranges is insufficient to become airborne and an exposure hazard to the public.

Therefore, the staff has concluded that, to ensure that the Army complies with the NRC's requirements for effluent emissions, the Army will need to collect an additional air sample during a ground disturbing activity on the PTA and Schofield ranges to demonstrate that residual DU from the M101 Davy Crockett spotting rounds are not hazardous to the personnel at PTA or Schofield Barracks or the public. This requirement is included in License Condition 22.

3.4.2 Plant/Biota

The staff has assessed the sites with respect to biota monitoring. The staff has concluded that the Army has presented sufficient justification for not performing terrestrial and aquatic animal sampling, but insufficient justification for not performing vegetation sampling at the sites.

The NRC staff notes that a study conducted by Los Alamos National Laboratory (LANL) appears to contradict the Army's assertion that there is no bioaccumulation of DU at the Hawaiian sites. LANL used environmental data collected from Aberdeen and Yuma Proving Grounds to model exposure from DU to humans (Ebinger 1996). LANL identified DU in food chain components, but the estimated doses to man showed that DU uptake was insufficient to cause adverse impacts from the radiological or toxicological effects to man and most

ecosystems. LANL detected uranium in deer kidneys at APG, but found that the concentrations were too small to determine the isotopic ratio and that deer off-site (e.g., background) had uranium concentrations that were nearly identical to the APG deer (Ebinger 1996). LANL detected DU in tadpoles and vegetation, such as cattail, milfoil, and pickerel weed in shallow ponds and catchment basins. LANL concluded that DU uptake, attachment, or adsorption in the tadpoles and plants occurred from dissolution of DU from DU fragments in the surface water sediments rather than from transport of DU deposited in the soils (Ebinger 1996). LANL's study also identified DU in two liver samples from desert iguanas and one kidney sample from a white-throated woodrat. Samples of small mammal and reptile carcasses of animals that consume insects, reptiles or other mammals can ingest DU from animal carcasses as well as ingest DU from soils (Ebinger 1996). The NRC staff notes that detection of DU in the food chain occurred at Army sites that contained several magnitudes more DU than located at PTA and Schofield Barracks. Therefore, the staff concludes that the Army has provided sufficient justification to not perform biota sampling for terrestrial and aquatic animals.

The NRC staff finds that the lack of vegetation at PTA, the limited amount of M101 Davey Crockett munition artifacts observed aurally, and the hazardous terrain within the PTA impact area is sufficient justification for the Army not to sample vegetation at PTA. However, the staff review of the Army's contractor prescribed burn study at Schofield Barracks finds that the contractor incorrectly concluded that the vegetation ash samples from the DU contaminated area on the range was incorrect. The contractor collected vegetation ash samples after the burn of vegetation growing in soils containing visible DU oxidation products (US ARMY 2008). The contractor intended to collect the vegetation ash separated from the contaminated soils in aluminum pans, but was unable to collect the vegetation ash separately from the contaminated soils. The contractor concluded that the DU measured in one of the vegetation ash samples from the contaminated area resulted from uptake (US ARMY 2008). The NRC finds that the DU measured was probably from the DU oxidation products that were present in the soil before the burn. Additionally, vegetation samples should be split into washed and unwashed partitions before analysis to determine if any DU present is a result of uptake, adsorption, or deposition from wind or surface waters.

Based on this evaluation, the staff has determined that the Army must demonstrate whether or not there is DU uptake in plants and that the limited amount of DU in the PTA and Schofield ranges is insufficient to cause adverse impacts.

Therefore the staff has concluded that the Army should collect additional plant samples to demonstrate that residual DU from the M101 Davy Crockett spotting rounds is not hazardous to the personnel at PTA or Schofield Barracks or the public. This requirement is included in License Condition 23.

3.4.3 Ground water

The staff has assessed the sites with respect to ground water monitoring. The staff has concluded the Army has presented sufficient justification for not performing ground water sampling at the sites.

The Army described the ground water bodies underlying Schofield Barracks and its vicinity, but presented limited information on ground water usage and sources either on Schofield Barracks or in the surrounding areas. The Army discusses the Southern Oahu Basal Aquifer which

underlies Schofield Barracks and which is part of the Schofield Barracks' East Range. The EPA has designated this aquifer as a Sole Source Aquifer under Section 1424(e) of the Safe Drinking Water Act. The Army stated that the quality of the ground water in the Schofield ground water area is generally good; the system has been affected by pesticides and fertilizers related to agricultural activities, and the ground water activities in the Schofield Barracks area have been affected by industrial contaminants such as trichloroethylene (TCE) and carbon tetrachloride. The ground water quality in the ground water system of the East Range is generally considered excellent but portions are contaminated with TCE. The Army stated that no ground water quality data is available for the South Range Acquisition Area but that several wells have been installed and are being monitored south of the South Range Acquisition Area.

Typically, when there is a concern about ground water contamination, monitoring test wells are established and samples are drawn from the wells to determine if contamination is occurring. However, the NRC staff independently evaluated the Army's RESRAD calculations and evaluated the site hydrology and stratigraphy to determine if DU would contaminate the ground water. Based on the staff's evaluation, the potential for ground water contamination was very low. Therefore, the NRC staff is not requiring the Army to collect ground water samples.

3.4.4 Surface Water

The staff has assessed the sites with respect to surface water monitoring. The staff has concluded the Army has presented sufficient justification for not performing surface water sampling at the sites. Sampling at PTA is not necessary because PTA has no surface water transecting the site.

The staff has also concluded that the Army has presented sufficient justification for not performing surface water sampling at Schofield Barracks. Surface water is limited at Schofield Barracks and the water samples already collected do not indicate transport after 40 years.

While the Army cites the data from APG in discussing surface water, the NRC staff notes that environmental monitoring data collected within the soft target DU impact area at APG between 1992 and 2004 measured DU in surface water and sediments (Oxenber 2007). This study of the environmental data collected at APG concluded that DU was measured in streams down gradient of the DU source term and in contact with the water table that resulted from dissolution of DU fragments in soils and transport in ground and overland flow. Seasonal variations in the natural U and DU concentrations measured in surface water and sediments indicated that natural U and DU particles in solution concentrate and sink in the sediments, but dislodge under increased rainfall and saturated conditions (Oxenber 2007). However, the results from APG are not relevant to Schofield Barracks because of the limited amount of surface water at Schofield Barracks in comparison to APG, and contamination at APG was found only where the surface waters intersected the contamination.

3.4.5 Soil

As noted in SER Section 3.3.5, above, although the Army proposed soil sampling in the 2009 ERMP, the Army has provided subsequent information as a basis for not requiring soil sampling. The Army relies on the RESRAD analysis as a basis for not requiring soil samples. Also, referring to studies completed for Kosovo, Eglin Air Force Base, and JPG, the Army states that "no scientific evidence exists to cause one to suspect that DU has migrated beyond the

immediate point of impact on the operation range” (US ARMY 2012). However, studies of subsurface transformations of DU at APG have shown that DU, although limited, migrated in soils the vadose zone up to 30 cm under oxidizing conditions and complexed with colloids in surface waters containing concentrations of 13 ppm of humic materials within the impact area.

The staff has assessed the submitted information with respect to soil sampling. Based on the information provided by the Army, including the RESRAD analysis, DU does not appear to be transported outside of the impact area and soil samples only indicated DU where visible oxidation products were present. Therefore, the NRC staff is not requiring the Army to perform soil sampling.

3.4.6 Sediment

The Army did not propose the sampling and analysis of any sediment at PTA. The Army’s basis for not proposing any sampling and analysis was the lack of surface streams, lakes or other bodies of water within the boundaries of PTA, and no perennial streams within 15 miles. Thus, there was no sediment to sample. The staff has assessed the PTA site with respect to sediment sampling. The staff concludes that based upon the information presented above, there are no streams, lakes or other bodies of water at which sediment sampling is necessary.

Section 3.3.4 of the Schofield Barracks ERMP discusses sediment sampling. In the 2009 ERMP, the Army proposed to collect sediment samples. However, the Army provided subsequent reasons as to why the NRC should not require sediment sampling in its response to the proposed license conditions (ML12265A173). These reasons are discussed in Section 3.4.5, along with the staff’s evaluation for not collecting soil samples. The staff concludes that based upon the information presented in Section 3.4.5, sediment sampling is not necessary.

3.4.7 Conclusions/Findings

The staff has reviewed the information provided by the Army and additional information identified by the staff. Based on this review, the staff has determined that the Army has provided insufficient monitoring to allow the staff to conclude that the Army’s program will comply with 10 CFR 20.1301(a) and (d), 20.1302(a) and (b), 20.1501, 20.2001(a), and 20.2103(b). With the modifications to the monitoring program identified in the Sections above and License Conditions 22 through 24, the staff can conclude that the Army will comply with 10 CFR 20.1301(a) and (d), 20.1302(a) and (b), 20.1501, 20.2001(a), and 20.2103(b).

4.0 Financial Assurance

4.1 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; and

10 CFR Part 20, Subpart L establishes the recordkeeping requirements for licensees.

4.2 Regulatory Acceptance Criteria

The application was reviewed for compliance with the applicable requirements of 10 CFR Parts 20 and 40 and was reviewed in accordance with guidance provided in NUREG-1556, Volume 7 and NUREG-1757, Volume 3 [NRC 2003].

4.3 Staff Review and Analysis

Decommissioning will not be authorized under the license at this time. If the Army elects to decommission the Schofield Barracks to PTA in the future, the Army will have to submit a decommissioning plan for each site.

The application dated November 6, 2008, included an estimate of the cost for decommissioning the sites listed in the application (Fort Benning, Georgia; Fort Campbell, Kentucky; Fort Carson, Colorado; Fort Hood, Texas; Fort Knox, Kentucky; Fort Lewis, Washington; Fort Riley, Kansas; Schofield Barracks, Hawaii; and PTA, Hawaii) and a statement that funding for decommissioning would be available when needed. The Army estimated the cost of decommissioning to be \$1.9M. A detailed cost estimate was stated to be included as an attachment to the initial application, but was omitted. On February 17, 2011, the Army provided a cost estimate for the decommissioning of the Schofield Barracks installation (ML110830582).

Section 21 of the RSP describes the records that will be maintained by the Garrison and License RSO, including those related to surveys, monitoring and disposal, which are important in developing a decommissioning cost estimate.

4.4 Evaluation Findings

The staff reviewed the decommissioning records maintenance and decommissioning financial assurance in accordance with the applicable requirements of 10 CFR 40.36, 10 CFR 40.42, and according to guidance in NUREG-1556, Volume 7, Section 11 and NUREG-1757, Volume 3.

10 CFR 40.36 describes the records important to decommissioning including records of spills or other occurrences that could spread contamination, drawings of areas where radioactive material is used and/or stored, and all areas designated as restricted areas. The RSP includes drawings of both the Schofield Barracks and PTA RCAs. The records described in Section 21 of the RSP are adequate to document where DU was used and or stored.

The staff reviewed the Army's cost estimate and Statement of Intent and is unable to determine if the cost estimate is reasonable. In addition, the Army has not submitted the decommissioning funding plan in accordance with 10 CFR 40.36

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 40.31, which establishes the criteria for the filing of an application for a license, and the guidance in NUREG-1556, Volume 7 and NUREG 1757, Volume 3 for decommissioning records maintenance.

However, the Army has not submitted an adequate decommissioning cost estimate or decommissioning funding plan in accordance with 10 CFR 40.36. Therefore, the staff has concluded that the Army must provide the staff with a site-specific cost estimate and financial assurance instrument for the Hawaiian installations. In addition, the Army must provide updated site-specific cost estimates and financial instruments for all installations containing DU from the Davy Crockett on a tri-annual basis. This requirement is included in license Conditions 15 and 16.

5.0 Consultations with Other Agencies

By letter dated March 14, 2011, the NRC requested the views of the Administrator of the Historic Preservation Division, Department of Land and Natural Resources on actions to identify historic properties that might be affected by the NRC's issuance of a license (ML110670408). By letter dated April 1, 2011, NRC requested this information from the Administrator of the Office of Hawaiian Affairs (OHA) and from Native Hawaiian Organizations (NHO) identified by NRC staff and the Army on any potential properties near the Schofield Barracks and PTA that might be of religious and cultural significance to the NHO (ML110880063).

The OHA responded on May 3, 2011, and stated that the information provided by NRC was not adequate to determine the scope of licensed areas within the larger Schofield Barracks and PTA (ML111300549). OHA recommended that NRC: 1) obtain access to a US Army Garrison-Hawaii, Cultural Resources Section database; 2) consult the Phase I and II archeological surveys conducted by Army archeological contractors for the Schofield Barracks and PTA; and, 3) consult a report entitled "Cultural Resource Evaluations of Stryker Transformation Areas in Hawaii" prepared by SWCA Environmental Consultant in 2009.

The Historic Preservation Division responded on May 3, 2011, and stated that more information on the location of DU fragments and proposed action regarding DU fragments at both Schofield Barracks and PTA would be needed before the State Historic Preservation Office could make a determination of effect from the licensing action (ML111320218).

None of the other NHOs responded to the NRC request.

On May 15, 2012, NRC responded to the State Historic Preservation Office and the OHA and provided additional information concerning the possession of DU and the activities that the Army would be required to undertake to ensure that cultural and historic properties were maintained and protected (ML121240756 and ML121240780).

On March 26, 2013, the NRC contacted the State of Hawaii OHA and State Historic Preservation Office and informed them that, contrary to NRC's understanding at the time (May 2012), the Army had recently informed NRC that the "Programmatic Agreement among the United States Army Garrison, Hawaii, the Hawai'i State Historic Preservation Office, and the Advisory Council on Historic Preservation for Section 106 responsibilities for the Army transformation of the 2nd Brigade, 25th (Light) to a Stryker Brigade Combat Team (SBCT)" (PA) was no longer in force (ML13070A463, ML13070A341). On April 30, 2013, the OHA responded, and stated that the PA was the controlling historic preservation document for the Stryker Brigade Combat Team project (ML13070A463). On June 10, 2013 the NRC staff

requested that the Army clarify this apparent discrepancy (ML13157A035). On June 13, 2013, the NRC informed the OHA of the NRC staff's actions (ML13162A229).

In its response to the NRC staff's comments on the RSP (ML13242A281), the Army stated that it and the OHA had agreed to develop a new successor PA, but that no extension or successor PA had, as yet, been entered into by the Army and OHA. The Army further stated that it operated as if the PA were in effect.

In a formal response to the NRC staff's request for the Army's position on the PA, dated September 25, 2013, (ML13276A084) the Army stated that "the 2004 Programmatic Agreement is irrelevant to the Army's license application to possess DU residuals from the M101 on Army operational ranges in Hawaii" However, the Army further stated "The Army considers the 2004 Programmatic Agreement to establish an important process for consultation under the NHPA with the other signatory agencies and organizations, and we seek to consult and cooperate with them by following the processes in the agreement as we carry out the SBCT conversion projects. Moreover, the Army considers its cooperative relationship with all the signatories to be of the utmost importance and we consult informally and formally with them whenever an Army project or activity comes up that is subject to the NHPA. We plan to continue to do that in partnership with these and other organizations."

Based on this information, the NRC staff determined that the Army would conduct its interactions with the OHA in a manner that was acceptable. The NRC staff informed the OHA on October 8, 2013 (ML13261A110) that the NRC staff's conclusion that issuing a license to the Army for possession of DU would have no potential to cause effects to cultural or historic properties was still valid.

By letter dated March 14, 2011, NRC requested information from the U.S Fish and Wildlife Service (USFWS) regarding the presence of endangered or threatened species or critical habitat on the Schofield Barracks and PTA (ML110670384). The USFWS responded on December 1, 2011 and January 12, 2012, by providing species lists for the areas (ML120300067).

By letter dated May 15, 2012, NRC requested USFWS concurrence that the proposed action would not have an effect on Federally listed endangered or threatened species or their critical habitat (ML121240737). The USFWS responded by emails on May 18, 2012, May 31, 2012 and June 1, 2012 (ML12165A432) and stated that they did not concur on other agency's "no effect" findings, but that USFWS did not have any issues with NRC licensing the Schofield Barracks or PTA. In the draft license, the NRC staff included a license condition whereby the Army was required to consult with the USFWS whenever it undertook an activity that could impact critical habitat or threatened or endangered species (ML12179A321). The Army stated that this condition was redundant and unnecessary as other statutes such as the Endangered Species Act controlled its interactions with the USFWS and were sufficient to ensure that the Army would consult with the USFWS. In a subsequent written response, dated February 6, 2013, the Army stated that it would "continue its direct consultation with the USFWS as appropriate to any activity on Army lands" (ML13046A176). In a letter to the USFWS, dated March 25, 2013, the NRC staff informed the USFWS that it was removing the license condition because the Army had confirmed that it would consult with the USFWS on Army actions impacting the Hawaiian installations (ML13052A656).

6.0 National Environmental Policy Act

6.1 Regulatory Requirements

10 CFR Part 51, Subpart A establishes the regulations for implementing Section 102(2) of the National Environmental Policy Act.

10 CFR 51.22 establishes the criteria for categorical exclusions.

6.2 Regulatory Acceptance Criteria

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

6.3 Staff Review and Analysis

A categorical exclusion (CATX) is a category of actions which the NRC has previously determined do not individually or cumulatively have a significant effect on the human environment and for which, therefore, neither an Environmental Assessment nor an Environmental Impact Statement 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 requirement of an environmental review the issuance of licenses under 10 CFR Part 40 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 that would authorize its possession of DU from military munitions, and as such, under 10CFR51.22(c)(14)(xv) this licensing action is categorically excluded from the provisions of 10 CFR Part 51.

6.4 Evaluation Findings

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

7.0 License Conditions

Based on the conclusions discussed above, the NRC staff has determined that the following conditions are necessary in order to ensure that the Army conducts its radiation safety program in accordance with NRC regulations. These license conditions were discussed in several meetings and correspondence with the Army (see Background section above) and the Army agreed with all of the conditions.

10. The authorized places of possession shall be United States Department of Army Installations at Schofield Barracks HI, and 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 Application dated November 6, 2008, the Physical Security Plan dated February 17, 2011, and the Radiation Safety Plan dated August 23, 2013 (jointly referred to as the approved license application). The approved license application is hereby incorporated by reference, except where superseded by license condition(s) below.

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.
13. If the licensee identifies information indicating that Davy Crockett-related depleted uranium may be present at a US Army installation not identified in License Condition 10 or included on the schedule developed under License Condition 12, the licensee will notify the NRC in writing within 15 days of the identification of this information. The licensee will evaluate the information and provide the NRC with a schedule for evaluating the presence of depleted uranium at the installation within 90 days of the identification of the information.
14. If it is determined that Davy Crockett-related depleted uranium is present at an US Army installation not listed in License Condition 10 or 12, the licensee shall submit a request to include the installation on this license. The request will include a Radiation Safety Plan, an Environmental Radiation Monitoring Plan, a Physical Security Plan, 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 dated November 6, 2008 will also be included in the request.
15. The licensee shall submit site-specific financial assurance instruments and decommissioning cost estimates, consistent with the requirements in 10 CFR Part 40, for the Schofield Barracks and Pohakuloa Training Area within 90 days of [the effective date of this license].
16. The licensee shall submit an updated site/installation specific decommissioning cost estimate and financial assurance instrument for each Army installation listed in License Condition 10 on a tri-annual basis, by December 31 of each year or, if applicable, in accordance with the requirements of 10 CFR 40.36(c)5.
17. The licensee shall not fire high-explosive munitions into areas containing depleted uranium without first informing NRC.
18. The licensee shall post "Caution - Radioactive Material" signs at a sufficient number of locations around 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.

19. 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 the Schofield Barracks or Pohakuloa Training Area without prior authorization from NRC.
20. 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 the Schofield Barracks or Pohakuloa Training Area consistent with the conditions and commitments of their license(s).
21. 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 the Schofield Barracks or Pohakuloa Training Area, 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.
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.
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.
24. 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 days and collect additional environmental samples within 30 days of the notification of NRC, unless prohibited by the absence of the sampling media.
25. All written notices and reports to USNRC required under this license shall be addressed to: ATTN: Document Control Desk, Deputy Director, Decommissioning and Uranium Recovery Licensing Directorate, Division of Waste Management and Environmental Protection, Office of Federal and State Materials and Environmental Management Programs, 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.

8.0 Assessment of the Army's Request for an Exemption and Responses to the Draft License

On June 28, 2012, NRC staff provided a draft license to the Army incorporating license conditions that the NRC staff determined were necessary to ensure that the Army complied with NRC's regulations and requirements for the possession of the DU. On July 12, 2012, NRC staff met with Army staff to discuss the draft license. At the meeting, the Army requested that the NRC staff delay issuing the license until the Army was able to comment on the draft license conditions. The NRC staff agreed to the Army's request on July 23, 2012. On September 10, 2012, the Army provided its comments on the draft license. In its response, the Army requested that the NRC exempt the Army from licensing DU from the Davy Crockett under the provisions of 10 CFR 40.13(c)(5) or 10 CFR 40.14(a) (ML12265A173). The Army also requested that, if an exemption from licensing was not justifiable, NRC issue the license without any license conditions or, failing that, issue the license without any conditions pertaining to environmental radiation monitoring. The NRC staff's assessment of the Army's request for an exemption is summarized below.

Request for an exemption pursuant to 10 CFR 40.13(c)(5)

In its response, the Army took the position that the depleted uranium (DU) is the same as a counterweight. The definition (in Webster's online dictionary) of a counterweight is an equivalent weight or force: counterbalance; and the definition of a counterbalance is a weight that balances another. The DU did not counterbalance the round in this sense and it was used to simulate the trajectory of the nuclear projectile.

The exemption contained in section 40.13(c)(5) includes 5 conditions, including that the counterweight is manufactured in accordance with an NRC or Atomic Energy Commission (AEC) license (the rounds were), that the counterweight is marked in 2 ways (the rounds were not marked in any way), the counterweight cannot be chemically, physically or metallurgically treated or processed (firing the round physically processed the round) and that the counterweight was not manufactured using Australian-obligated source material (the Army response is silent on this).

In its response, the Army inferred that markings were not required prior to 1969, when section 40.13(c)(5) was revised. However, the regulations in effect when the rounds were manufactured did contain requirements for marking counterweights. The rounds do not contain any markings.

In addition, the Statements of Consideration for the 1962 revision to section 40.13(c)(5) indicates that the counterweights are to include "plating or other encasement" assumedly to prevent oxidation of the uranium (27 FR 251 (December 29, 1962)). The 1969 revision indicated that plating or covering of the counterweight was no longer necessary because the manufacturing techniques used provided adequate protection against oxidation of the uranium (34 FR 170 (September 5, 1969)). Oxidation is clearly occurring on round fragments at the Schofield Barracks.

Based on the above, the Army did not demonstrate: (1) that the rounds are similar enough to the counterweights that are the subject of the exemption in 40.13(c)(5); and (2) that the rounds

meet the marking requirements of either the 1962 or 1969 versions of the exemption. Thus, the staff has determined that the Army has not provided adequate justification to grant the exemption request.

Request for an exemption pursuant to 10 CFR 40.14

10 CFR 40.14(a) provides that the Commission may grant an exemption from the requirements of the regulations as it determines is authorized by law and will not endanger life or property or the common defense and security and is otherwise in the public interest. In its response, the Army cited several Army regulations that the Army claimed ensures that activities on Army ranges do not endanger life or property or the common defense and security and that the exemption is in the public interest. In its response to the proposed license conditions, the Army used the RESRAD computer code³ to estimate doses for two scenarios: Resident Farmer and Current Worker. The Army assumed the RESRAD default values for most parameters. The site-specific inputs are the area of the contaminated zone and the concentrations of DU, which are based on the contents of 1000 M101 rounds distributed evenly across the contaminated zone area. As defined in *NUREG-1757, Consolidated Decommissioning Guidance, Vol. 2, Rev.3*, the Resident Farmer scenario assumes that a farmer moves onto the site and grows some of his or her diet and uses water tapped from the aquifer under the site. Pathways include external exposure from soil, inhalation to (re)suspended soil, ingestion of soil, ingestion of drinking water from aquifer, ingestion of plant products grown in contaminated soil and using aquifer to supply irrigation needs, ingestion of animal products grown onsite (using feed and water derived from potentially contaminated sources) and ingestion of fish from a pond filled with water from the aquifer. The Army calculated the peak dose for the Resident Farmer scenario to be 3.3×10^{-4} mSv/yr (0.033 mrem/yr). The Current Worker scenario assumes that a worker is in the contaminated area for 160 hours out of the year. Also, the only pathways are external gamma, inhalation, and soil ingestion. The Army calculated a peak dose of 1.10^{-5} mSv/yr (1.10^{-3} mrem/yr) for the Current Worker.

The NRC staff determined that the Army's RESRAD analysis described in Section 3.3.1 of the ERMP is conservative for the following reasons: (1) the Army uses RESRAD defaults for most of the parameters, which are conservative for a generic site; (2) the Army assumes 1000 M101 spotting rounds were fired as opposed to 714 rounds; (3) the Army assumes the rounds are concentrated within a smaller area than is the likely case; and (4) the resident farmer scenario is a conservative scenario. The Army assumes that 1000 rounds are contained in a single target area of 1 square km (10^6 m²). The ERMPs describe three target areas for Schofield Barracks, and three for PTA - each being 1 km². By assuming a smaller contaminated zone area than what is likely the case (1 target zone in total as opposed to 6 target zones), the concentration is biased higher and is therefore a conservative assumption. The NRC staff notes that RESRAD accounts for the dose due to the in-growth of the progeny such as Th-230, Ra-226, and Pb-210.

In summary, the NRC staff has independently verified the RESRAD calculations provided by the Army, and finds the use of scenarios, parameters and assumptions to be reasonable and

³ RESRAD is a computer model code designed to estimate radiation doses and risks from RESidual RADioactive materials developed by ANL. The DOE through ANL currently maintains code and version control (DOE, 2008).

appropriate. The results from the RESRAD analysis support the staff's decision to not require environmental monitoring of the soil, sediment, surface water or ground water (see below). However, although RESRAD assumes some portion of the contamination is available for inhalation, the code does not attempt to simulate the environmental conditions present during ground disturbing activities such as a fire or use of high impact explosives and therefore is not relevant to the requirements for air monitoring. RESRAD, by default, assumes a mass loading for inhalation of 2.0^{-4} g/m³, which is the air/soil concentration ratio of airborne contaminated soil particles, taking into account short periods of high mass loading and sustained periods of normal activity on a typical farm.

Based on the above, it is not clear if the activities requested by the Army, such as range burns and live fire exercises, would not have the potential to allow DU to be released from the impact areas. Thus, the Army has not demonstrated that DU will not potentially be released from the ranges in excess of NRC criteria at 10 CFR Part 20 and, as such, granting an exemption pursuant to 10 CFR 40.14 is not warranted.

In addition, the exemption, were it to be granted, would be applicable to all depleted uranium from the Davy Crockett weapon on all 17 installations identified by the U.S. Army. The U.S. Army has informed NRC that the total number of spent rounds on the 18 U.S. Army installations that were identified during the Army's Archive Search Report project may be almost 30,000 rounds. 30,000 rounds would contain in excess of 5,000 kilogram of depleted uranium, with some installations containing over 9,000 spent rounds on multiple ranges. Exempting the depleted uranium in the spent rounds from licensing would result none of the ranges being posted as containing radioactive material, no radiation safety or DU awareness training would need to occur, range reclamation and maintenance activities could occur without consideration of the radiological hazard and no evaluation of the potential for the DU to be transported off the ranges would be undertaken.

Based on the above discussion, the NRC cannot conclude that exempting the depleted uranium from the Davy Crockett weapon from licensing would either not endanger life or property or be in the public interest and has therefore determined that an exemption was not warranted and denied the Army's request (ML13226A143).

9.0 References

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[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.

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