



UNITED STATES
NUCLEAR REGULATORY COMMISSION

REGION II
SAM NUNN ATLANTA FEDERAL CENTER
61 FORSYTH STREET SW SUITE 23T85
ATLANTA, GEORGIA 30303-8931

July 13, 2000

Department of the Navy
Naval Radiation Safety Committee
Chief of Naval Operations (N-45)
ATTN: ADML L. Baucom
Chairman
Room 636
2211 S. Clark Place
Arlington, VA 22244-5108

SUBJECT: NRC INSPECTION REPORT NO. 45-23645-01NA/00-04

Dear Admiral Baucom:

This refers to the inspection conducted May 31 - June 13, 2000, of the depleted uranium (DU) ammunition recovery activities performed by naval personnel on the Live Impact Area (LIA) of the Atlantic Fleet Weapons Training Facility on Vieques Island, Puerto Rico. The enclosed report presents the results of that inspection. The purpose of the inspection was to determine if the recovery operations performed by the Navy were carried out in a radiologically safe manner and in accordance with the "Survey Work Plan for Depleted Uranium (DU) Penetrators" that was submitted to the NRC for review on January 10, 2000, by the Naval Radiation Safety Committee (NRSC).

During the inspection, direct observations related to the recovery of DU ammunition were made by the inspectors, and numerous discussions were held with key individuals. Representatives from the Radiological Health Division of the Puerto Rico Department of Health observed portions of the inspection. Within the scope of the inspection, violations were not identified.

The NRC determined that the DU recovery activities were performed in a radiologically safe manner. However, coordination problems in clearing dense vegetation in areas where unexploded ordnance is present, prevented recovery of all the DU penetrators. Following the inspection, the NRSC committed to return to the LIA on Vieques to resume recovery operations. The NRC will continue to monitor the Navy's DU penetrator recovery efforts. The NRC's review of the "Survey Work Plan for Depleted Uranium Penetrators" indicated that the Navy should address the potential for residual contamination in the soil following DU penetrator removal. The Navy has not fully evaluated how this will be addressed in the long term.

Soil samples were collected by NRC inspectors in the LIA on Vieques. The samples were shipped to Oak Ridge Institute for Science and Education in Oak Ridge, Tennessee, for

analysis. A supplement to this report will be issued when the results of those samples are available.

In accordance with 10 CFR 2.790 of the NRC's "Rules of Practice," a copy of this letter and its enclosure will be available electronically for public inspection in the NRC Public Document Room or from the Publicly Available Records (PARS) component of NRC's document system (ADAMS). ADAMS is accessible from the NRC Web site at <http://www.nrc.gov/NRC/ADAMS/index.html> (the Public Electronic Reading Room).

Should you have any questions concerning this letter, please contact us.

Sincerely,

/RA/

Mark S. Lesser, Chief
 Materials/Licensing Inspection Branch 2
 Division of Nuclear Materials Safety

Docket No. 030-29462
 License No. 45-23645-01NA

Enclosure: NRC Inspection Report
 No. 45-23645-01NA/00-04

cc w/encl:
 Commonwealth of Virginia
 Commonwealth of Puerto Rico

*See next page for prior concurrence

OFFICE	RII:DNMS	RII:DNMS	RII:DNMS	
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DATE	7/11/00	7/11/00	7/11/00	7/ /2000
E-MAIL COPY?	YES NO	YES NO	YES NO	YES NO

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DATE	7/11/00	7/11/00	7/11/00	7/13/2000
E-MAIL COPY?	YES NO	YES NO	YES NO	YES NO

In accordance with 10 CFR 2.790 of the NRC's "Rules of Practice," a copy of this letter and its enclosure will be made publically available.

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 Division of Nuclear Materials Safety

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NAME	MFuller	JHenson	TDecker	
DATE	7/11/2000	7/11/2000	7/11/2000	7/11/2000
E-MAIL COPY?	YES NO	YES (NO)	YES (NO)	YES NO

U. S. NUCLEAR REGULATORY COMMISSION

REGION II

Docket No.: 030-29462

License No.: 45-23645-01NA

Report No.: 45-23645-01NA/00-04

Licensee: Department of the Navy

Date: May 31 - June 13, 2000

Inspectors: Michael L. Fuller, Health Physicist, Region II
Jay L. Henson, Senior Health Physicist, Region II

Accompanied by: Osiris Siurano Perez, Acting Director, Radiological Health Division, Puerto Rico
Rico Department of Health
Sandra Rodriguez Roche, Radiological Health Division, Puerto Rico
Department of Health
Lourdes Maldonado, Radiological Health Division, Puerto Rico
Department of Health

Approved by: Mark S. Lesser, Chief
Materials Licensing/Inspection Branch 2
Division of Nuclear Materials Safety

Enclosure

EXECUTIVE SUMMARY

Department of the Navy
NRC Inspection Report No. 45-23645-01NA/00-04

This special, announced inspection was conducted to evaluate the recovery activities performed by naval personnel on the Live Impact Area (LIA) of the Atlantic Fleet Weapons Training Facility on Vieques Island, Puerto Rico. The purpose of the inspection was to determine if the recovery operations performed by the Navy were carried out in a radiologically safe manner and in accordance with the "Survey Work Plan for Depleted Uranium (DU) Penetrators" that was submitted to the NRC for review on January 10, 2000, by the Naval Radiation Safety Committee (NRSC). Within the scope of the inspection, violations were not identified.

The NRC determined that the DU recovery activities were performed in a radiologically safe manner. However, coordination problems in clearing dense vegetation in areas where unexploded ordinance is present, prevented the recovery of all the DU penetrators.

A total of approximately 37 of the remaining 206 DU penetrators were recovered by the team. This total includes 32 full or whole DU penetrators and pieces or fragments of penetrators equivalent to five whole penetrators. When DU penetrators were recovered that were fractured or fragmented, the recovery team accounted for them by adding up the "pieces" until the dimensions of a full penetrator was approximated. This composite is termed an "equivalent penetrator." Approximately 169 DU penetrators remain unaccounted for.

In the NRC's review of the Navy's "Survey Work Plan," comments were provided to the Navy that should be addressed regarding how the Navy plans to address potential residual contamination or unrecovered DU penetrators. At the time of this inspection, the Navy had not completed its evaluation of these longer term issues. The Navy's position on potential residual contamination and potential unrecovered DU penetrators remains unresolved.

Soil samples were collected by NRC inspectors in the LIA on Vieques. The samples were shipped to Oak Ridge Institute for Science and Education in Oak Ridge, Tennessee, for analysis. A supplement to this report will be issued when the results of those samples are available. In addition, the inspector determined that radiation levels measured in areas where DU penetrators were not reported to have been fired, were not distinguishable from background radiation levels.

Following the inspection, the NRSC committed to return to the LIA on Vieques to resume recovery operations. The NRC will continue to monitor the Navy's DU penetrator recovery activities.

Attachment:

List of Persons Contacted
Inspection Procedures Used
List of Acronyms

REPORT DETAILS

1. Description of Incident

On February 19, 1999, during a training exercise, two U. S. Marine Corps Harrier aircraft expended 263 ammunition rounds containing depleted uranium (DU) on the Live Impact Area (LIA) of the Atlantic Fleet Weapons Training Facility on Vieques Island, Puerto Rico. The area is a naval weapons firing range, and DU ammunition rounds are not authorized, under NRC regulatory requirements, to be fired there. The NRC was notified of the incident by the Naval Radiation Safety Committee (NRSC) Executive Secretary on March 5, 1999. Between March 10 and 19, 1999, a team comprised of Navy health physics personnel was dispatched to the LIA on Vieques and recovered a total of 57 equivalent penetrators.

The NRSC identified the issuance of the DU ammunition and the subsequent firing of it as a Severity Level IV violation of the Navy's master materials license; specifically, a violation of naval radioactive material permit No. 13-00164-L1NP. This permit is issued to the Naval Surface Warfare Center, in Crane, Indiana, and specifies the DU ammunition as war reserve material, deployed only for combat use.

As part of its corrective actions, the Navy committed to the recovery of all detectable DU rounds from the LIA on Vieques. A "Survey Work Plan for DU Penetrators" was developed by the Navy and submitted to the NRC on January 10, 2000, for review. The NRC completed its review on March 21, 2000.

2. Radiological Safety

a. Scope

Between May 31 and June 13, 2000, an inspection was conducted, in part, to determine if licensee personnel performed the DU recovery operations in a radiologically safe manner. The inspector directly observed naval personnel recover several DU rounds from the LIA and interviewed various members of the recovery team.

b. Observations/Findings

Through direct observation of and discussions with naval personnel involved in the recovery of DU ammunition from the LIA, the inspector determined the following:

- (1) When areas were identified as potential locations of DU penetrators, recovery personnel used an Eberline® Model E-600 Survey Meter (E-600) coupled with a 2" by 2" sodium iodide (2X2 NaI) detector, to carefully survey soil as it was removed. Very small amounts of soil above and around each penetrator were removed using a standard garden hand trowel. Each "scoop" was carefully surveyed. If the E-600's count rate indicated the presence of DU, recovery personnel collected the soil in a plastic bag for disposal. Once the penetrator was visualized, recovery personnel carefully collected it in a plastic bag, as well. Soil located around the collected penetrator was collected for

disposal until the E-600 count rates indicated an absence of DU contamination in that location, i.e., less than twice the background count rate. Background count rates ranged from less than 1500 counts per minute (cpm) to approximately 3500 cpm.

- (2) At the completion of each DU penetrator recovery evolution, recovery personnel carefully surveyed the trowels, their gloves, and their clothing for DU contamination. The DU contamination was observed by the inspector to be discreet particles or flakes, bright yellow in color (presumably from oxidation), that were easily visualized and collected. The DU contamination did not tend to adhere to trowels, gloves, soil grains, or clothing. The inspector determined that contamination control did not pose any significant difficulty for recovery personnel. Especially noteworthy was the fact that the 2X2 NaI detectors did not become contaminated even when placed in direct contact with soils surrounding recovered penetrators. This fact was established when it was observed that the E-600's background count rates did not increase, and daily quality assurance checks remained constant from day to day with no decontamination of the detectors.
- (3) As each DU penetrator, or penetrator fragment was located and collected, various amounts of associated soil was also collected. The amount of soil collected was dependent upon the depth at which the penetrator was located below the surface of the soil. Penetrators were located at depths ranging from the surface of the soil to 18 to 20 inches below the surface of the soil. Recovery personnel carefully collected the penetrators and soil in plastic bags and subsequently placed them in five gallon plastic containers. The plastic containers were marked as containing radioactive material and stored under lock and key for eventual collection, packaging, and shipping as low level radioactive waste.
- (4) The Officer in Charge of the recovery team stated to the inspector that a prospective evaluation was performed with respect to potential external radiation exposure from the DU recovery activities. The evaluation determined that recovery team members were not likely to receive a dose in excess of ten percent of any regulatory limit. Based upon this prospective evaluation, the decision was made to not require recovery team members to wear personnel dosimetry. The inspector determined, based upon measured radiation levels in the affected areas, that the licensee's evaluation was reasonable.

c. Conclusions

The NRC inspector determined that the recovery of DU ammunition from the LIA on Vieques was performed in a radiologically safe manner.

3. Depleted Uranium Recovery Team's Adherence to "Survey Work Plan"

a. Scope

The May 31 - June 13, 2000, inspection was also conducted, in part, to assess the Navy's DU Recovery Team's adherence to the "Survey Work Plan" submitted by the NRSC to the NRC on January 10, 2000. The inspector reviewed the "Survey Work

Plan," directly observed naval personnel perform surveys and scans of the affected areas, and interviewed various members of the recovery team.

b. Observations/Findings

Through direct observation of and discussions with naval personnel involved in the recovery of DU ammunition from the LIA, the inspector determined the following:

- (1) As described in the "Survey Work Plan," the recovery team utilized a commercial differential global positioning system (DGPS) and data management system in conjunction with commercial radiation detection equipment. Specifically, the team utilized a NAVTRACK 2200® system connected to four E-600 survey instruments, each coupled to a 2X2 NaI detector. The system simultaneously collected data from each detector and the DGPS, and transmitted it to a personal computer. The computer compiled the count rates from each detector, as well as the position of the entire system. This data was then plotted, giving the recovery team visual indications of elevated count rates, relative to a specific point in the affected area. This system was used by the recovery team to systematically "scan" large portions of the affected area.
- (2) Quality assurance tests were performed each day, prior to the initiation of scanning. Each detector was tested with a National Institute of Standards and Technology (NIST) traceable source with known activity for the purpose of ensuring that the detectors were performing as expected. The entire system was also tested for consistent and expected operation each day, prior to scanning areas for the presence of DU penetrators.
- (3) In areas clear of heavy vegetation and brush, the NAVTRAK® system performed as expected. In areas previously surveyed for DU penetrators in March, 1999, where penetrators had been recovered, and considered to be "clean," the NAVTRAK® system identified six areas suspicious for the presence of a DU penetrator. When investigated, recovery personnel recovered a DU penetrator in five of the six areas identified.
- (4) The Navy's "Survey Work Plan," requires that all brush in the survey area be removed or cut to a height of no more than four inches (Section 9.1). Due to coordination problems encountered with the removal of unexploded ordnance in areas planned for scanning with the NAVTRAK® system, it was not possible to safely clear the vegetation or cut it to a maximum height of four inches. Consequently, the recovery team was unable to scan large portions of the affected areas of the LIA as planned.
- (5) In an attempt to compensate for the fact that the NAVTRAK® system could not be utilized in areas where vegetation was present, the recovery team used single E-600 survey instruments coupled with 2X2 NaI detectors and surveyed these areas for the presence of DU penetrators. The recovery team was aware that the sensitivity was significantly diminished. They partially compensated for the loss of sensitivity and precision afforded by the NAVTRAK® system, by dividing the affected area into small plots and meticulously surveying those plots. The team successfully located approximately 32 equivalent DU penetrators using this method. The recovery team developed the concept of an equivalent DU penetrator in response to the fact that some

of the penetrators were recovered in a fractured or fragmented state. When DU penetrator fragments were encountered, the recovery team accounted for them by adding up the "pieces" until the dimensions of a full penetrator was approximated.

- (6) Upon completion of its review of the Navy's "Survey Work Plan," the NRC provided comments to the Navy that should be addressed regarding how the Navy plans to disposition potential residual contamination or unrecovered DU penetrators. The inspector interviewed the Officer in Charge about the status of these issues. The Officer in Charge indicated that the focus of the work being performed was to recover as many DU penetrators as possible, and that Navy had not completed its evaluation of these longer term issues. The Navy's position on potential residual contamination and potential unrecovered DU penetrators remains unresolved.
- (7) A telephone conversation was held on June 27, 2000, between the inspector and the NRSC Executive Secretary. At that time, the NRSC Executive Secretary informed the inspector that the Navy planned to return to the LIA on Vieques for the purpose of resuming recovery activities. The Executive Secretary further explained that the necessary resources for the clearing of unexploded ordnance and vegetation would be made available, thereby allowing for the use of the NAVTRAK® system, as originally planned. The Navy has not yet determined how it will disposition potential residual contamination.

c. Conclusions

The NRC inspector determined that the recovery team adhered to the guidance of the "Survey Work Plan" submitted by the NRSC to the NRC on January 10, 2000. The team recovered approximately 37 of the remaining 206 equivalent DU penetrators. Coordination problems in clearing dense vegetation areas where unexploded ordnance is present, prevented effective use of the NAVTRAK® system and the inability to recover approximately 169 penetrators. Furthermore, the NRSC has committed to returning to the LIA on Vieques to resume recovery activities.

4. Independent Surveys

a. Scope

During the inspection conducted between May 31 and June 13, 2000, numerous surveys were performed and soil samples were collected for the purpose of independently assessing the licensee's performance.

b. Observations/Findings

- (1) The inspector performed independent surveys of the recovery team's activities in the LIA on Vieques using a Ludlum® Model 19 micro-R-meter, serial No. 101627, an Eberline® ESP-2 survey meter, serial No. 00793, equipped with an Eberline® Model SPA-3 gamma scintillator probe, and an Eberline® Model E-600, serial No. 01876, equipped with an Eberline® Model HP-380 alpha/beta scintillator probe. Each survey meter had been

calibrated within the last year and quality assurance tests were performed on the instruments at the beginning of each day of use to ensure the instruments were operating as expected.

- (2) The inspector performed surveys in areas where recovery team members recovered DU penetrators. The inspector surveyed the soil where DU penetrators had been excavated by the recovery team with the three meters described above. In all cases, the radiation levels could not be distinguished from background levels when using the gamma detecting instruments. However, in two of the excavated holes, the instrument with the alpha/beta scintillator did detect slightly elevated levels of beta radiation (two to five times the background levels). Background levels were established by the inspector and determined to range from one to four micro Roentgen per hour ($\mu\text{R/hr}$) for the Ludlum® Model 19 survey meter, 2000-2800 counts per minute for the Eberline® ESP-2 survey meter and 90-127 counts per minute for the Eberline® E-600 meter in the beta detection mode.
- (3) The inspector performed independent surveys of recovered DU penetrators. Radiation levels on contact with full DU penetrators were approximately 400 $\mu\text{R/hr}$.
- (4) Two NRC inspectors collected samples of soil in the LIA on Vieques. Soil samples were collected from the areas where DU penetrators were excavated, and the recovery team had deemed free of DU penetrators or penetrator fragments. In addition, soil samples were collected down grade (downhill) of areas known to have been impacted by the DU penetrators. The samples were shipped to Oak Ridge Institute for Science and Education in Oak Ridge, Tennessee for analysis. A supplement to this report will be issued when the results of those samples are available.
- (5) The inspector also performed independent surveys, using the micro-R-meter, in areas of the LIA where DU penetrators were not reported to have been fired. These areas included "targets" such as tanks, aircraft, and other types of vehicles. In all areas surveyed, the inspector did not identify radiation levels distinguishable from background radiation levels. Measured background radiation levels ranged from less than 1 $\mu\text{R/hr}$ in beach areas where only sand was present to 7 $\mu\text{R/hr}$ in inland areas where the soil was rocky in nature.

c. Conclusions

The inspector determined through the performance of independent surveys that measured radiation levels in the LIA on Vieques were consistent with the levels measured by the licensee. In addition, the inspector determined that radiation levels measured in areas where DU penetrators were not reported to have been fired, were not distinguishable from background radiation levels. Various soil samples were collected in the LIA and forwarded to an independent laboratory for analysis. A supplement to this report will provide the results of that analysis.

EXIT MEETING SUMMARY

An exit meeting was held with the Officer in Charge of the DU penetrator recovery team on June 13, 2000. The overall scope and findings of the inspection were discussed. No dissenting comments were received.

On June 27, 2000, a telephone conversation was held between the inspector and the NRSC Executive Secretary. At that time, the Executive Secretary committed to returning a team to the LIA on Vieques to resume recovery activities.

ATTACHMENT

LIST OF PERSONS CONTACTED

RADM K. Green, Commander, Naval Command, South
ADML J. Moran, Commander, Southeast Region (by telephone)
CAPT J. Stark, Commanding Officer, Naval Station, Roosevelt Roads
CDR D. Farrand, Director, Radiological Controls Program Office, Naval Sea Systems Command
CDR(s) L. Fragoso, Deputy Director of Radiological Health, Norfolk Naval Shipyard
LCDR V. Deinnocentiis, Environmental Project Manager, Radiological Affairs Support Office
Mr. L. Martin, Environmental Project Manager, Radiological Affairs Support Office
Mr. T. Blanton, Environmental Project Manager, Radiological Affairs Support Office
LCDR T. Bracek, Inner Range Manager/Range Control Officer
CAPT N. Delgado (U.S. Marines), Assistant Inner Range Manager/Range Control Officer
Mr. N. Hines, Site Manager (OP1 Compound)
Numerous Explosive Ordnance Disposal Personnel

INSPECTION PROCEDURES USED

87103 - Inspection of Materials Licensees Involved in an Incident or Bankruptcy Filing

LIST OF ACRONYMS

CPM - Counts per Minute
DGPS - Differential Global Positioning System
DU - Depleted Uranium
E-600 - Eberline Model E-600 Survey Meter
LIA - Live Impact Area
NaI - Sodium Iodide
NIST - National Institute of Standards and Technology
NRC - Nuclear Regulatory Commission
NRSC - Naval Radiation Safety Commission
 μ R/hr - Micro Roentgen per Hour