Joint Service Safety Testing Study
Phase II Final Presentation

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Agenda

- Study Overview
- Work Plan
- Results
- Summary and Conclusions
- Next Steps

Agenda

- **Study Overview**
  - **Hypothesis**
  - **Paradigm Shift in Thinking**
  - **Why Develop Service-Wide Safety Testing Requirements?**
- Work Plan
- Results
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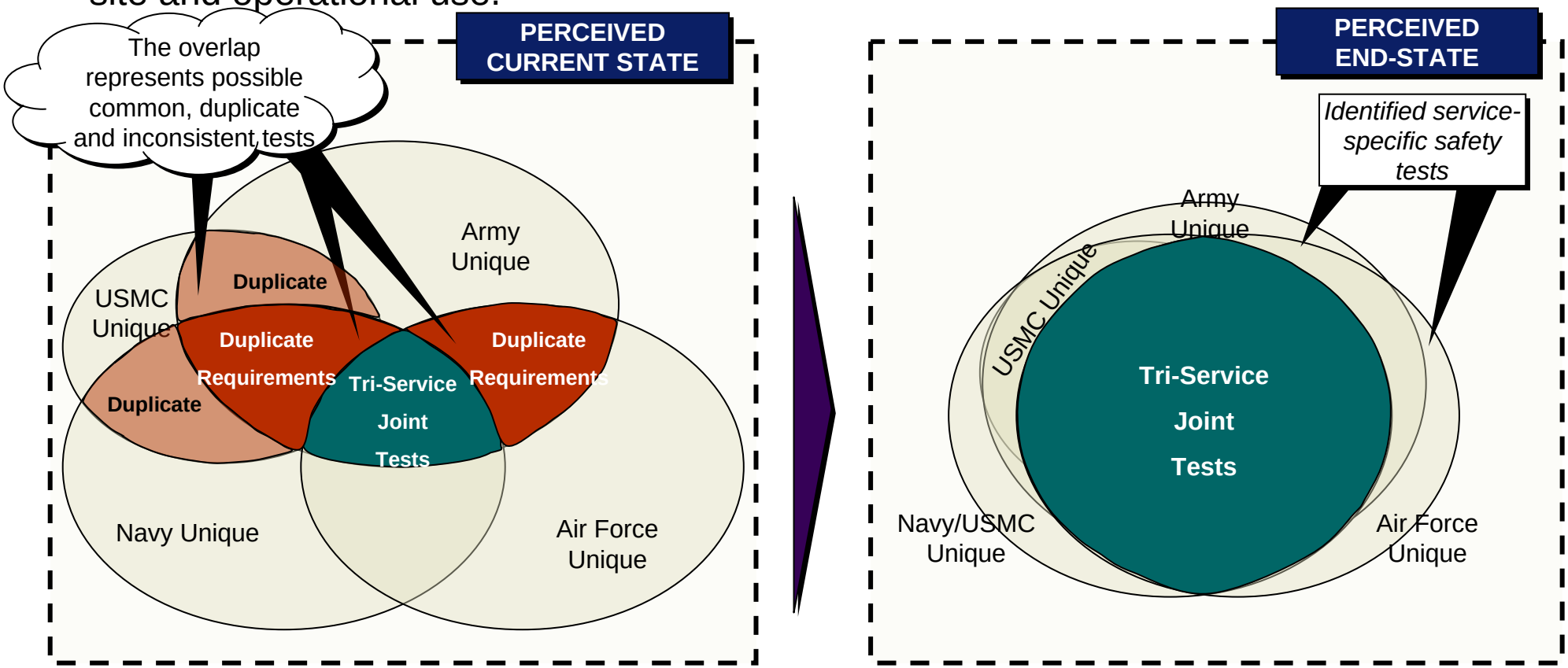
Hypothesis Statement – PROVEN in Phase I

- Given the increasingly joint nature of American military deployment, Services are increasingly hindered and delayed by the current need to require duplicate and inconsistent safety tests in order to qualify for military transportation to a deployed site and operational use.



The goal…

Modes / Joint Warfighting Environments

- ❑ Handling
  - ❑ Forklift
  - ❑ Handcart
  - ❑ Crane
  - ❑ Man Carried
  - ❑ Underway Replenishment (VERTREP, CONREP)
- ❑ Storage
  - ❑ Protected/Environmentally-Controlled Land Based Magazines
  - ❑ Unprotected/Open Land Based Magazines
- ❑ Transportation
  - ❑ Wheeled Land Vehicles
  - ❑ Rail
  - ❑ Fixed Wing Aircraft
  - ❑ Rotary Wing Aircraft
  - ❑ Navy and Army Vessels
  - ❑ Prepo/Merchant Marine/Commercial
  - ❑ Undersea
- ❑ Employment
  - ❑ Tracked Land Vehicles
  - ❑ Wheeled Land Vehicles
  - ❑ Fixed Wing Aircraft
  - ❑ Rotary Wing Aircraft
  - ❑ Operational Navy Vessels
  - ❑ Undersea
  - ❑ Man Carried

Drives System Independent Tests

System Independent and Dependent Tests

1. **Joint** Shock Test
2. **Joint** Vibration Test
3. **Joint** Temperature Test
4. **Joint** EEE Test
5. …

Drives System Dependent Tests

- ❑ Generic Subsystem
- ❑ System-Specific
- ❑ Ammunition
- ❑ Cannon
- ❑ Electric Initiators
- ❑ Explosives
- ❑ Fuze
- ❑ Power Sources
- ❑ Rocket Motors
- ❑ Software
- ❑ Submunitions
- ❑ Unmanned Targets

Safety test results will be detailed in the CPD.

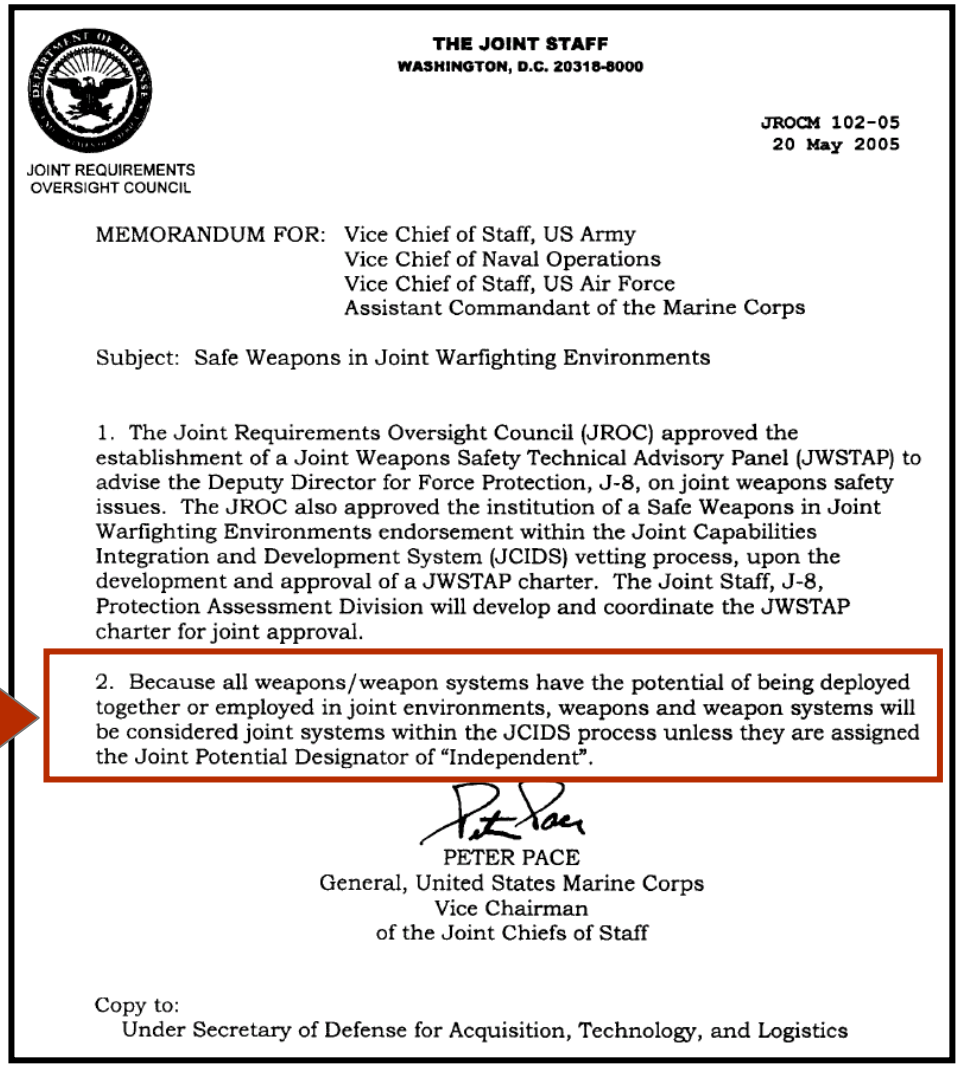
Phase II focused on identifying the system independent tests for each mode. Modes will be defined in the ICD and CDD. The ICD and CDD will reference this report for specific safety tests. Future work consists of defining system-dependent safety tests.

Paradigm Shift in Thinking

- System Safety Community
  - Safety engineers and Service safety boards historically tailored tests to a specific system under development
  - Safety boards previously addressed and enforced only Service-specific safety tests rather than a set of common tests for all Services
  - Safety tests identified in this report are specifically defined by the joint warfighting environment, whereas these tests were previously loosely defined in the test documents.
- JWSTAP Members
  - Membership is primarily leaders for each of the Service's safety review boards
  - Tendency to view this concept from the acquisition perspective not JCIDS perspective
  - Acquisition perspective causes members to become overly concerned about the JWSTAP role duplicating the well established roles of their Service's safety boards
    - Enforcement of weapon/explosive system safety requirements is a Service safety board role not reviewing and writing capability-based safety requirements for JCIDS documents
    - Deviations from an established set of safety testing requirements is also clearly a JWSTAP role

Why Develop Service-Wide Safety Testing Standards?

- Moving forward, all weapons/ weapon systems will be developed as **joint systems** vis a vis JCIDS
- A joint approach promotes consistency and will get systems fielded sooner. Reduces (1) the overall number of tests, (2) time to fielding and (3) cost.



THE JOINT STAFF
WASHINGTON, D.C. 20318-8000

JOINT REQUIREMENTS OVERSIGHT COUNCIL

JROCM 102-05
20 May 2005

MEMORANDUM FOR: Vice Chief of Staff, US Army
Vice Chief of Naval Operations
Vice Chief of Staff, US Air Force
Assistant Commandant of the Marine Corps

Subject: Safe Weapons in Joint Warfighting Environments

1. The Joint Requirements Oversight Council (JROC) approved the establishment of a Joint Weapons Safety Technical Advisory Panel (JWSTAP) to advise the Deputy Director for Force Protection, J-8, on joint weapons safety issues. The JROC also approved the institution of a Safe Weapons in Joint Warfighting Environments endorsement within the Joint Capabilities Integration and Development System (JCIDS) vetting process, upon the development and approval of a JWSTAP charter. The Joint Staff, J-8, Protection Assessment Division will develop and coordinate the JWSTAP charter for joint approval.

2. Because all weapons/weapon systems have the potential of being deployed together or employed in joint environments, weapons and weapon systems will be considered joint systems within the JCIDS process unless they are assigned the Joint Potential Designator of "Independent".

PETER PACE
General, United States Marine Corps
Vice Chairman
of the Joint Chiefs of Staff

Copy to:
Under Secretary of Defense for Acquisition, Technology, and Logistics

Agenda

- Study Overview
- **Work Plan**
  - **Approach**
  - **Scope and Assumptions**
  - **Joint Warfighting Modes**
  - **Key Terms**
- Results
- Summary and Conclusions
- Next Steps

Study Approach

- Identify Stakeholders
  - OSD and MARCORSYSCOM
  - Program Managers
  - Test SMEs
- Collect, Review and Analyze Test Data
  - Identify and Collect all Safety Testing Documents
  - Define and Establish Modes and Test Classifications for the Weapon/Explosive System
  - Review and Categorize each Safety Test
    - Mode
    - Test Classification
    - System-Independent vs. System-Dependent
  - Store all documentation obtained or created as part of this effort that is accessible to the Project Officer and other authorized users
- Identify Common, Duplicate, Inconsistent and Singular Safety Tests
  - Conduct more detailed analyses
  - Interview stakeholders
  - Develop web-based surveys to collect test information

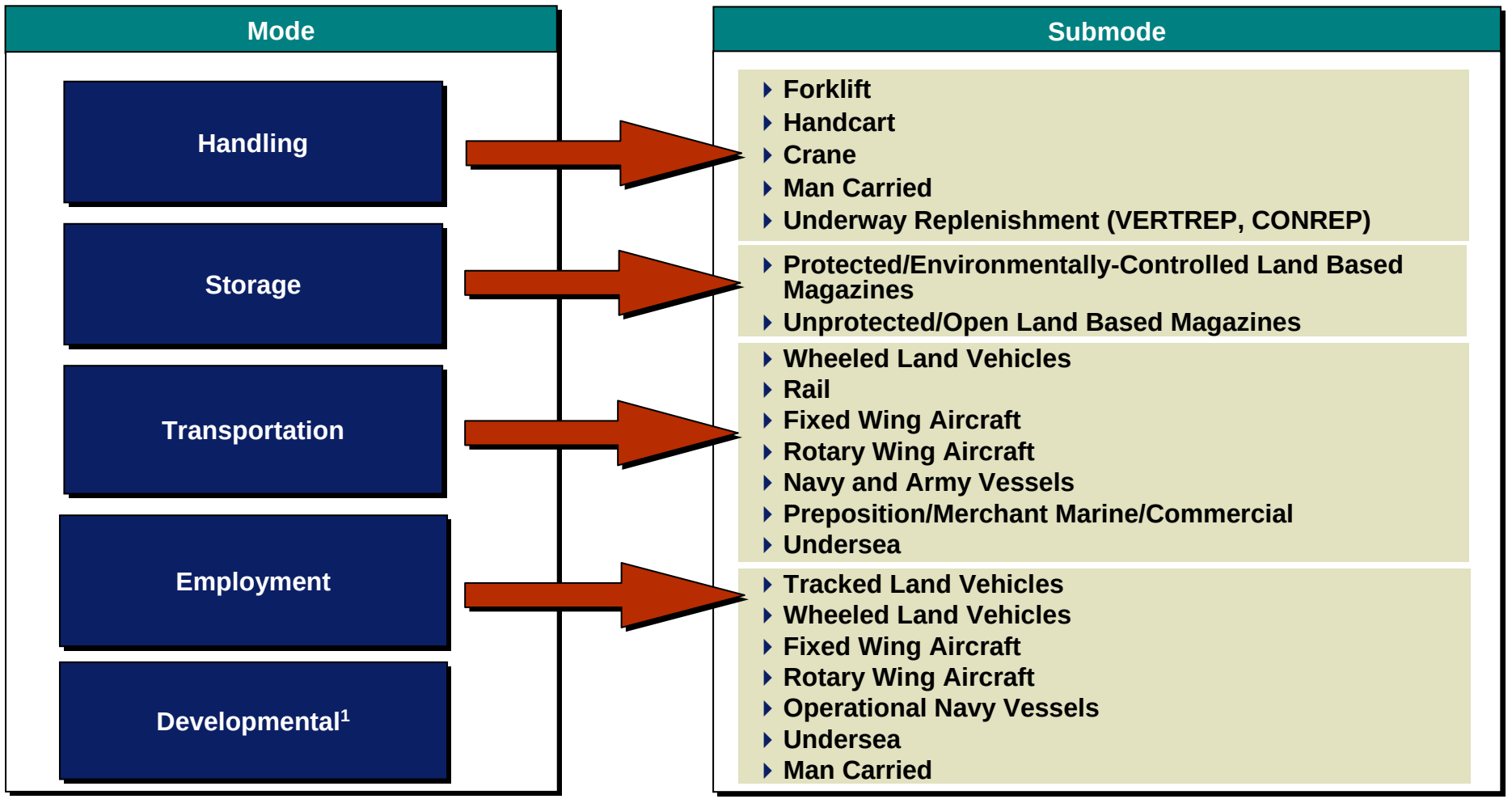
Study Approach

- Conduct SME workshops to obtain consensus on eliminating duplicate and inconsistent tests and unjustified singular tests
  - EEE Tests
  - Short and Long Drop Tests
- Prepare a report for the JWSTAP
  - Identify a common set of system-independent tests by joint warfighting mode
  - Provide a summary of the study, conclusions and recommendations to the JWSTAP

Study Scope and Assumptions (Phase II)

- Scope
  - Weapon and weapon container safety test procedures and requirements in all safety MIL-STDs, MIL-SPECs, STANAGs, ITOPs, TOPs and AOPs
  - Only standards that are actively being used
  - Analysis of system-independent tests defined by established modes
  - Tests that simulated an environment in one of the established modes
  - Maintenance and updates to the web-based repository of all the data collected
- Out of Scope
  - Commercial standards, developmental tests, IM tests, 49 CFR tests, and AECTPs
  - Analysis of system-dependent tests (unless used as a system-independent test).
- Assumptions
  - All proposed required tests in this study are tests required to validate safety tests in a joint warfighting environment
  - All weapons transported by ship are in the transportation mode; not the storage mode
  - Assignment of test classifications, based on test documentation, is accurate

Joint Warfighting Modes



[1]Tests assigned to the Developmental Mode define the characteristics of the item; are not typically tested in a shipping or operational configuration; and do not simulate a mechanical, climatic or electrical environment.

Key Terms

- System Independent Tests – system-level tests performed regardless of the weapon system or configuration (e.g., vibration, temperature, drop).
- System Dependent Tests - tests driven by specific components of a system
- Test Classification - grouping of specific types of external stimuli (simulating a mechanical, climatic or electrical environment) that the AUR/component is exposed to during a mode (i.e., temperature, shock, or vibration).
- Safety Test Categories
  - Common - More than one military Service uses the same safety test, test parameters, and test parameter values given the same AUR/Component, mode, and test classification
  - Duplicate - More than one Service uses different safety tests for the same AUR/Component, mode, and test classification. Different safety tests may be driven by a lack of coordination, knowledge, or focus on joint requirements; higher levels of rigor applied to one test over another; programmatic legacy; and unique mission environment
  - Inconsistent - More than one Service uses the same safety test and test parameters, and at least one of the test parameter values is different given the same AUR/Component, mode, and test classification
  - Singular - Only one Service uses the safety test for the same AUR/Component and test classification and either the same or different mode.

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- Study Overview
- Work Plan
- **Results**
  - **SME Workshop Summary**
  - **Test Documents and Test Classifications**
  - **Safety Tests included in Scope of Study**
  - **Recommended Tests by Joint Warfighting Mode**
  - **Proposed Changes to JCIDS documents**
- Summary and Conclusions
- Next Steps

SME Workshop Summary

- Purpose: reach consensus on a common set of safety tests to include test requirements, test procedures and test passing criteria
- Great difficulty identifying SMEs
- Three SME Workshops held
  - EEE: Nov 7-9, 2007
  - Long and Short Drops #1: Jan 22-25, 2008
  - Long and Short Drops #2: March 25-26, 2008
- EEE Workshop Successful
  - Reached Service-wide test procedure clarification and consensus for HERO, Personnel-borne ESD, Helicopter-borne ESD, Lightning Effects
  - Identified the need to update ESD test standards (MIL-STD-464, MIL-STD-331, MIL-HDBK-240).
  - Agreed that changes to the common standard require a deviation coordinated through the Joint Weapon Safety Technical Advisory Panel (JWSTAP).
- Long and Short Drop Workshops
  - Reached partial agreement on long drop test; short drop tests excluded from this phase

SME Workshop Summary – Success Factors for Workshops

- Have all Service SMEs represented including various organizations within the same Service
- Limit attendance to SMEs only
- Divorce SMEs from specific tests as much as possible; focus on joint warfighting environments
- Drive discussion to technical rationale as much as possible
  - No clear technical basis why some Services use specific tests and test parameters
  - With no clear technical basis for the conduct of the test, there is no clear path in choosing one test or test parameter over another
- Fundamental differences among the Services for test requirements make agreements more difficult to obtain
  - Army develops ITOPs that are primarily system level and commodity specific
  - Navy and Air Force use MIL-STDs that are more general in nature and are developed for both the system and subsystem/component level
- Clearly establish terms since terms vary between the Services
  - Safety test vs. performance test vs. development
  - Safe to use/fire, safe to operate, safe to dispose

Tests Documents and Test Classifications System Independent Only

- 10 Test Documents – Reduced from 86 Documents
  - ITOP 4-2-504(2), Safety Testing of Field Artillery Ammunition
  - ITOP 4-2-601, Drop Test for Munitions
  - ITOP 4-2-602, Rough Handling Tests
  - MIL-STD-331, Fuze and Fuze Components, Environmental, and Performance Tests
  - MIL-STD-464, Electromagnetic Environmental Effects Requirements for Systems
  - MIL-STD-648, Design Criteria for Specialized Shipping Containers
  - MIL-STD-810, Environmental Engineering Considerations
  - MIL-STD-2105C, Hazard Assessment Tests for Non-Nuclear Munitions
  - MIL-S-901, Shock Tests, High Impact Shipboard Machinery Equipment, and Systems Reqmts
  - STANAG 4375, Safety Drop Munition Test Procedure
- 13 Test Classifications and 152 Tests – Reduced for 40 Test Classification and over 650 Tests
  - Contamination and Corrosion (16)
  - Shock (17)
  - EEE (12)
  - Short and Long Drops (33)
  - Icing (3)
  - High and Low Temperature (19)
  - Leak (Internal) (7)
  - Impact (8)
  - Temperature and Humidity (11)
  - Tiedown (1)
  - Vibration (17)
  - High and Low Pressure (4)
  - Lifting (4)

Analysis Results
Safety Tests Included in Scope of Study

Test Name	Test Number	Document	Comments
Electromagnetic Radiation Hazards*	5.8.3	MIL-STD-464	SI
ESD (Personnel Borne and Helicopter)	F1.2	MIL-STD-331	SD (fuze); MIL-STD-464 sections 5.7.1 and 5.7.3 refer to MIL-STD-331
Lightning	5.4	MIL-STD-464	SI
Incline-Impact	5.2.7 and Appendix L	MIL-STD-648	SI; primarily a packaging safety test
Pendulum Impact	5.2.7 and Appendix M	MIL-STD-648	SI; primarily a packaging safety test
Superimposed Load	5.7	MIL-STD-648	SI; primarily a packaging safety test
Pendulum	4.8.9	ITOP 4-2-504(2)	SD (tank ammunition); primarily a safety test
Low Pressure (Altitude)	Method 500.4	MIL-STD-810	SI; primarily a performance test with significant safety implications
3 Meter Drop	4.2	ITOP 4-2-601	SI
12 Meter Drop	8a	STANAG 4375	SI; workshop consensus was to use STANAG 4375
28-Day Temperature and Humidity	5.1.1	MIL-STD-2105C	SI; primarily a safety test
4-Day Temperature and Humidity	5.1.3	MIL-STD-2105C	SI; primarily a safety test
Hoisting Fitting and Tiedown Attachment Points	5.8	MIL-STD-648	SI; a packaging safety requirement; a test failure would result in a primary safety issue
Vibration	5.1.2	MIL-STD-2105C	The specific test methodology must be tailored to address the mode

Recommended Safety Tests by Joint Warfighting Mode

Handling	
Crane	STANAG 4375, Test 8a; MIL-STD-648, Test 5.8.3
Man Carried	MIL-STD-331, Test F1.2 (Personnel-borne ESD)
Vertrep	MIL-STD-331, Test F1.2 (Helicopter-borne ESD); STANAG 4375, Test 8a; MIL-STD-648, Test 5.8.3
Storage	
Protected/Environmentally-controlled Land Based Magazine	MIL-STD-2105C, Test 5.1.1; MIL-STD-2105C, Test 5.1.2; MIL-STD-2105C, Test 5.1.3; MIL-STD-648, Test 5.7
Unprotected/Open Land Based Magazine	MIL-STD-464, Test No. 5.8.3; MIL-STD-331, Test F1.2 (Lightning Strike); MIL-STD-2105C, Test 5.1.1; MIL-STD-2105C, Test 5.1.2; MIL-STD-2105C, Test 5.1.3
Transportation	
Wheeled Land Vehicle	MIL-STD-464, Test No. 5.8.3; MIL-STD-648, Test 5.11
Rail	MIL-STD-648, Test 5.2.7 & Appendix L (smaller items) OR Appendix M (larger items); MIL-STD-648, Test 5.11
Fixed Wing Aircraft (Transport)	MIL-STD-464, Test No. 5.8.3; MIL-STD-648, Test 5.8; MIL-STD-810, Method 500.4
Rotary Winged Aircraft	MIL-STD-464, Test No. 5.8.3; MIL-STD-331, Test F1.2 (Helicopter-borne ESD); MIL-STD-648, Test 5.8; MIL-STD-810, Method 500.4
Navy and Army Vessels	MIL-STD-464, Test No. 5.8.3; MIL-S-901, Test 3.1.2a/b/c; STANAG 4375, Test 8a; MIL-STD-648, Test 5.8
Prepo/Merchant Marine/Commercial	MIL-STD-648, Test 5.8; STANAG 4375, Test 8a
Undersea	ITOP 4-2-601, Test 4.2; MIL-STD-648, Test 5.8
Employment	
Tracked Land Vehicle	MIL-STD-464, Test No. 5.8.3; ITOP 4-2-601, Test 4.2; ITOP 4-2-504(2), Test 4.8.9
Wheeled Land Vehicle	MIL-STD-464, Test No. 5.8.3; ITOP 4-2-601, Test 4.2
Fixed Wing Aircraft	MIL-STD-464, Test No. 5.8.3; MIL-STD-331 (Lightning Strike), Test F1.2; MIL-STD-810, Method 500.4
Rotary Winged Aircraft	MIL-STD-464, Test No. 5.8.3; MIL-STD-331, Test F1.2 (Helicopter-borne ESD, Personnel-borne ESD and Lightning Strike); MIL-STD-810, Method 500.4
Operational Navy Vessel	MIL-STD-464, Test No. 5.8.3; MIL-S-901, Test 3.1.2a/b/c; STANAG 4375, Test 8a
Undersea	MIL-S-901, Test 3.1.2a/b/c; ITOP 4-2-601, Test 4.2
Man Carried	MIL-STD-331, Test F1.2 (Personnel-borne ESD)

Proposed Changes to JCID Document

- CJCSI 3170.01F Changes
  - (1) Enclosure C, paragraph 9, line 9:

    "…when the weapon is handled, stored, transported or used in joint…" to "…when the weapon is handled, stored, transported, or employed in joint…"
  - (3) Enclosure C, paragraph 9.2b, line 2:

    "…provide for safe operation, handling, storage, and transport integration…" to "…provide for safe weapon employment, handling, storage, and transport integration…"
- CJCSM 3170.01C Changes
  - (1) Appendix A, Enclosure F, paragraph 6e:

    "…to provide for safe weapon storage, handling, transportation or use…" to "…to provide for safe weapon storage, handling, transportation, or employment…"
  - (2) Appendix A, Enclosure E, paragraph 5a:

    a. Describe in general terms the operational environment, including joint operating environments, in which the capability must be exercised and the manner in which the capability will be employed. Summarize the organizational resources that provided threat support to capability development efforts. For safe weapons endorsement, specify the warfighting environments in accordance with Reference TBD.

Proposed Changes to JCID Document (cont'd)

- CJCSM 3170.01C Changes
  - (3) Appendix A, Enclosure F, paragraph 6e of CJCSM 3170.01C:

    e. For weapon programs, the required joint operating environment attributes and performance parameters must be addressed as the basis for the weapon safety endorsement. Identify, as specifically as possible, all projected requirements necessary to provide for safe weapon storage, handling, transportation, or employment by joint forces throughout the weapon lifecycle, to include required performance and descriptive, qualitative, or quantitative attributes. This shall include updating the warfighting environments in accordance with Reference TBD and the corresponding safety testing requirement in Table 2-1 of Reference TBD.

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Study Summary

- Study established a common set of safety tests aligned with common terminology for joint warfighting environments to be conducted on all joint Service weapon and explosive systems during development, thereby reducing program costs and time to fielding.
  - Identified 14 safety tests in 10 test classifications
- Phase I identified 86 test documents, 40 test classifications and over 650 tests. Phase II reduced analysis to 13 test classifications and 152 tests.
- These safety tests will be required if the JWSTAP incorporates the tests into their review of JCIDS documents.
- This report is the culmination of a year and a half long effort to align safety tests for joint warfighting environments.
- Varying degrees of success to obtain participant agreement at SME workshops of which tests and test parameters would be used by all Services for each warfighting environment were obtained from each workshop.

Study Conclusions

- Implementing the results of this study will expedite delivery of the weapon or explosive system quicker, at less cost, and will reduce the overall safety risk because systems will be designed to operate in joint warfighting environments rather than the traditional single Service environment.
- Satisfying the safety tests identified in this study alone does not mean that the system is safe; a proactive system safety program, IAW MIL-STD-882, and additional system-unique safety tests are also required during system development.
- This study has been conducted for the JWSTAP and will primarily benefit the PMs as they develop a weapon or explosives system.
- In order for the intent of this study to be fulfilled, the following JWSTAP actions are necessary:
  - Validate that the safety tests are properly aligned to each joint warfighting environment
  - Assist in implementation of the mode philosophy and the associated validation tests
  - Coordinate with J-8 to implement the recommended changes to CJCSI 3170.01F and CJCSM 3170.01C
  - Follow the recommendations in Section 6 when reviewing new capabilities in JCIDS documents
  - Establish a process for deviations from the required tests and future updates to this report.

Study Conclusions (cont'd)

- Paradigm Shift in Thinking - System Safety Community
  - Safety engineers and Service safety boards historically tailored tests to a specific system under development
  - Safety boards previously addressed and enforced only Service-specific safety tests rather than a set of common tests for all Services
  - Safety tests identified are specifically defined by the joint warfighting environment, whereas these tests were previously loosely defined in the test documents.
- Paradigm Shift in Thinking - JWSTAP Members
  - Membership is primarily leaders for each of the Service's safety review boards
  - Tendency to view this concept from the acquisition perspective not JCIDS perspective
  - Acquisition perspective causes members to become overly concerned about the JWSTAP role duplicating the well established roles of their Service's safety boards
    - Enforcement of weapon/explosive system safety requirements is a Service safety board role not reviewing and writing capability-based safety requirements for JCIDS documents
    - Deviations from an established set of safety testing requirements is also clearly a JWSTAP role

Study Conclusions (cont'd)

- Difficulties for Service-Wide Agreements
  - Fundamental differences in developing test requirements
  - With no clear technical basis for the conduct of the test, there is no clear path in choosing one test or test parameter over another
  - No clear definition of what is defined as a safety test vs. a performance test vs. a development test.
- Other Observations
  - There is an overall reluctance to use STANAGs even after the STANAG has been ratified by the U.S.
  - System dependent tests are used as system independent tests.
  - JWSTAP members have little involvement with or knowledge of the weapons test community.
  - Many active standards are not being used, e.g., the AECTPs and STANAGs.
  - Some of the workshops have identified other areas needing improvement that were not within the scope of this study. As a result, specific Service organizations have taken the initiative for these actions.

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Study Recommendations – Next Steps

- Support JWSTAP in implementing and maintaining follow-on efforts in this report to ensure the intent of this study has been fulfilled. These efforts include:
  - Validate that the safety tests are properly aligned to each joint warfighting environment and make changes as necessary
  - Assist in the implementation of the joint warfighting mode concept and the associated validation tests, including review of the JCIDS documents
  - Coordinate with J-8 to implement the recommended changes to CJCSI 3170.01F and CJCSM 3170.01C
  - Follow the recommendations in Section 6 when reviewing new capabilities in JCIDS documents.
  - Establish a process for deviations from the required tests and future updates to the list of tests aligned to each joint warfighting mode.
  - Socialize the joint warfighting mode process within the system safety community, including education and training at Service road shows, phone conversations, and email correspondence.

Study Recommendations – Next Steps (cont'd)

- Address and resolve outstanding areas as a result of the Phase II effort
  - Develop and obtain Service agreement for the terms "Safe and Operable," "Safe to Use/Fire," and "Safe to Dispose"
  - Determine whether to keep ITOP 4-2-601 (Test 4.2) within the standard set of safety tests
  - Determine whether the electromagnetic pulse test in MIL-STD-464 should be included as a required test
  - Host a workshop on the vibration test classification to determine specific tests for each mode
  - Conduct a detailed comparison of the test sequence and associated induced stress levels of the rough handling series in ITOP 4-2-602, STANAG 4375, and possibly ITOP 5-2-619. Host workshops to obtain consensus on a standard set of safety tests using one standard for all weapon and explosive systems. Little technical rationale exists within the Services as to why these test differences exist, though each Service is comfortable with their own historical test sequence.
  - Identify system-dependent tests and host applicable SME workshops. Initially, identifying which tests to conduct workshop reviews for will be based on analysis from the Microsoft Access database developed as part of the previous phases. Based on this analysis, a set of test classifications will be recommended to the JWSTAP for concurrence prior to hosting any workshops.

Study Recommendations – Next Steps (cont'd)

- Establish an OSD-staffed (full time) position reporting directly to the Director of Systems and Software Engineering as the Chair of the JWSTAP. The makeup of the existing JWSTAP members are the leaders of the Service's safety boards. The benefits of OSD leadership would be to maintain the vision of the JWSTAP charter with no conflict with Service safety boars agendas and to ensure continuity. This effort is currently a collateral duty for the Service's safety board; an increased work load at the Service level may reduce the effectiveness of the JWSTAP.
- Because this study has provided a wealth of information, recommendations outside of the specific goals of this study include:
  - Identify inconsistent and duplicate test requirements (not primarily safety specific) not currently addressed in this report
  - Recommend and implement a strategy for development of and changes to current STANAGs
  - Propose strategies to identify and analyze safety requirements for joint Service applications.