Safety Review of USDA APHIS Wildlife Services’ Use of Explosives and Pyrotechnics

by

Institute of Makers of Explosives

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EXECUTIVE SUMMARY

The Institute of Makers of Explosives (IME) conducted a safety and security review of WS use of explosives and pyrotechnics. Wildlife Services (WS) has an outstanding explosives and pyrotechnics safety and security program and fosters a culture, from top to bottom, that promotes safety. The WS explosives and pyrotechnics safety and security program could serve as a model for other agencies or groups looking to improve their own program. The recommendations made by IME the report address relatively minor safety and security issues. They should in no way reflect poorly on WS employees. Only through IME’s intimate knowledge and experience of commercial explosives and blasting could these recommendations be known.

The IME reviewed 6 WS Directives and 36 documents used for safety and security training by WS. In general, WS documentation was well written and covered the essential topics. IME suggested many minor modifications to the documentation that WS should consider making.

No training classes were held during the review period so IME was not able to attend a training class(es). WS training instructors are highly skilled and experienced safety professionals and WS training documents are outstanding. IME has no doubts that the WS training and certification programs could serve as a model for other agencies.

IME conducted four separate field audits of state WS explosives programs involving six field offices. Each auditor prepared a field audit report which was reviewed by IME. Each auditor was very impressed with the emphasis WS places on safety and in particular, explosives safety and security. Field audits included a review of the availability of relevant safety information and equipment, employee knowledge of and adherence to safety policies, use of Personal Protective Equipment, on-site hazard communication rules, transportation, handling and storage of hazardous materials, and equipment condition. No major deficiencies were observed in any of these areas, although several of the recommendations made by IME address minor issues in these areas. The recommendations were prioritized by IME.

INTRODUCTION

The Institute of Makers of Explosives (IME) conducted a safety and security review of WS use of explosives and pyrotechnics.

The IME has been the safety and security institute of the commercial explosives industry since 1913. Our mission is to promote safety and the protection of employees, users, the public and the environment; and to encourage the adoption of uniform rules and regulations in the manufacture, transportation, storage, handling, use and disposal of explosive materials used in blasting and other essential operations.

The IME represents U.S. manufacturers and distributors of commercial explosive materials and oxidizers as well as other companies that provide related services. Over 3 million metric tons of high explosives, blasting agents, and oxidizers are consumed annually in the United States. Of this, IME member companies produce over 98 percent of the high explosives and a great majority of the blasting agents and oxidizers. These products are used in every state of the Union and are distributed worldwide. IME members and their affiliates conduct over half of all blasts in the U.S.
Commercial explosives are the backbone of our industrial society. Metals, minerals, oil, power, construction activities and supplies, and consumer products are available today because of commercial explosives. The ability to transport and distribute commercial explosives safely and securely is critical to all industries.

As such, explosives and pyrotechnics provide valuable tools to Wildlife Services (WS). Appropriate application of these tools improves the safety and efficiency of WS operations. WS should continue to use explosives and pyrotechnics and could increase their use. State Directors who choose not to use these tools should be reminded annually of the potential benefits.

WS' need for the use of explosives and pyrotechnics will likely increase in coming years due primarily to increased use of capture nets for surveillance of avian influenza and other wildlife diseases, increased beaver dam blasting due to a burgeoning native beaver population, increased need to control avian hazards to aircraft due to increasing air traffic and continued emphasis on nonlethal management options.

WS has an outstanding explosives and pyrotechnics safety and security program and fosters a culture, from top to bottom, that promotes safety. The WS explosives and pyrotechnics safety and security program could serve as a model for other agencies or groups looking to improve their own program. The recommendations that IME make in this report address relatively minor safety and security issues. They should in no way reflect poorly on WS employees. Only through IME's intimate knowledge and experience of commercial explosives and blasting could these recommendations be known.

REVIEW OF APPLICABLE DIRECTIVES

The IME Technical Committee (Tech)\(^1\) reviewed the following applicable directives and referenced documents related to the WS explosives and pyrotechnics safety and security program:

- WS Directive 2.401, PESTICIDE USE, dated 02/17/04
- WS Directive 2.435, EXPLOSIVES USE AND SAFETY, dated 01/06/06
- WS Directive 2.601, SAFETY, dated 10/07/05
- WS Directive 2.625, PYROTECHNICS, ROCKET NET CHARGES, AND INCIDENTAL EXPLOSIVE MATERIALS, dated 01/06/06
- APHIS SAFETY INSPECTION CHECKLIST (Hazardous Chemical Storage, Explosives Storage, and Waste Disposal), APHIS FORM 256-5 (June 97)

Tech reviewed the documents for their adequacy, certification requirements, and completeness.

IME found no deficiencies in WS Directives 2.401, 2.465, 2.601 and makes no recommendations for changes in these directives.

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\(^1\) Tech is comprised of 45 of the best technical people in IME member companies.
WS Directive 2.435, EXPLOSIVES USE AND SAFETY

WS should make the following modifications to this directive:

1. Add a paragraph to section four addressing the explosives possession prohibitions from the Safe Explosives Act. Federal Law prohibits the possession of explosives by certain individuals. WS should ensure that employees are aware of these prohibitions and take action to prohibit possession of explosives by prohibited individuals.
2. The web address (http://www.aphis.usda.gov/mrpbs/forms/aphis/aphis256-5.pdf) listed in section four does not work and should be updated.
3. Add a reference to Department of Transportation regulations at 49 CFR Parts 106, 107, 110, 171 through 180, and 397 in section five.
4. Eliminate and expand certain references to 27 CFR Part 555. Subpart D does not apply to any WS activity and can be deleted. All of Subpart G could be referenced, not just 555.126 and 127. All of Subparts I, J and K should be referenced.

WS Directive 2.625, PYROTECHNICS, ROCKET NET CHARGES, AND INCIDENTAL EXPLOSIVE MATERIALS

WS should make the following modifications to this directive:

1. Add a paragraph to section four addressing the explosives possession prohibitions from the Safe Explosives Act. Federal Law prohibits the possession of explosives by certain individuals. WS should ensure that employees are aware of these prohibitions and take action to prohibit possession of explosives by prohibited individuals.
2. The references in section five should be consistent with WS Directive 2.435 for 49 CFR and 27 CFR.
3. Delete the phrase “and approved as legal explosive devices by the Bureau of Alcohol, Tobacco, Firearms and Explosives (ATF)” from section I of Attachment 1. ATF does not engage in such approvals.
4. Delete the phrase “exceeds these standards and” from section IIA, Rule 3b. An IME 22 container does not necessarily meet the bullet or theft resistant requirements of a Type 2 magazine, or the theft resistance of a Type 4 magazine.
5. Mention the OSHA requirement for indoor magazines being readily removable from the building in the event of an emergency in Section IIA, Rule 3b.
7. Add a rule for informing the local jurisdiction responsible for fire safety of explosives and pyrotechnics storage in magazines.
8. In Section V, delete “site” from the first sentence. Each magazine should be inspected, not just the site.

APHIS SAFETY INSPECTION CHECKLIST (Hazardous Chemical Storage, Explosives Storage, and Waste Disposal), APHIS FORM 256-5 (June 97)

WS should consider the following modifications to this directive:

1. Insert “at least” before “once” in question #39.
REVIEW SAFETY MANUALS AND PROCEDURES FOR EXPLOSIVES, ROCKET/CANNON NETS AND PYROTECHNICS

The IME Technical Committee (Tech) reviewed the following applicable safety manuals, procedures and referenced documents related to the WS explosives and pyrotechnics safety and security program:

Use Restrictions for the Use of Fuse Detonators by Wildlife Services Explosives Specialists, May 2007

IME recommends no changes.

Wildlife Services Explosives Training Workshop, What-to-bring List

Consider eliminating the reference to a “nonsparking” knife. It is not a well-defined term.

Rocket/Cannon Net Workshop Agenda, June 26-27, 2007, Mississippi State University

IME recommends no changes.

Standard Operating Procedures For Rocket and Cannon-net Use, August 8, 2006

1. The terms “should” and “will” are used apparently interchangeably in the document. WS should consider whether both terms should be used and if not which one should be used. If both terms are used, WS should be able to justify why one term is used in one place and the other is used in another place.

2. Edit section III.A.8 as follows: “Smoking, matches, open flame, and spark-producing devices are not permitted within 50 feet of outdoor explosives magazines or in the same room as indoor magazines. Combustible materials and flammable liquids will not be stored within 50 feet of outdoor magazines. The land surrounding an outdoor magazine will be kept clear of all combustible materials for a distance of at least 25 feet.”

3. Revise Section IV in accordance with the resolution of the IME recommendation number one on use of SLP-22 boxes.

4. Refer to IME SLP-20 in section VIII.1 for control of radio frequency hazards.

5. Add “NET OPERATOR-IN-CHARGE looks for a misfire, gives the all clear, or goes to XI.” as the first step in section X.

APHIS Safety Inspection Checklist, WS form 256-5 (June 97)

IME recommends no changes.

Explosives Inventory Record, WS form 22 (Oct 99)

IME recommends no changes.
Site Blasting Record, WS form 23 (Sept 98)

IME recommends no changes.

Explosives Handling Procedures for Beaver Damage Management, September 2007

1. Consider adding a definition for the “Chair of Explosive Committee.”

2. In section II, part D.1, delete the phrase “quantities of more than 1,000 detonators (regardless of package classification); quantities of more than 1,000 detonators (regardless of package classification).” Quantities of over 1,000 detonators may be shipped as Division 1.4. Likewise, delete the phrase “[less than 1,000]” in D.4.

3. Edit the last sentence in section II, part D.6, to read: “Detonators packaged as Division 1.4 explosives can be stored in Type 4 magazines.”

4. Consider replacing the definition of “shock tube” and “electric detonator” with that found in IME SLP-12.

5. Relabel the section titled “D. Miscellaneous” section “E”.

6. Replace the phrase “blasting site” with “blast site” throughout all WS literature.

7. Add a definition for “blast area: The area of a blast within the influence of flying material, gases, and concussion.” Use this term instead of “blasting area” throughout WS literature.

8. Examine font issues in the document since it looks like quotation marks are not displayed properly in either the electronic or hard copies provided.

9. Alphabetize the list of terms in section “[E]. Miscellaneous”.

10. Consider replacing the definition of “shunt” with the newly revised IME definition from SLP-12:

    SHUNT (noun) - A connection between two wires of an electric detonator which prevents building up of opposing electrical potential in them.

    SHUNT (verb) - The means (or action) whereby build-up of extraneous electrical energy is prevented, diverted, current limited, or redirected in a detonator assembly to minimize the probability of an unplanned actuation of the ignition element.

11. Delete the phrase “size No. 8 or equivalent” from section IV.A.3. Strictly speaking, detonators are not tested to this standard making it essentially impossible to meet. As an alternative, WS could say “400-450 milligrams PETN base charge or equivalent.”

12. Add the phrase “when the combination of the magazine and the building provide bullet resistance” to the end of section XII Rule 4b.
13. Delete Rule 9 in section XII. WS needs to prepare explosives for shipment in smaller boxes and this may be best accomplished inside the magazine.

14. Edit the first sentence in section XII, Rule 13 as follows. “Smoking, matches, open flames, and spark or flame-producing devices are not permitted inside or within 50 feet of an outdoor magazine; or in the same room as an indoor magazine.

15. Add the word “outdoor” before “magazine” in Rule 14 in section XII.

16. Make Rule 15 in section XII consistent with the resolution of IME’s recommendation on magazine warning signs.

17. Consider adding rocket net charges to section XIII.

18. Revise rules 2-5 based on resolution of IME’s recommendation on use of Type 3 magazines for transportation.

Wildlife Services Explosives Program Definitions (undated?)

Consider eliminating this document since it appears to be redundant with section II of Explosives Handling Procedures for Beaver Damage Management, September 2007. Duplicative standards are prone to developing inconsistencies.

Misfire Procedures Ez Det Detonator Nonelectric Shock Tube Assembly, June 2002

Remove the trade name “Ez Det” and replace it with the generic term “dual ended”. “EZDet” is a registered trademark of Dyno Nobel Inc. and in places where the term word is appropriate, WS could include the registered trademark symbol (®) following the word.

Checklist for the Use of Nonelectric Shock Tube Detonators, May 2003

IME recommends no changes, except as discussed in the recommendation for covering starter caps.

Checklist for the Use of Ez Det Detonator Nonelectric Shock Tube Assembly, June 2002

Remove the trade name “Ez Det” and replace it with the generic term “dual ended”. “EZDet” is a registered trademark of Dyno Nobel Inc. and in places where the term word is appropriate, WS could include the registered trademark symbol (®) following the word.

Checklist for The Use of Fuse Detonators, May 2003

IME recommends no changes, except as discussed in the recommendation for covering starter caps.

Checklist for the Use of Electric Detonators, May 2003

IME recommends no changes, except as discussed in the recommendation for covering starter caps.
Detonating Cord Checklist, May 2003

IME recommends no changes.

Step by Step Misfire Procedures Fuse Detonators, May 2003

IME recommends no changes.

Step by Step Misfire Procedures Nonelectric Shock Tube Detonators, May 2003

IME recommends no changes.

Step by Step Misfire Procedures Electric Detonators, May 2003

IME recommends no changes.

Tread Day Boxes

IME recommends no changes.

Subpart K-Storage

This is apparently intended to be a copy of ATF storage regulations. WS should provide a copy of the most recent version of ATF publication 5400.7, Federal Explosives Law and Regulations to trainees and consider eliminating this section of the Manual.

IME Lock ‘em Up poster

IME recommends no changes.

Untitled

A WS form for “Transportation Inventory” and “Daily Vehicle Inspection” is in the Manual, but has no title and should be given one. IME recommends no other changes, but notes that the form is applicable to beaver dam blasting only.

IME Emergency Routing Poster

IME recommends no changes.

IME Bulk Truck Marking & Placarding Guide

IME recommends elimination of this from the Manual. It has no applicability since WS does not allow transport of explosives and oxidizers in the manner covered by the guide.
Procedures for Preparing Safety Fuse and Fuse Detonator Assemblies, No. 5A, Feb 9, 1998

Consider elimination of the document. Relevant parts should be already in or added to the Checklist for the Use of Fuse Detonators, May 2003.

Safe Practice with Nonelectric, Shock Tube Initiation System, No. 4, March 11, 1994

Eliminate this document. It does not accurately describe the phenomenon. WS should continue to emphasize the IME recommendation from SLP-4 to “NEVER pull wires, safety fuse, shock tube, coupling device, plastic tubing, or detonating cord out of any detonator or delay device.”


IME recommends no changes.

Safety Considerations Related to Explosives Inventory Stock Rotation and Disposal, No. 6, April 11, 2007

IME recommends no changes.


WS should replace this with the Feb., 2005 edition.

Voluntary Security Checklist


IME Poster on Explosive Magazine Emergency Procedures

IME recommends no changes.

Product Data Sheets and MSDS

IME recommends no changes.

Explosives Specialist Certification / Refresher Training Inspection Form (8/03)

IME recommends no changes.

Delay Detonator Use (12/5/03)

IME recommends no changes.

Explosives Training Workshop, June 26-28, 2007

IME recommends no changes.
Delayed Detonator Workshop, May 20, 2003

IME recommends no changes.

Self-Inspection Checklist Residential Storage Sites for Pesticides, Pyrotechnics, Rocket Net Charges and/or Incidental Explosive Materials

IME recommends no changes.

REVIEW TRAINING AND CERTIFICATION PROGRAMS

No training classes were held during the review period so IME was not able to attend a training class(es). IME reviewed the documentation listed above related to the training and certification programs and recommends minor edits as seen above. Outside contractors used by WS as training instructors are highly skilled and experienced safety professionals and IME has no doubts that their instruction meets WS needs. WS Explosives Committee members that serve as instructors exhibit the skills and knowledge necessary to perform this task. The WS training and certification programs could serve as a model for other agencies.

FIELD AUDITS

IME conducted four separate field audits of WS explosives programs involving six field offices. Lon Santis, IME Manager of Technical Services visited the VA field office. Steve Harris, Austin Powder Co. Western Regional Manager visited the WA and ID field offices. John Lee Turner, Orica Technical Manager for the Eastern Region visited the WI field offices in Waupun and Rhinelander. Joe McDonald, Senior Area Technical Representative for Dyno Nobel Inc visited the OK field office. A brief summary of each reviewer’s education and background is included in Appendix A. Each reviewer prepared a field audit report which was reviewed by IME.

Each auditor was very impressed with the emphasis WS places on safety and in particular, explosives safety and security. Field inspections included a review of the availability of relevant safety information and equipment, employee knowledge of and adherence to safety policies, use of Personal Protective Equipment, on-site hazard communication rules, transportation, handling and storage of hazardous materials, and equipment condition. No major deficiencies were observed in any of these areas, although several of the recommendations made by IME address minor issues in these areas.

During the field audits, IME verified that in general:

- WS employees adhere to WS policy/manuals/safety procedures and guidelines regarding the use of explosives and pyrotechnics.
- WS makes available all the necessary personal protective equipment (PPE) and provides adequate training for its use.
- WS applies an adequate Hazard Communication Plan for hazardous materials.
- Emergency response materials are readily availability.
- WS record keeping meets ATF, DOT and industry standards.
• Periodic safety inspections are conducted adequately.
• Explosives, pyrotechnics and associated equipment were properly stored.
• Explosives and pyrotechnics were transported safety and securely.
• Explosives and pyrotechnics equipment was in good condition and maintained.
• Explosives, pyrotechnics, and associated equipment were properly labeled.
• MSDS were available for hazardous materials.
• Appropriated safety equipment was available (e.g., first aid kits, Automated External Defibrillator (AED), fire extinguisher).
• Field communications were good.

Several of the recommendations made by IME would make minor improvements in some of these areas.

STATE DIRECTOR AND DISTRICT SUPERVISOR INTERVIEWS

IME interviewed State Directors, Assistant State Directors, District Supervisors, and Assistant District Supervisors as described in the field audit reports and elsewhere.

Because of the diversity of wildlife damage management needs within each state, State Directors have a great deal of latitude in setting policy for the State office. A national safety and security program like that administered through the WS Explosives Safety Committee establishes certain national policy and is necessary for safe and secure WS operations. WS appears to have struck the proper balance between State Director independence and national policy. State Directors and their staff seem to welcome guidance from the WS Explosives Committee in these areas and understand the limitations of their own knowledge of explosives and pyrotechnics safety and security. During the interviews and in general, IME did not observe a single instance of WS field staff substituting their opinion for that of the WS Explosives Committee.

Every interviewee displayed a level of understanding of the issues to adequately administer an effective safety program. Safety incentives (e.g., awards, performance standard elements) are offered and given to WS employees. Supervisors and State Directors had through knowledge of activities and hazards associated with the use of explosives and pyrotechnics. Supervisors displayed an adequate knowledge of WS safety and security program requirements, monitored and reviewed employee field activities, provided oversight of the WS safety and security program and corrective action process, and included a safety component in employee performance standards.

REVIEW OF 2007 PYROTECHNICS ACCIDENT

IME conducted a review of the 2007 pyrotechnics accident that WS experienced in Washington State. Explosives and pyrotechnics are often unpredictable and it appears impossible to prevent a situation where a rocket, banger, screamer or pyrotechnic round goes in an unintended direction. Therefore, policies to minimize the consequences of known errant behavior were instituted. WS appears to have had adequate policies in place before the incident.
According to information provided to IME, the root primary cause of the accident was an employee’s failure to follow safety policies that were provided to the employee. Corrective action in that regard is beyond the scope of IME’s review.

RECOMMENDATIONS

As stated previously, the WS explosives and pyrotechnics safety and security program could serve as model for similar agencies and groups. The following recommendations are based on IME’s intimate knowledge and experience with commercial explosives blasting and products and on IME’s observations of the WS explosives safety program during the audit. The recommendations do not in all cases suggest additional restrictions. In some areas, IME believes that WS is overly restrictive and that safety and security would be enhanced by relaxation of certain policies.

IME used a qualitative risk assessment process to prioritize the recommendations. An estimate of the probability of an incident occurring was coupled with the expected consequences of that incident to determine the risk. The recommendations are listed from highest to lowest risk, assuming the recommendation was not instituted. The first four recommendations rated equally as did recommendations numbers 8 and 9.

1. Implement ways to limit WS employees working alone with explosives and water hazards related to beaver impoundments.

Whenever possible, WS employees should not work alone with explosives or water hazards. IME understands that many circumstances may require WS employees to work alone with explosives and water hazards, and in those circumstances, WS should have a check-in policy to ensure, at a minimum, that the employee has returned safely from a day in the field. Cooperators should be encouraged, perhaps through modification of cooperative agreements if necessary, to watch out for WS employees while working around water hazards and with explosives.

2. Improve cooperator assistance with safety.

Cooperators should provide more assistance to WS on safety. In addition to the potential assistance mentioned above, cooperators could do more in the areas of traffic control and control of ignition sources. For example, when WS employees are working near roadways, cooperators with the proper authority should control traffic rather than sit in their vehicles while traffic whizzes by at speed. It should be made very clear to cooperators that smoking and other sources of ignition are prohibited within 50 feet of explosives.

3. Involve the WS Explosives Committee in the review of all accidents involving explosives or pyrotechnics.

Any accident involving explosives or pyrotechnics should involve the WS Explosives Committee as early in the post-accident process as possible. State Directors should still have primary authority over the accident investigation and corrective action, but involvement of the WS Explosives Committee should be required. WS appears to properly investigate accidents and institute corrective action to prevent a recurrence at a local level. Involvement of the WS Explosives Committee would ensure that the
corrective action could be transferred to other applicable offices. The WS Explosives Committee would also provide valuable input to causative and preventive analysis.

4. Ensure that at least ½ FTE be devoted to the national coordination of the WS explosives and pyrotechnics safety and security program.

If an IME member company conducted the type of nationwide blasting program conducted by WS, at least 1/2 person-year would be devoted to managing the safety, security and compliance of the program from a national level.

5. Carry-over the certification process for blasters to the rocket net program.

WS has an outstanding certification program for blasters. IME believes that essentially the same type of program should be applied to the use of rocket nets. Most of the infrastructure in terms of training, guidance, and policy for this certification already exists and is of outstanding quality. The WS rocket net certification process should ensure that the net-operator-in-charge is certified and that helpers have been safety trained.

6. Consider purchasing manufactured fuse cap assemblies.

WS assembles its own fuse cap assemblies. Preassembled fuse cap assemblies are commercially available and can be more reliable.

7. Consolidate explosives storage sites and make efficient use of indoor magazines.

WS should review their explosives storage for potential consolidation or relocation of indoor magazines at the local level. Safety, security and efficiency may be increased by sensible consolidation, relocation and use of indoor magazines. For example, less road miles traveled to the magazine for products and inspections translates directly into improved employee safety and efficiency. More frequent attendance, such as storage in the State office instead of at a remote location can improve security. Each building WS has access to should be considered for use as an indoor magazine site; potentially eliminating the need for outdoor magazines. During this review, WS should evaluate the bullet resistance of indoor Type 2 magazines and compliance with 27 CFR 555.208(b)(1). The walls of an indoor Type 2 magazine may not be bullet-resistant only if the additional protection of the building, in combination with the magazine, provides bullet-resistance.

8. Purchase multi-function gas detectors for blasters that enter confined spaces such as culverts and train such blasters in confined space entry procedures.

Some WS blasters enter confined spaces such as culverts blocked by a beaver dam on the upstream end. This can create stagnant air in the culvert and the decay of organic matter in the dam may generate gases that displace oxygen and create a dangerous atmosphere. Detonation generates CO and NOx, toxic gases that might linger in the culvert. Detectors purchased should be capable of measuring oxygen, carbon monoxide, methane, and sulfur dioxide. Standard confined space entry procedures are applicable, readily available and could be adapted by the Explosives Committee to meet WS needs.
9. Provide employees with proper personal protective equipment (PPE).

For the most part, WS employees are provided the proper PPE. WS employees should wear safety glasses at all times around explosives and pyrotechnics. When handling SLP-22 or Type 3 boxes and rocket nets, WS employees should be provided and wear steel toe shoes.

10. Modify training or checklists to include the following elements.
   a. Control starter cap shrapnel with shock tube systems

WS typically uses detonators designed for initiation of high explosive charges (so called in-hole or standard or high strength detonators) attached to a lead in line or fuse to initiate beaver dam blasts. With these detonators, there is the potential for shrapnel from the detonator shell flying out and cutting off shock tube or detonating cord trunklines and downlines before the reaction front reaches that point, thus leading to a misfire. The concern is much greater when using shock tube surface delays since detonating cord is much more resistant to this problem. WS training seems to adequately address this issue with use of detonating cord. More base charge in the detonator means a higher risk of downstream cut-off. Standard strength starter caps should be shielded with dirt, mud, a rock, log, branch, or other means of preventing shrapnel from cutting off shock tube downstream of the initiation. Alternatively, low-strength detonators like those used on the surface end of a dual ended nonelectric shock tube assembly could be used without the need for shielding. If WS continues to use standard strength starter caps with shock tube surface delays, instructions on shielding should be added to the training program and orange checklists for shock tube systems.

   b. Include and discuss Figure 9 from IME SLP-4

Figure 9 in the March 2000 edition of IME SLP-4 Warnings and Instructions for Consumers in Transporting, Storing, Handling, and Using Explosive Materials shows the recommended method of attaching a detonator to detonating cord. This figure should be included in WS blaster’s training. In particular, blaster’s should be trained to keep the loop of detonating cord behind the detonator plug as shown in the figure to minimize the possibility of the detonator become detached from the cord.

   c. Discuss the importance of determining the resistance of blast circuits

During training, WS blasters should be instructed to determine the actual resistance of the blast circuit and compare that value to the expected value. Determining the continuity of the blast circuit merely tells the blaster that an open circuit is not present. It does not provide enough assurance that circuit is not shorted, or an initiator was left out. WS training contractors should provide instructions on how to estimate resistance and troubleshoot measured resistance values that do not match the expected values. This should be added to the checklist for electric detonators and the Standard Operating Procedures for Rocket and Cannon-net Use.

   d. Encourage replacing blasting wire when it becomes damaged

During training, WS blasters should be encouraged to replace blasting wires or any other equipment when it becomes damaged. Nicks in the insulation and splices are indications of damage. Introduce the concept of “lead-lines” and “connecting wire”. From SLP-12, lead lines, also called firing lines, are “[t]he wire(s) connecting the electrical power source with the electric or electronic blasting circuit.”
Connecting wire is "[w]ire used to extend the firing line or leg wires in an electric blasting circuit." Connecting wire should be discarded after each use. Trim the blasting wire ends every time prior to making a wire splice connection for beaver dam blasting and rocket nets.

e. Discuss proper wire connection techniques

During training, WS blaster's should be shown the recommended techniques for proper wire connections, i.e. page 182 of the ISEE Blaster’s Handbook and manufacturer literature. Additionally, WS should consider the use of quick connectors like alligator clips on trunklines to minimize the "time-over-charge" while hooking up rocket net charges.

11. Ensure that Type 2 magazines are secured to a fixed object or otherwise protected from unauthorized removal.

WS should ensure all Type 2 magazines meet the standard for anchoring in Explosives Handling Procedures for Beaver Damage Management, September 2007, section XII Rule 4a.

12. Allow the use of a Type 3 magazine for transportation rocket net charges and explosives other than detonators.

IME commends WS’ policy to use a separate container for the transportation of rocket net charges. The charges contain heat and friction sensitive materials primed with an electric squib. Although it would be legal to transport the rocket net charges outside of a separate container in approved packaging, a considerable margin of safety and security is added by using a separate box. IME believes that WS should allow the use of lighter, Type 3 day boxes in lieu of IME SLP-22 boxes as presently required for transportation of rocket net charges and other explosives besides detonators. This would not compromise the safety and security of the transportation. It would improve the safety of handling the container, which is usually taken in and out of the vehicle after each project, since it could be lighter in weight. Type 3 magazines could also be used to transport items such as detonating cord, safety fuse, pull-wire igniters, and shock tube without compromising safety or security.

13. WS should review the general housekeeping of magazines.

Magazines should be used exclusively for the storage of explosive materials and other such blasting materials and accessories as may be permitted by WS. No tools, except approved conveying and cleaning equipment, should be stored in a magazine. Magazine floors should be swept regularly and kept clean, dry, free of grit, paper and rubbish. Sweepings from floors of magazines shall be disposed of in accordance with approved practices. The land within twenty-five (25) feet (7.6 m) of any magazine should be kept clear of rubbish, brush, dried grass, leaves, dead trees, and all live trees less than ten (10) feet (3 m) high. Volatile materials should not be stored within fifty (50) feet (15.2 m) of outdoor magazines.

14. Develop an internal SOP for repackaging explosives for transportation.

For the same benefit as mentioned in recommendation number 12, WS should develop Standard Operating Procedures (SOP) and provide the materials for repackaging of explosives in smaller packages. This would allow the use of smaller, lighter, more manageable, and ultimately safer transportation from a material handling standpoint without compromising safety or compliance.
In general, WS needs an SOP to provide guidance on obtaining and using DOT-approved cardboard boxes for Packing Group II hazmat, maintaining the distributor’s approved packaging and re-closure method, and applying proper hazmat marking and labels to the package. Detailed guidance on the elements of this SOP is beyond the scope of the current work, but IME would be happy to assist WS in the development of the SOP. The SOP could serve as the primary tool for compliance with DOT hazmat employee training as described in 49 CFR 172 Subpart H.

15. Revisit the validity of various letters and approvals from ATF and DOT.

In general, a letter, variance, or approval must be reviewed for continued validity any time an agency changes the affected regulation or policy regarding the regulation. Examples of these types of documents in the WS program are:
   a. Letter from Wayne Miller, ATF to W.F. Stevens dated July 14, 1989,
   b. DOT Special Approvals nos. SA-890925 and 890604 from 1989, and
   c. Temporary overnight vehicle storage variance.

These types of documents may not be valid or may need updating. For example, today, ATF would probably not issue the same letter to Mr. Stevens and would likely remind the recipient of maintaining bullet resistance as discussed elsewhere in this report. The DOT SA letters refer to specific trade names that may no longer be applicable or all-encompassing. Any other such letters should be reviewed.

16. Ensure that Type 2 magazines are secured to a fixed object or otherwise protected from unauthorized removal.

WS should ensure all Type 2 magazines meet the standard for anchoring in Explosives Handling Procedures for Beaver Damage Management, September 2007, section XII Rule 4a.

17. Ensure that magazine sites are posted with proper warning signs.

The premises upon which all outdoor magazines, except Type 3, are located should be posted with signs reading “Explosives - Keep Off.” These signs should be in contrasting colors with a minimum letter size of 3 inch (75 mm) height with 1/2 inch (12.5 mm) brush stroke. All signs should be located so that a bullet passing through the sign will not strike a magazine and no sign should be attached to a magazine.

All normal access routes to explosive materials storage facilities should be posted with the following warning sign:

DANGER
NEVER FIGHT EXPLOSIVE FIRES
EXPLOSIVES ARE STORED ON THIS SITE
CALL ________________

The sign should be weather-resistant with a reflective surface and lettering at least 2” (50 mm) high. The first two lines shall be in red lettering and the remaining printing in black.
18. Document all safety training including tailgate sessions and instructions to cooperators.

WS does an outstanding and complete job of safety training employees and cooperators. Some of the training, like blaster’s certifications and national rocket net training classes are well documented. However, WS should document all training including “tailgate” sessions and training given to cooperators. This documentation needs to record the date, names of the individuals trained, and description of the elements covered. For example, if a cooperator is trained on how to use bird bangers and screamers using the “Quick Card” developed jointly by WS and OSHA, the description of training merely needs to state “reviewed WS/OSHA Quick Card.”
APPENDIX A
Dossiers of Field Audit Personnel

Lon D. Santis
Manager of Technical Services
Institute of Makers of Explosives
Washington, DC
March 25, 2007

Lon was born near Pittsburgh, Pennsylvania and graduated from the University of Pittsburgh with a BS and MS in Mining Engineering in 1985 and 1986 respectively.

He worked a short time for the Ensign-Bickford Company as a explosives sales representative before 12 years of employment at the Pittsburgh Research Laboratory of the US Bureau of Mines, now operated by NIOSH. There, he managed a variety of explosives research projects relating to transportation, initiation systems, permissible explosives, lightning, toxic gasses, and environmental concerns. In 1998 he became the Manager of Technical Services at the Institute of Makers of Explosives (IME) in Washington, DC. At IME, he manages the IME Technical Committee, the Transportation and Distribution Committee, and the Security Committee. He interacts with all Federal Agencies with interest in commercial explosives and oversees IME’s safety library.

He has authored dozens of technical papers and given scores of presentations on many explosive safety and security topics. He is a member of many professional societies and committees including:

- Board member of the Potomac chapter of the International Society of Explosives Engineers (ISEE),
- Member of ISEE and their
  - Program Committee
  - Security Committee
  - Transportation Committee
- Member of the American National Standards (ANSI) A10 Committee on Construction Safety and
  - Chair of A10.7 Committee on explosives safety in construction
- Member of three National Fire Protection Association (NFPA) technical committees,
  - Explosives
  - Lightning
  - Static Electricity
- Member of the International Code Council

Lon and his family reside in Ijamsville, MD.
NAME: John L. Turner  
COMPANY: Orica USA Inc. – Eastern Division  
ADDRESS: 8518 Allman Rd. (home)  
          Lenexa, KS  66219-1820  
          Mobile (913) 708-5382

NAME: John Turner

TITLE: Technical Manager for the Eastern Division of Orica USA Inc.

EDUCATION:
• 1975 Bachelor of Science from the University of Tennessee

EXPLOSIVES WORK EXPERIENCE:
• From 1981 to 1989 -- positions with Atlas Powder Co. as a Sales Representative, Technical Representative, and Bulk Emulsion Technical Specialist. Gained blasting experience in the quarries, construction projects, and coal fields of Tennessee, Kentucky, and West Virginia. Underground experience in the metal mines in TN and the limestone mines in Central KY.

• From 1989 to 1995 -- Senior Technical Representative in the Central Division of Atlas Powder Company which became part of ICI Explosives in 1990. Gained extensive experience in the quarries, construction projects, and underground limestone and metal mines of the Central US.

• From 1995 to present — Technical Manager for the Central Division of ICI Explosives USA, Inc. which was reorganized into a division of the Quarry & Construction business unit by Energetic Solutions, Inc., in 1996 and then purchased by Orica USA Inc.

• Technical papers presented at the International Society of Explosives Engineers concerning a review of wall control techniques and blast design for a major construction project MN.

• Blaster training seminars, blast design, and analysis for Orica USA Inc. customers, and blasting industry related organizations, such as the NSSGA and NIOSH.

• Active representative for Orica to the Institute of Makers of Explosives.
Steve Harris
Western Division President
Austin Powder Company

Education:

1977 Bachelor of Science – Business Administration - California State University

Employment History

- 1987 to present – Austin Powder Company
  - Location Manager and Blaster, NW Oregon and SW Washington
    - Managed the location and blasted at various quarries and construction projects
  - Technical Sales Representative
    - Sales and technical consulting in Alaska, Oregon, Washington, Wyoming, Nevada, California, Hawaii, Idaho
  - Western Division Technical Manager
    - Blaster Training
    - Division Safety and Compliance
    - Blast design and analysis
    - Involved in the development of QED blast design modeling software
    - Product development
  - Western Division President
    - Overall responsibility for sales and operations in the Western Division
- 1985 to 1987 – North Pacific Drilling and Blasting
  - General Manager – Hawaii Operations
- 1981 to 1987 – Burrell Drilling and Blasting
  - Estimator
  - Project manager
  - Blaster
- 1975 to 1981 – Don Harris and Associates
  - Seismograph Technician

Member: International Society of Explosives Engineers (ISEE)
Joe McCormick  
881 S Jupiter Hills Cir  
Syracuse, UT  (801) 232 - 8786 Mobile  (801) 328 - 6510 Office  
Position  Dyno Nobel, Sr. Technical Service Representative, SLC, UT  
Experience  
DNA, Sr. Technical Service Representative  May 2004 - Present  Syracuse, UT  
- Co-leader KUC/DNA Blast Optimization Team  
- Manage DNA’s Western Region Blaster and Equipment Operator Appraisal Program and conversion to a Competency Vs Compliance Program for our wholly owned sites  
- Electronic Initiation Systems Training Coach  
- Manage DNA’s Western Region Customer Dissatisfaction Report and Complaint Program  
- Work with DNA’s 50/50 JV’s and Independent distributor training requests and electronic detonator trials  
DNNA, Technical Coordinator PRCC  Nov 2002 - May 2004  Gillette, WY  
- Assisted in the development and presentation for the PRCC/DNNA MER  
- Coordinate consistency with DNNA corporate technical staff, DC, South Basin Distribution Site shot service crews and PRCC management for standardized pattern designs, which meet 2003 budgetary requirements in the T/S operation.  
- Participate in T/S, Cast and HWST BOT Process and implemented best practices from BOT process and documentation of improvements with design modifications.  
DNI, Technical Support/Training Manager  Jan 2000 - Nov 2002  Miami, FL  
- Trained SE Region blasters and equipment operators in DNNA’s Blasting Safety, Surface Blasting SOP’s, Open Pit’s I, II and III –20/20 Vision Modules  
- Assisted outside counsel for arbitration and defending alleged blast damage.  
- Assisted corporate technical staff and DC to resolve loss of depth issue at WRQ’s, limit liability for construction blasting, design patterns standards for close in proximity of residential neighborhoods for DNNA’s account base in Florida.  
Ireco of Florida, Sales/Tech Services/Blaster  Jun 1991 - Jan 2000  Miramar, FL  
- Sales – Prepared and presented quotes for surveying, price increases and new business for limestone construction and mining accounts in FL market base.  
- Technical Services – developed risk assessment procedure to control blast event loss, quarterly report process for contract with Tarmac, weekly BOT for WRQ’s and GPS program for Broward County Blasting Ordinance. Serviced mining and construction industry to stay within varying local vibration ordinances.  
- Blaster for limestone construction and mining accounts in South East FL.  
- Technical Services – Managed shot service crew for JWA’s limestone mining and construction accounts in Dade, Broward and Palm Beach Counties, FL.  
Thermex Energy Corporation/SEC  Mar 1986 - Jun 1990  Miami, FL  
- Technical Services – Managed shot service crew for JWA’s limestone mining and construction accounts in Dade, Broward and Palm Beach Counties, FL.  
- Managed explosive delivery contract for Tarmac which produced 10 mil tons/yr  
Alpha Explosives  Dec 1985 – Mar 1986  Sonora, CA  
- Technical Services – Managed shot service crew for Sonora Gold and serviced mining and construction accounts near Lincoln, CA  
Thermex Energy Corporation  July 1985 - Dec 1985  Gallup, NM  
- Technical Sales – Servicing P&M’s McKinley, Peabody Energy’s Kayenta, Utah International’s Navajo, San Juan and Laplata surface coal mines and Phelps’ Dodge copper mining operations in NM and AZ  
The Ensign-Bickford Company  May 1984 - July 1985  SLC, UT  
- Sales Representative - Serviced independent distributors that carried EBCo products for the mining and construction market base in UT, NV, ID and WY  
Education  South Dakota School of Mines and Technology  
- B.S. Mining Engineering  May 1982