

Applying the OSHA Process Safety Management Standard to Manufacturing Explosives at U.S. Government Facilities

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The Occupational Safety and Health Administration (OSHA) Process Safety Management (PSM) standard, 29 CFR 1910.119, is in place to prevent or minimize the consequences of a release of toxic, reactive, flammable, or explosive chemicals. Although the majority of explosives do not use chemicals in excess of the threshold quantities listed in Appendix A of the standard, paragraph 1910.109(k)(2) mandates that the manufacturers of explosives comply with the PSM standard. This paragraph refers back to 1910.109(a)(3) which is the applicable definition of "explosives". It defines "explosives" in accordance with the Department of Transportation (DOT) classification guide, and the paragraph ends with the explanation of commercial explosives. However; there are letters of interpretation issued by OSHA that define the manufacture of explosives to include mixing, blending, extruding, synthesizing, assembling, disassembling and other activities involved in the making of chemical compounds, mixtures, or devices that are intended to explode. This also pertains to the storage of parts used in these processes. The inclusion of assembly and disassembly in the letter of interpretation could involve every installation in the Department of Defense (DOD) that trains with ammunition and explosives.

The OSHA PSM standard has 14 elements that cover all aspects of the program from employee participation to protecting trade secrets. The Army uses several of its own regulations to manage the manufacturing of explosives at government installations. Although the requirements of both agencies are similar, military vernacular and installation-specific terms can make the interpretation difficult. The "Process Hazard Analysis" and "Hazard Analysis Working Group" perform the same function. The "What-If" methodology and composite risk management are identical and acceptable to both agencies. Lightning protection system visual and electrical inspections, deluge system response time tests, and building grounding system checks are just a few of the many methods used to verify the "mechanical integrity" of the manufacturing systems. The rigid standard operating procedure regulation ensures that changes are staffed and approved by the person with risk acceptance authority and demonstrates a working "management of change" program. Emergency procedures, hot work

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permits, and pre-startup safety reviews are already engrained into the military way of doing business.

The elements of PSM are:

1. Employee participation: Employers are required to have a written plan outlining their employee participation. Employee participation should begin at the inception of PSM implementation. Such participation not only improves employee commitment to PSM, but a facility will end up with a much more viable implementation process. The involvement should include employees at all levels of the organization, from field operators, up through supervision, to operations management. The employee participation program effectively includes workers and resolves their safety issues. The participation should extend to every element of PSM. NOTE: The safety staff should be a resource for PSM, not the ones in charge of the program.
2. Process Safety Information (PSI): OSHA states that PSI is "Complete and accurate written information concerning process chemicals, process technology, and process equipment." It is the information necessary for implementation of all other aspects of PSM. Complete information on every chemical involved in the process, including intermediates, is required. Process technology includes not only Process Flow Diagrams (PFDs) and Piping & Instrumentation Diagrams (P&IDs), but operating and storage conditions as well as operating procedures (see below) and operating history (for existing processes). Process equipment information should include the underlying codes and standards relied upon, in addition to information about the specific equipment used in the process. Explosives safety programs provide an understanding of the hazards and control of detonation sources. These include: foreign objects in raw materials; use of substitute raw materials; specific handling requirements for raw materials; impact by tools or equipment; impingement; friction; sparking; and static discharge.
3. Process Hazard Analyses (PHA): A PHA is a systematic evaluation of the hazards involved in the process. PHAs are required for initiation of a process and at least once every five years after that. The PHA team should be multi-disciplinary, including maintenance, operations, and engineering. There are a variety of methods that can be used to conduct a PHA. The method selected will depend on the maturity of the process and operational experience, in addition to process size and complexity. The facilitator of the PHA must be trained in the methodology being used. For proper conduct of a PHA, the PSI must be as complete as possible. Process hazard analyses include examination of quantity-distance requirements, building, design, human factors, incident reports, and lessons learned from explosives manufacturers. Operations in explosives manufacturing plants are separated by adequate intra-plant distances to reduce the risk of propagation. Unrelated chemical or industrial operations or facilities are separated from explosives facilities using quantity distance guidelines. Facilities are designed to reduce secondary fragmentation that could result in the propagation of explosions

4. **Operating Procedures:** Operating procedures include not only the steps for normal operations, but for upset conditions, temporary operations, start-up, and shutdown. Very important safety information must also be included in operating procedures. Such information includes basic hazards of exceeding operational limits, appropriate response to upset conditions, safety and health information, and emergency operations. The procedures need to be up to date and reliable. They are also a critical element in training of personnel.
5. **Training:** Training is required for all employees new to a process before they become involved in that process. Training requirements extend beyond operating personnel to anyone involved in the process. This would normally include at least maintenance personnel and, possibly, contractors. The training must include the hazards of the chemicals and process and what is necessary to protect themselves, their fellow employees, and their surrounding communities. Training should be both written/classroom and hands-on. Employers must evaluate the effectiveness of training and make adjustments to content and frequency of training based on those evaluations. Explosives training and certification programs for workers and line managers provide and require demonstration of an understanding of explosives safety principles and job-specific knowledge.
6. **Contractors:** Employers using contractors need to ensure that use of those contractors will not jeopardize the safety of operations. This starts with the selection process, where the employer needs to evaluate the safety performance and capabilities of potential contractors. Once selected, the employer must make sure that contractor employees have the appropriate skills and training to perform their work safely. The employer must also provide contractors with sufficient information/training to perform their jobs safely. Ongoing, the employer should keep a log of contractor injuries and illnesses (in addition to its own employees) and periodically evaluate the safety performance of its contractors. The contractors themselves also have various requirements, including ensuring that all of their employees are appropriately trained or informed to perform all of their responsibilities.
7. **Pre-startup Safety Review (PSSR):** The Pre-Startup Safety Review is done before startup of a new operation or startup following a change in the process (see Management of Change, below). It is a means for ensuring that all essential action items and recommendations from the PHA have been completed prior to beginning operations. It is also the point at which the design parameters and standards used for construction are verified. If training or modifications to PSI are necessary, completion of these items is also verified during the PSSR. Startup should not be allowed to occur until all safety-critical PSSR items have been completed.
8. **Mechanical Integrity (MI):** Employers are required to have a written program to ensure the integrity of processes and equipment. Aspects include listing applicable equipment,

training of maintenance personnel, inspection and testing, and maintenance of such systems as controls, vessels, piping, safety systems, and emergency systems.

Development and modifications to the mechanical integrity program should be made based on operational experience, relevant codes, and industry standards.

9. **Hot Work Permit:** Hot work permits must be issued for any work to be performed on, or near, a PSM-covered process. While the OSHA standard specifically lists Hot Work, permits should be developed for any non-routine work to be performed in or around PSM covered processes. In addition to hot work, this could include line breaking, lock-out/tag-out, confined space entry, etc. Again, while the standard is titled “permit”, it really means an entire procedure covering all hazards of the work to be performed.
10. **Management of Change (MOC):** “Change” includes anything that would require a change in Process Safety Information. This includes changes to equipment, processes, and instrumentation. A proper MOC system requires that any change be evaluated prior to its implementation. The level of evaluation can depend on the degree of change and its criticality to the safety of the operation. In addition to the evaluation and approval of a change, MOC requires that suitable training be conducted (if necessary) and the relevant PSI be updated.
11. **Accident Investigations:** Incident Investigation is required for any incident that did, or could have, resulted in a release of a PSM-covered chemical. There are very specific requirements for the timing of an investigation, the makeup of the investigation team, the resulting report, and the use/dissemination of the information obtained. If done properly, it is one of the primary tools for learning from the operation of a process. It should truly determine the root cause of an incident, not merely find someone or something to blame.
12. **Emergency Planning and Response:** Employers are required to develop and implement an emergency action plan for the entire plant, not just the process(es) covered by PSM. It needs to address the actions to be taken in response to the release of any PSM-covered chemical. The plan needs to be comprehensive, including notification to emergency responders, operational responses such as shutdown, and precautions to protect other employees and the public. There is a good probability that requirements for emergency response are also covered by other regulatory standards.
13. **Compliance Audits:** Per OSHA, compliance audits must be conducted at least once every three years. The purpose of the audits is to determine whether the practices and procedures developed under the provisions of the PSM standard are being followed and are effective. The auditor(s) must be knowledgeable in PSM and should be impartial to the facility being audited. According to OSHA, selection of appropriate auditors is “critical to the success of the process.” An audit report must be developed and the

employer must promptly respond to each of the findings. Once deficiencies are corrected, the corrective action must also be documented.

14. Trade Secrets: The trade secrets provision of PSM requires that the employer provide all information necessary to comply with PSM to all persons who need it. This does not preclude the employer from taking steps necessary to safeguard the integrity of any information disclosed. It merely prohibits the employer from using trade secrets as an excuse not to provide information to either employees or contractors.

As OSHA works toward annual audits of all federal facilities, installations must develop the cross-walk between OSHA and Army functions and package their programs to satisfy both oversight agencies. There are very few installations that do not perform one of the ammunition and explosives tasks defined in the OSHA letters of interpretations. Ammunition Surveillance Workshops disassemble and assemble ammunition and explosives items daily as a part of their routine duties. Installations who have obtained or in pursuit of OSHA Voluntary Protection Program status must comply with the PSM standard and include it in their annual assessment. Be proactive and show OSHA how you conform to the PSM standard using existing Army and DOD requirements before they make you show how you conform to theirs.

PROCESS SAFETY MANAGEMENT (PSM)	
ELEMENT/REQUIREMENTS	MILITARY/ARMY STANDARDS
Employee Participation Employers are required to have a written plan outlining their employee participation. Employee participation should begin at the inception of PSM implementation. Such participation not only improves employee commitment to PSM, but a facility will end up with a much more viable implementation process. The involvement should include employees at all levels of the organization, from field operators, up through supervision, to operations management. The participation should extend to every element of PSM. NOTE: The safety staff should be a resource for PSM, not the ones in charge of the program.	-AR 385-10, Chapter 16-6-a (Voluntary Protection Program)
Process Safety Information (PSI) Occupational Safety & Health Administration (OSHA) states that PSI is "Complete and accurate written information concerning process chemicals, process technology, and process equipment." It is the information necessary for implementation of all other aspects of PSM. Complete information on every chemical involved in the process, including intermediates, is required. Process technology includes not only Process Flow Diagrams (PFDs) and Piping & Instrumentation Diagrams (P&IDs), but operating and storage conditions as well as operating procedures (see below) and operating history (for existing processes). Process equipment information should include the underlying codes and standards relied upon, in addition to information about the specific equipment used in the process.	-ER 385-1-40, Section 4-4 (Responsibilities) -ER 385-1-41, Section 4-d-4 (Responsibilities) -DA Pam 385-10, Chapter 14-2-b-2 (Hazard Communication Program) -AR 700-141, Appendix C-1 (Hazard Communication Program) -EM 385-1-1, Section 06.B.a (Hazardous or Toxic Agents)
Process Hazard Analyses (PHA) A PHA is a systematic evaluation of the hazards involved in the process. PHAs are required for initiation of a process and at least once every five years after that. The PHA team should be multi-disciplinary, including maintenance, operations, and engineering. There are a variety of methods that can be used to conduct a PHA. The method selected will depend on the maturity of the process and operational experience, in addition to process size and complexity. The facilitator of the PHA must be trained in the methodology being used. For proper conduct of a PHA, the PSI must be as complete as possible.	-DA Pam 385-16, Chapter 3-7 (Health Hazards) -DA Pam 385-16, Appendix D (Preliminary Hazard List/Analysis) -DA Pam 385-10, Chapter 8-3-d-1-6 (Standards) -AR 385-10, Chapter 1-11 (Existing Documentation and Programs) -EM 385-1-1, Section 1.c (Safety and Health Requirements) -AR 385-64, Chapter 7—3-a-2 (Requests for Waivers, Exemptions, Certificates of Compelling Reason) -AR 385-64, Chapter 5-2 (Hazard Classifications) -DA Pam 385-64, Chapter 2-1 (Hazard Analysis and Risk Assessment) -DA Pam 385-64, Chapter 17-6 (New Demilitarization Technologies) -DA Pam 385-64, Chapter 1-5 (Policy on Existing Explosive Facilities)
Operating Procedures Operating procedures include not only the steps for normal operations, but for upset conditions, temporary operations, start-up, and shutdown. Very important safety information must also be included in operating procedures.	-DA Pam 385-10, Chapter 9 (Safe Operating Procedures for Hazardous Operations) -AR 385-10, Chapter 18-5 (Standing

PROCESS SAFETY MANAGEMENT (PSM)	
ELEMENT/REQUIREMENTS	MILITARY/ARMY STANDARDS
Such information includes basic hazards of exceeding operational limits, appropriate response to upset conditions, safety and health information, and emergency operations. The procedures need to be up to date and reliable. They are also a critical element in training of personnel.	Operating Procedures) -AR 385-16, Chapter 4-1-14 (Responsibilities) -EM 385-1-1 (throughout Manual listed) -DA Pam 385-64, Chapter 3-24 (Emergency Planning) -DA Pam 385-64, Chapter 18-2-d-4 (Safety Requirements)
Training	
Training is required for all employees new to a process before they become involved in that process. Training requirements extend beyond operating personnel to anyone involved in the process. This would normally include at least maintenance personnel and, possibly, contractors. The training must include the hazards of the chemicals and process and what is necessary to protect themselves, their fellow employees, and their surrounding communities. Training should be both written/classroom and hands-on. Employers must evaluate the effectiveness of training and make adjustments to content and frequency of training based on those evaluations.	-DA Pam 385-16, Chapter 2-15-f-2,3,4 (System Development and Demonstration) -DA Pam 385-10, Chapter 7 (Safety Training Requirements) -DA Pam 385-10, Chapter 11-10 (Emergency Response for Conventional Munitions and Explosives-Training) -AR 385-10, Chapter 10 (Training Requirements) -AR 385-16, Chapter 4-g-3-a-2 (Responsibilities) -EM 385-1-1, Section 01.B (Indoctrination and Training) -AR 385-64, Chapter 1-4-c-7 (Responsibilities) -AR 385-64, Chapter 1-4-i-11&12 (Responsibilities) -DA Pam 385-64, Chapter 3-3 (Training) -DA Pam 385-64, Chapter 14-11 (General Training Requirements for Training Operations)
Contractors	
Employers using contractors need to ensure that use of those contractors will not jeopardize the safety of operations. This starts with the selection process, where the employer needs to evaluate the safety performance and capabilities of potential contractors. Once selected, the employer must make sure that contractor employees have the appropriate skills and training to perform their work safely. The employer must also provide contractors with sufficient information/training to perform their jobs safely. Ongoing, the employer should keep a log of contractor injuries and illnesses (in addition to its own employees) and periodically evaluate the safety performance of its contractors. The contractors themselves also have various requirements, including ensuring that all of their employees are appropriately trained or informed to perform all of their responsibilities.	-DA Pam 385-16, Chapter 7-2 (Contractor Selection) -AR 385-10, Chapter 4 (Contracting Safety) -AR 385-16, Chapter 4-h-3 (Responsibilities) -EM 385-1-1, Appendix A (Minimum Basic Outline for Accident Prevention Plans) -AR 385-64, Chapter 4 (Contractor Safety Requirements for Ammunition and Explosives) -DA Pam 385-64, Chapter 4-1-h (Hazard Classification and Compatibility Group) -DA Pam 385-64, Chapter J-1-b-7 (Explosives Safety Programs)
Pre-Start-up Safety Review (PSSR)	
The Pre-Startup Safety Review is done before startup of a new operation or	-DA Pam 385-16, Chapter 2-15-b & c (System Development and Demonstration)

PROCESS SAFETY MANAGEMENT (PSM)	
ELEMENT/REQUIREMENTS	MILITARY/ARMY STANDARDS
startup following a change in the process (see Management of Change, below). It is a means for ensuring that all essential action items and recommendations from the PHA have been completed prior to beginning operations. It is also the point at which the design parameters and standards used for construction are verified. If training or modifications to PSI are necessary, completion of these items is also verified during the PSSR. Startup should not be allowed to occur until all safety-critical PSSR items have been completed.	-AR 385-10, Chapter 5-6 (Explosives Safety Site Plan) -AR 385-16, Chapter 4-a-3 (Responsibilities) - AR385-16, Chapter 5-g (Policy) -AR 385-64, Chapter 7-7 (Reviews and Renewals) -DA Pam 385-64, Chapter 8-3 (Review and Approval of Explosives Safety Site Plan) -DA Pam 385-64, Chapter 17-3-a (Safety Precautions)
Mechanical Integrity	-DA Pam 385-16, Chapter 7-4-5-e (System Safety Program Plan)
Employers are required to have a written program to ensure the integrity of processes and equipment. Aspects include listing applicable equipment, training of maintenance personnel, inspection and testing, and maintenance of such systems as controls, vessels, piping, safety systems, and emergency systems. Development and modifications to the mechanical integrity program should be made based on operational experience, relevant codes, and industry standards.	-AR 385-10, Chapter 4-8 (System Design, Development, and Production) -AR 385-64, (U.S. Army Explosives Safety Program) <i>Information about this specific sub-element is scattered throughout the program and not in one specific area.</i> -DA Pam 385-64, (Ammunition and Explosives Safety Standards) <i>Information about this specific sub-element is scattered throughout the program and not in one specific area.</i>
Hot Work Permits	-DA Pam 385-10, Chapter14-4-i-3 (Confined Space)
Hot work permits must be issued for any work to be performed on, or near, a PSM-covered process. While the OSHA standard specifically lists Hot Work, permits should be developed for any non-routine work to be performed in or around PSM covered processes. In addition to hot work, this could include line breaking, lockout/tagout, confined space entry, etc. Again, while the standard is titled "permit", it really means an entire procedure covering all hazards of the work to be performed.	-EM 385-1-1, Section 01.C.01.c (Hot Substances) -DA Pam 385-64, Chapter 3-7-a (Fire Prevention Requirements)
Management of Change (MOC)	-DA Pam 385-16, Chapter 5-2-c (Facility System Safety Management)
"Change" includes anything that would require a change in Process Safety Information. This includes changes to equipment, processes, and instrumentation. A proper MOC system requires that any change be evaluated prior to its implementation. The level of evaluation can depend on the degree of change and its criticality to the safety of the operation. In addition to the evaluation and approval of a change, MOC requires that suitable training be conducted (if necessary) and the relevant PSI be updated.	-AR 385-10, Chapter 4-8 (System Design, Development, and Production) -AR 385-64, Chapter 6-2 (Site Plans)
Incident Investigations	-DA Pam 385-16, Chapter 3-6-d-6 (Human Factors Engineer)
Incident Investigation is required for any incident that did, or could have, resulted in a release of a PSM-covered chemical. There are very specific requirements for the timing of an investigation, the makeup of the	-DA Pam 385-10, Chapter 8-6-f (Department of Labor/Occupational Safety

PROCESS SAFETY MANAGEMENT (PSM)	
ELEMENT/REQUIREMENTS	MILITARY/ARMY STANDARDS
investigation team, the resulting report, and the use/dissemination of the information obtained. If done properly, it is one of the primary tools for learning from the operation of a process. It should truly determine the root cause of an incident, not merely find someone or something to blame.	and Health Administration Inspections -DA Pam 385-10, Chapter 11-8 (Accident Investigation) -AR 385-10, Chapter 3 (Incident Investigation and Accident Reporting) -EM 385-1-1, Section 8 (Accident Reporting) -AR 385-64, Chapter 3-6 (Reports of Accidents and Investigations) -DA Pam 385-64, Chapter K-3 (Investigation Reports) -DA Pam 385-64, Chapter K-4 (Chemical Agent Mishaps)
Emergency Planning and Response	
Employers are required to develop and implement an emergency action plan for the entire plant, not just the process(es) covered by PSM. It needs to address the actions to be taken in response to the release of any PSM-covered chemical. The plan needs to be comprehensive, including notification to emergency responders, operational responses such as shutdown, and precautions to protect other employees and the public. There is a good probability that requirements for emergency response are also covered by other regulatory standards.	-DA Pam 385-16, Chapter 6-9-a (Facility/Project Operation and Maintenance) -DA Pam 385-10, Chapter 10 (Emergency Planning) -DA Pam 385-10, Chapter 11 (Emergency Response for Conventional Munitions and Explosives) -AR 385-10, Chapter 19 (Emergency Planning and Response) -EM 385-1-1, Section 01.E (Emergency Planning) -DA Pam 385-64, Chapter 3-24 (Emergency Planning)
Compliance Audits	
Per OSHA, compliance audits must be conducted at least once every three years. The purpose of the audits is to determine whether the practices and procedures developed under the provisions of the PSM standard are being followed and are effective. The auditor(s) must be knowledgeable in PSM and should be impartial to the facility being audited. According to OSHA, selection of appropriate auditors is "critical to the success of the process." An audit report must be developed and the employer must promptly respond to each of the findings. Once deficiencies are corrected, the corrective action must also be documented.	-DA Pam 385-10, Chapter 8-2-f (Workplace Inspection and Safety and Occupational Health Programs/Assessments/Inspections/Reporting) -AR 385-10, Chapter 2-11 (Program Audits) -EM 385-1-1, Section 01.A.12 (Inspections) -EM 385-1-1, Section 16.B.03.b.5 (Personnel Qualifications)
Trade Secrets	
The trade secrets provision of PSM requires that the employer provide all information necessary to comply with PSM to all persons who need it. This does not preclude the employer from taking steps necessary to safeguard the integrity of any information disclosed. It merely prohibits the employer from using trade secrets as an excuse not to provide information to either employees or contractors.	<i>Could not find any information on this matter in any of the programs that were read.</i>



DDESB Seminar

Process Safety Management at US Government Explosives Manufacturing Facilities

**James Hammonds, CSP
McAlester Army Ammunition Plant**



Process Safety Management



The Occupational Safety and Health Administration (OSHA) Process Safety Management (PSM) standard, 29 CFR 1910.119, is in place to prevent or minimize the consequences of a release of toxic, reactive, flammable, or explosive chemicals.

Application

- Processes involving chemicals at or above the specified threshold (e.g. Chlorine – 1000 pounds)
- Process which involves flammable liquid or gas on site in one location in a quantity of 10000 pounds or more.

Ready – Reliable – Lethal





Why us?



OSHA Letter of Interpretation 02/04/1998

Applicability of PSM standard to explosive and pyrotechnic manufacturing.

“OSHA considers the manufacturing of explosives to mean: mixing, blending, extruding, synthesizing, assembling, disassembling, and other activities involved in the making of a chemical compound, mixture, or device which is intended to explode.”

Ready - Reliable - Lethal





Elements of PSM



1. Employee Participation
2. Process Safety Information
3. Process Hazard Analysis
4. Operating Procedures
5. Training
6. Contractors
7. Pre-Startup Safety Review
8. Mechanical Integrity
9. Hot Work Permit
10. Management of Change
11. Accident Investigations
12. Emergency Planning and Response
13. Compliance Audits
14. Trade Secrets



Ready - Reliable - Lethal





Crosswalk



We already do what OSHA is asking us to do

Employee Participation (Lean Six Sigma, Voluntary Protection Programs, ISO, EMS, QMS)

Training (Needs to be documented and quantifiable)

Accident Investigations (Reports on hand, hazard abatement plans, corrective actions, lessons learned)

Ready - Reliable - Lethal





Crosswalk



Management of Change

- Evaluates a change prior to implementation
- Changes to equipment, process material, operations, and instrumentation

Standard Operating Procedures

Level 2 and 3 ISO Procedures

Drawings and Diagrams

Documentation is the key!

Ready - Reliable - Lethal





Crosswalk



Mechanical Integrity

Written Plan to ensure integrity of processes and equipment

Forklift Load Test
Lightning Protection System
(Visual and Electrical Checks)
Load Testing of Slings
Shoe Testers
Calibration of Equipment
Ground Checks

Pressure Relief Valves
Pressure Vessel Certifications
Piping and Instrumentation
Gauges and Dials
Pollution Abatement
Vehicle Utilization Logs

You have items that require mechanical integrity checks –
don't get hung up on chemical processes.

Ready – Reliable – Lethal





Crosswalk



Operating Procedures and Pre-Startup Safety Reviews

Operating procedures must include not only the steps for normal operations, but for non-normal, temporary, emergency, stops, and starts.

Up-to-date – affected by changes - MOC

Used for training – identifies hazards

Ready – Reliable – Lethal





Crosswalk



Emergency Planning and Response

Developed for the entire plant – not the process

Actions to be taken – employees trained

Comprehensive – includes public responders

They will check!

Ready - Reliable - Lethal





PSM is for Everyone



Almost every DOD installation performs an assembly and/or disassembly operation on ammunition and explosives

Participation in VPP requires participation in PSM

We already conform to the PSM standard using our Service and DOD standards

Ready - Reliable - Lethal





Questions



Be Proactive

Show OSHA how you conform using our standards

Ready - Reliable - Lethal

