



*Department of the Navy
Naval Ordnance Safety & Security Activity
Indian Head, MD 20640-5035*

**Insensitive Munitions –
Evolving Technology to Meet
Emerging Threats**

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AGENDA

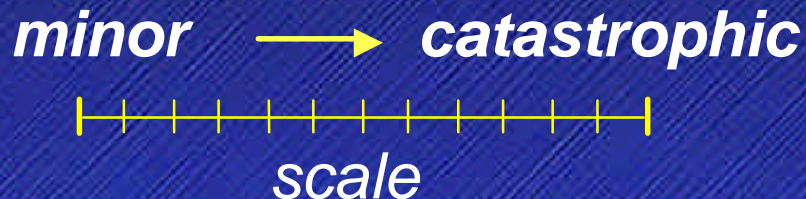
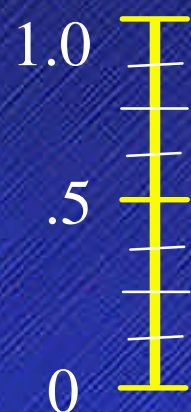
- ◆ **NOSSA's Mission**
- ◆ **Organization**
- ◆ **Insensitive Munitions**
- ◆ **Thrusts**

NOSSA's MISSION

**...TO ENHANCE NAVAL OPERATIONAL
READINESS, BY EFFECTIVELY IDENTIFYING
AND MANAGING RISKS THROUGHOUT THE LIFE
CYCLE OF AMMUNITION, WEAPONS &
EXPLOSIVES.**

EXPLOSIVES SAFETY PROGRAM RISK MANAGEMENT

Probability of Occurrence **X** Consequences of Mishap **>>** Acceptable Risk (Attitude)



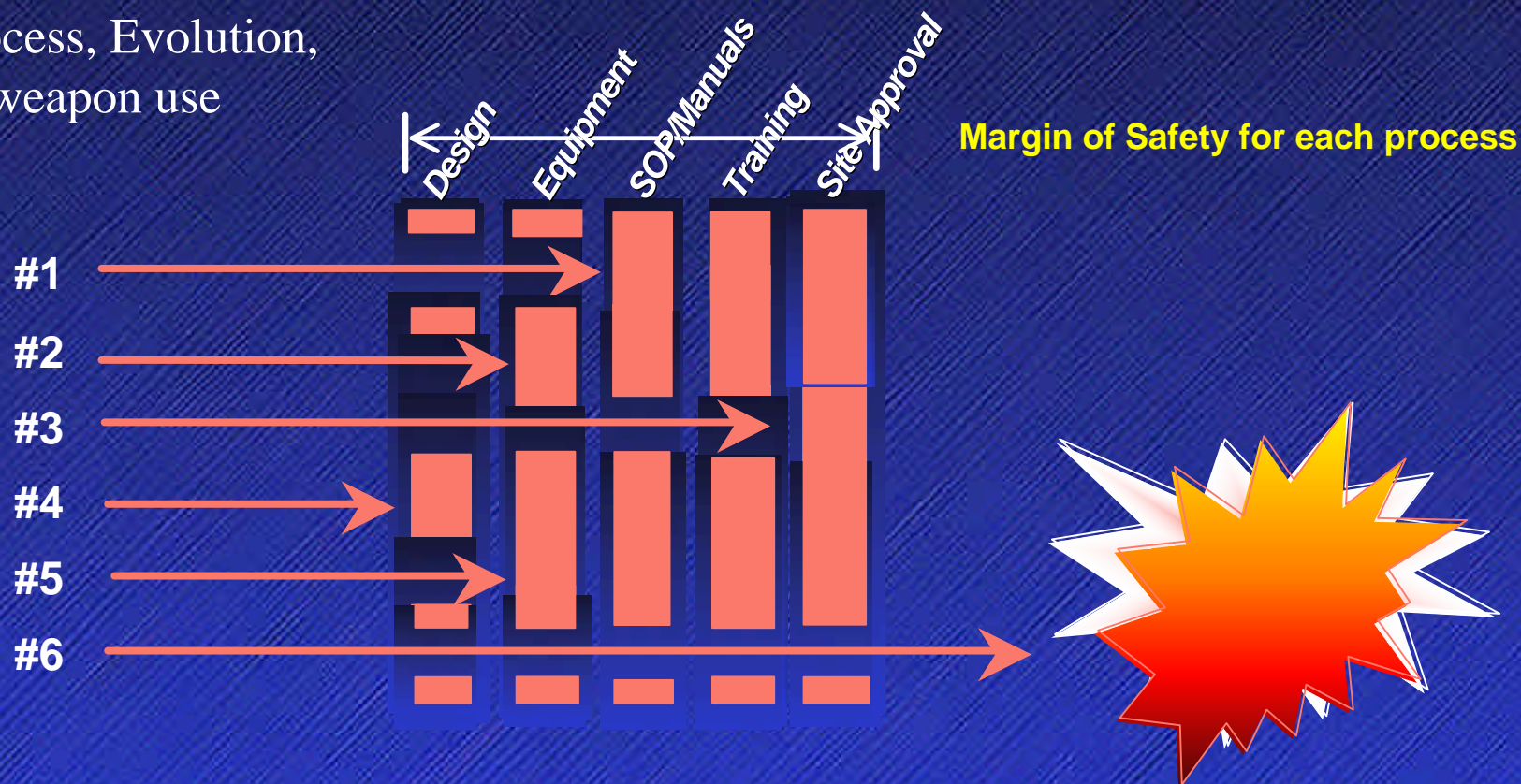
Varies Among Individuals

Goal: Mishap Prevention

RISK DIFFERS FOR EVERY PROCESS/EVOLUTION/WEAPON USE

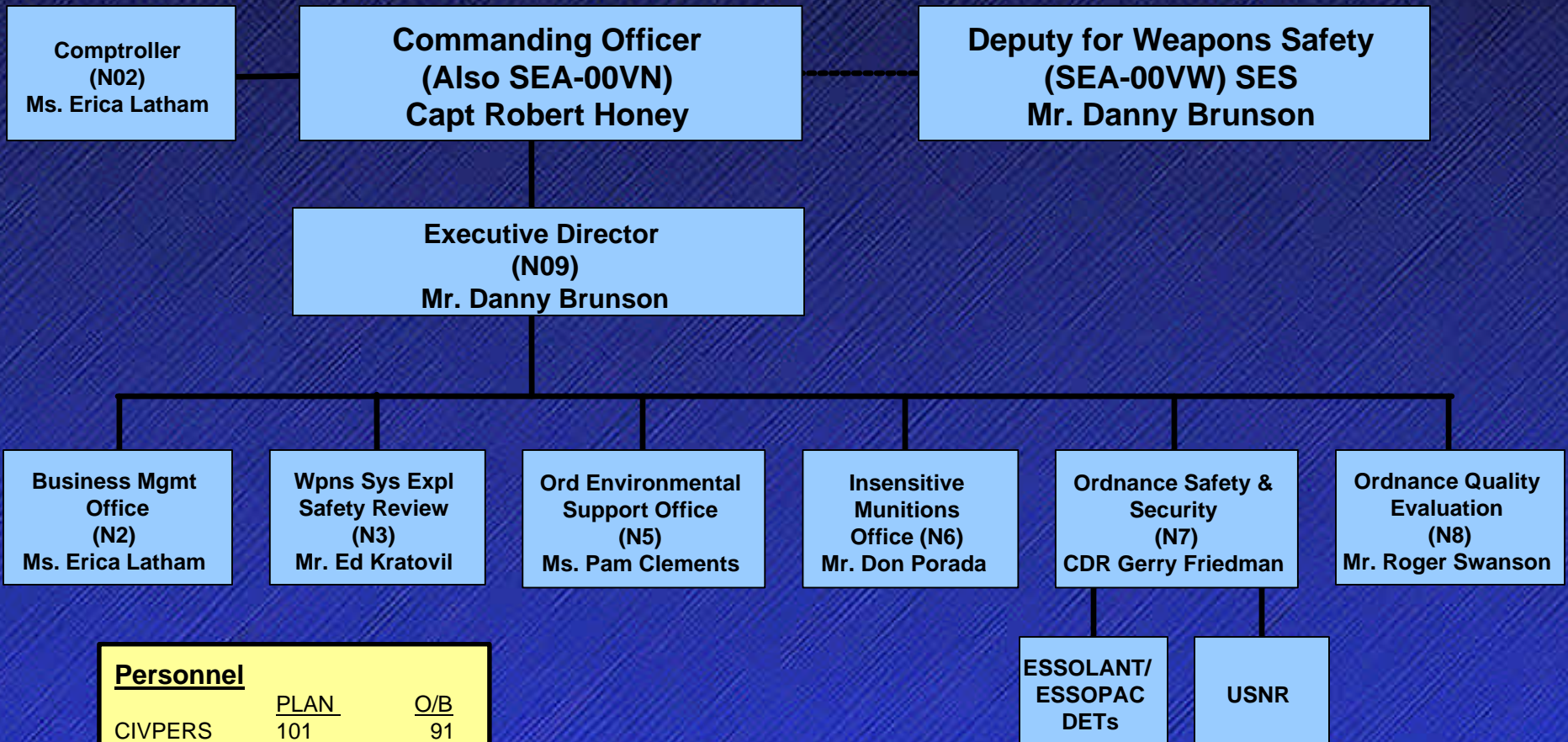
Multiple Controls/Barriers

Process, Evolution,
or weapon use



Weaknesses in **multiple controls/barriers** related to a specific process or evolution are **more risky**

NAVAL ORDNANCE SAFETY AND SECURITY ACTIVITY (NOSSA)



Personnel		
	<u>PLAN</u>	<u>O/B</u>
CIVPERS	101	91
MILITARY		
• NAVY	4	4
• MARINE	<u>1</u>	<u>1</u>
TOTAL	106	96

ORDNANCE SAFETY

- **Policy and Procedures Afloat and Ashore**
- **Joint Ordnance Commander's Group Executive Committee (JOCG EXCOM) Participation**
- **Ordnance Transportation Safety Policy**
- **HERO Program**
- **Afloat Assists**
- **AA&E Physical Security**
- **Facilities Safety Certification:**
 - ✓ **Safety Standards Development**
 - ✓ **Safety Publications & SOPs**
 - ✓ **Explosives Safety Inspections**
 - ✓ **Safety Training**
 - ✓ **ESQD Arc Determination**
 - ✓ **Site Approvals**
 - ✓ **AMHAZ Board**
 - ✓ **Waiver & Exemption Review**
 - ✓ **Qual/Cert Program Monitoring**
 - ✓ **NAR Evaluations for Safety Considerations**
 - ✓ **Safety Data Assessments**
 - ✓ **Hazard Classification & Analyses**

NOSSA EXPLOSIVES SAFETY PROGRAMS

USS Solar



- ✓ Ordnance Safety
- ✓ Insensitive Munitions
- ✓ Ordnance Environmental Compliance
- ✓ Weapons & Ordnance Quality Evaluation
- ✓ Weapon System Explosives Safety Review Board

INSENSITIVE MUNITIONS (IM)

MISSION: Provide the Inensitive Munitions and Energetics technology and technical expertise necessary for the development of cost effective weapons systems for the Fleet that exhibit reduced vulnerability to unplanned stimuli (accidental or intentional).

VALUE:

- ◆ Assures Fleet interoperability with NATO Allies
- ◆ Certifies Navy explosives as safe and suitable for service use
- ◆ Develops processes to design and assess munitions as safe and suitable for service
- ◆ Serves as IM Working Group Chairman and IM Coordination Group Exec. Secretary
- ◆ Technical Director for Environmentally Compliant Energetics (Environmentally Safe Energetic Materials (ESEM) and Green Energetic Materials (GEM) Programs)



ISSUES/CHALLENGES:

- Program Managers Unwilling to Accept Risks of New Technology Transition
- IM Funding Insufficient to Meet Technology Readiness Levels Required
- Lack of 6.1 and 6.2 Supporting Technology Programs

UNITED STATES IM LAW

Congress by Public Law Number 107-107 (2001) issued the IM Law Statement (Title 10, Chapter 141, Section § 2389) "National Defense Authorization Act for Fiscal Year 2002"

United States Code, Title 10, Chapter 141, Section 2389.

§ 2389. Ensuring safety regarding insensitive munitions. The Secretary of Defense shall ensure, to the extent practicable, that munitions under development or procurement are safe throughout development and fielding when subjected to unplanned stimuli.

DOD DIRECTIVE 5000.1

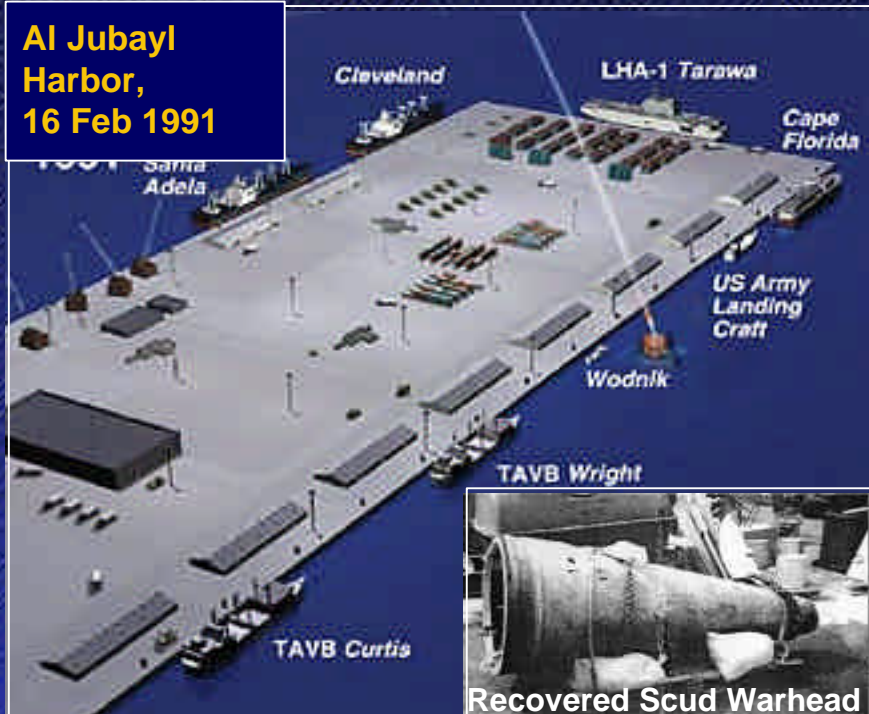
New DoD Directive 5000.1 and DoD Instruction 5000.2 on Defense Acquisition System, the two key DoD mandatory documents on acquisition, are to be signed and released in March 2003. A Defense Acquisition Guidebook, to be released later on, will provide non-mandatory information.

DoD Directive 5000.1:

3.XX. Safety. Safety shall be addressed throughout the acquisition process. Safety encompasses human (includes human / system interfaces), toxic / hazardous materials and substances, production / manufacturing, testing, facilities, logistical support, weapons, and munitions / explosives. All systems containing energetics shall comply with insensitive munitions criteria.

IM CAN HELP REDUCE THE POTENTIAL FOR DISASTER

**Al Jubayl
Harbor,
16 Feb 1991**



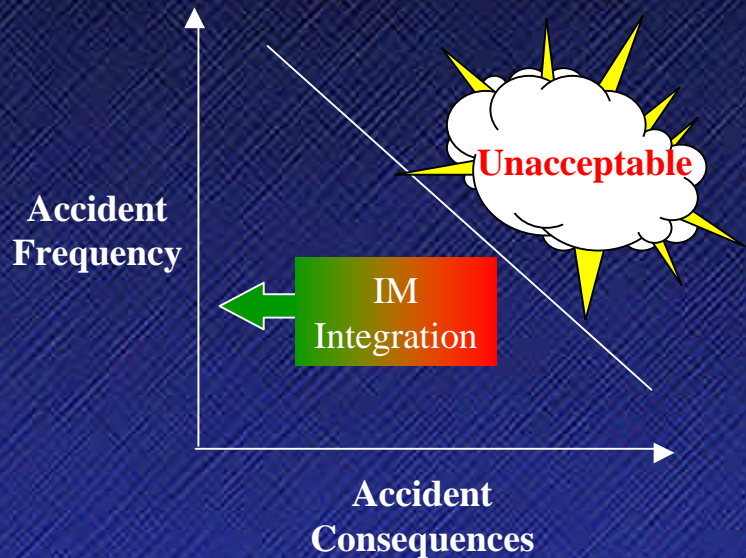
2003?



In February 1991, a single Iraqi Scud splashed harmlessly into the waters of the Arabian Gulf 150 meters from the massive commercial pier at Al Jubayl in Saudi Arabia. Had this missile landed on the ammunition-laden pier, or been part of a volley of multiple missiles, the results could have been catastrophic. With another possible war looming, defending vulnerable ports from such a threat is more important than ever. Insensitive munitions could make the difference between minor and major collateral damage



IM IN A SAFETY CONTEXT



- *IM focuses on energetic materials and reducing the consequences (collateral damage) of specific unplanned stimuli*
- *Safety involves the risk management of reducing accident frequency and consequences*

- *Newer bombs, for example, are intrinsically safer.*
- *Reduced risk to personnel and equipment.*
- *No gains from Hazard Classification standpoint.*

Which weapons would you rather own and deploy?

General Purpose Bombs IM Results:

	FCO	SCO	BI	FI	SD
MK 82/83 (H6)	DET	DET	DET	DET	DET
BLU-110/111 (PBXN-109)	BURN	BURN	BURN	BURN	DET



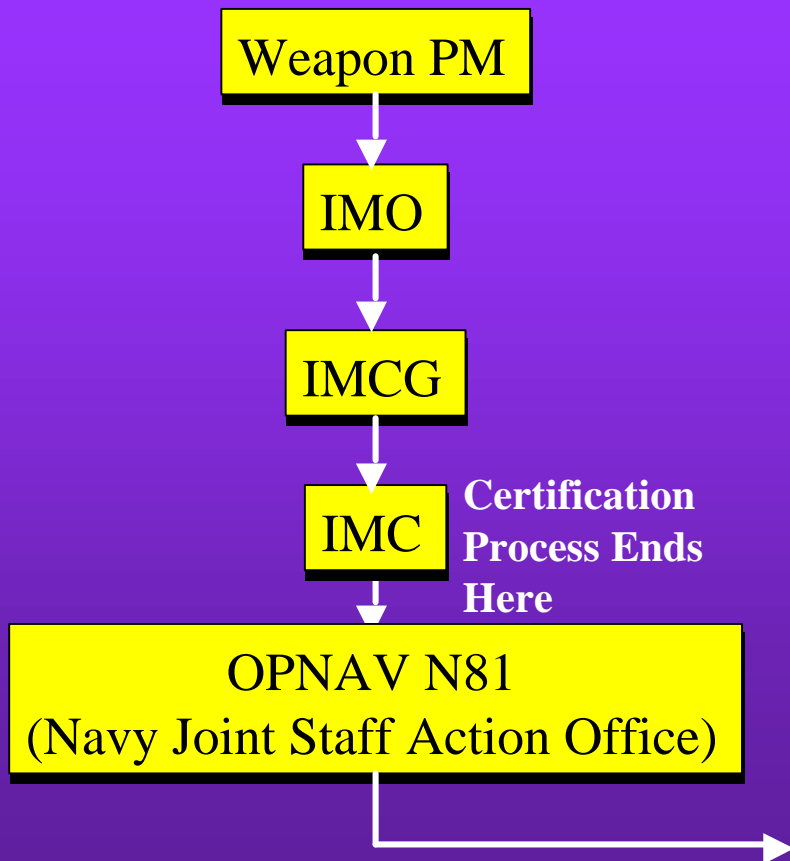
MK83 H6



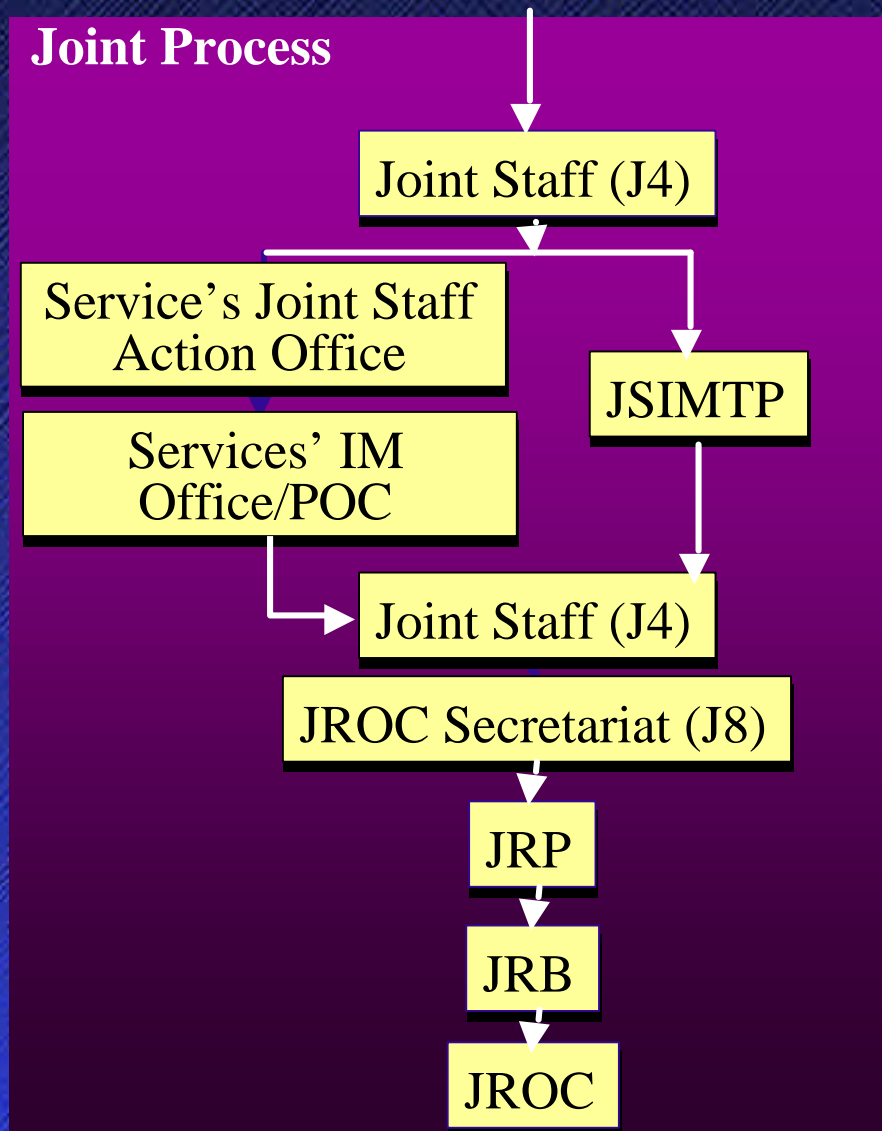
BLU-110 PBXN-109

IM CERTIFICATION & WAIVER REVIEW PROCESS

Navy Review



Joint Process



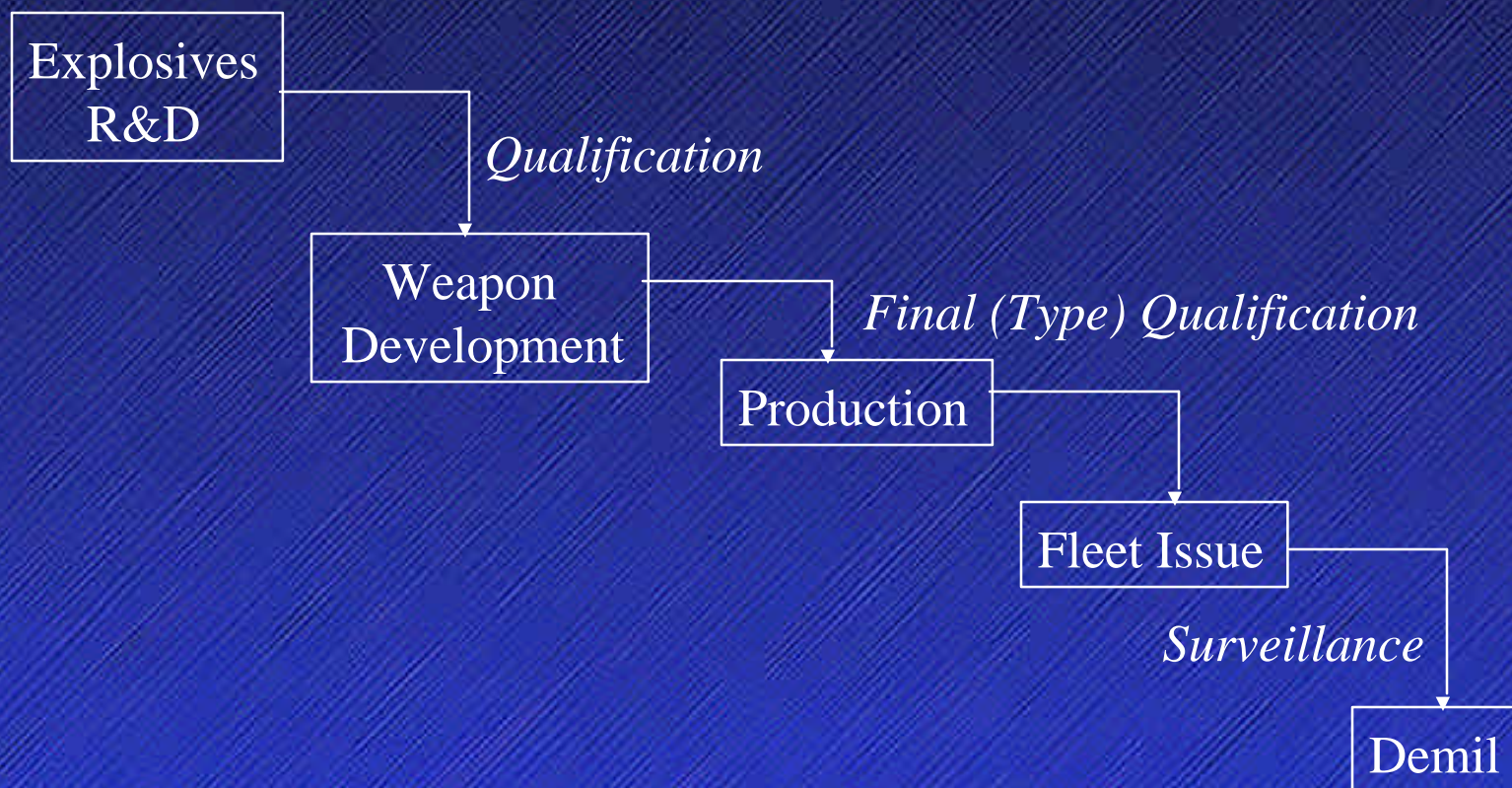
NAVSEAINST 8020.5C APPLICABILITY

- ◆ **Applies to Explosives at Navy Installations and Aboard Navy Ships or Aircraft Intended for Operational Use, Testing, Training, or Transport.**
- ◆ **Fleet Nuclear Weapons Are Excluded.**

DEFINITIONS

- ◆ **Explosives:** Substances capable, by chemical reaction, of producing gas at such a temperature, pressure and rate as to be capable of causing damage to the surroundings. Includes high explosives, propellants, pyrotechnics and blasting agents.
- ◆ **Qualified Explosive:** An explosive that possesses properties judged to make it safe and suitable, primarily from a safety point of view, for consideration for use in a particular role.
- ◆ **Final (Type) Qualified Explosive:** A material in a specific application or weapon system that has been formally approved by NAVSEA for service use and deemed safe and suitable in the proposed design mode.

TIMELINE FOR EXPLOSIVES QUALIFICATION



EXPLOSIVE QUALIFICATION POLICY

- ◆ **NAVSEA Is Assigned Navy-Wide Responsibility for Explosive Materials, Energetic Materials, and Insensitive Munitions (OPNAVINST 8010.13C)**
- ◆ **Least Sensitive Explosive Which Meets Performance/Operational Requirements Shall Be Used With Emphasis on Slow and Fast Cook-off, Bullet and Fragment Impact, and Sympathetic Detonation Responses During Munition Lifecycle**
- ◆ **Only Qualified Explosives Shall Be Used in Munition Development or Product Improvement Programs.**

POLICY (CONT.)

- ◆ **Only Final (Type) Qualified Explosives Shall Be Employed in Munitions and Explosive Devices Introduced for Operational and Training Use**
- ◆ **Under Certain Circumstances, Unqualified Explosives May Be Final (Type) Qualified With Restricted Use**

IMPLEMENTING DOCUMENT FOR STANAG 4170 AND MIL-STD-1751

STANAG 4170

- ◆ “Principles and Methodology for the Qualification of Explosive materials for Military Use”
- ◆ Refers to MIL-STD-1751 as US implementing document for qualification tests
- ◆ Establishes international test standards

MIL-STD-1751

- ◆ “Safety and Performance Tests for the Qualification of Explosives”
- ◆ Applies to all new explosives intended for conventional applications
- ◆ Describes mandatory test methods and data required for qualification
- ◆ Permits substitution of test regimes by the Service qualification authority on a case-by-case basis

QUALIFICATION REQUIREMENTS

- ◆ **Sufficient Supporting Data to Show Explosive Safety and Suitability**
- ◆ **Requirements Include:**
 - **Mandatory Test Data**
 - **Proliferation Statement**
 - **Technical Report**
 - **Material Specification**
 - **MSDS**
 - **Technical Recommendation**
 - **Preliminary Environmental Analysis**
 - **Hazard Classification (Substance)**

MANDATORY QUALIFICATION TESTS/ASSESSMENTS

TESTS	HIGH EXPLOSIVES			PROPELLANTS	PYROTECHNICS	BLASTING AGENTS
	PRIMARY	BOOSTER	MAIN CHARGE	SOLID ROCKET, GAS GENERATOR & SOLID GUN		
IMPACT SENSITIVITY	X	X	X	X	X	X
CAP TEST(1)	-	X	X	X	X	X
GAP TEST	-	X	X	X	-	-
THERMAL STABILITY(2)	-	X	X	X	X	X
IGNITION AND UNCONFINED BURNING(3)	-	X	X	X	-	X
VACUUM STABILITY	X	X	X	X	X	-
SELF HEATING (DSC/DTA)(4)	X	X	X	X	X	X
FRICTION SENSITIVITY	X	X	X	X	X	X
ELECTROSTATIC SENSITIVITY	X	X	X	X	X	X
DETONATION VELOCITY	-	X	X	-	-	-
AGING CHARACTERISTICS (5)	X	X	X	X	X	-
CRITICAL DIAMETER	-	X	X	X	-	-
TOXICITY(6)	X	X	X	X	X	X
BULK SELF-HEATING PROPERTIES(7)	-	-	-	-	-	X
COMPATIBILITY DATA(8)	-	-	-	-	-	X

(1) NO. 8 CAP, 2" CUBES, CYLINDERS (2" DIAMETER, 2" LONG) MAY BE SUBSTITUTED

(2) 75°C, 2" CUBES, CYLINDERS (2" DIAMETER, 2" LONG) MAY BE SUBSTITUTED

(3) 2" CUBES, CYLINDERS (2" DIAMETER, 2" LONG) MAY BE SUBSTITUTED

(4) ROGERS, RN, THERMOCHEMICA ACTA, NO. 11 (1975) PP. 131-139

(5) SEE ENCLOSURE (3), PARAGRAPH 3.d.

(6) ASSESSMENTS OF INGREDIENTS, COMBUSTION PRODUCTS, AND BY-PRODUCTS OF PROCESSING

(7) CONTACT NAVORDSAFSEC ACT CODE N6 IF CALCULATION INSTRUCTIONS ARE NEEDED

(8) COMPATIBILITY DATA WITH COMMON MATERIALS, E.G., METALS, ACIDS, BASES

FINAL (TYPE) QUALIFICATION REQUIREMENTS

- ◆ **Supporting Data Showing Safety and Suitability in the Intended Application**
- ◆ **Requirements Include:**
 - **Statement of Completion of System Safety Program**
 - **Mandatory Test Data**
 - **NMD, Finalized Materials Documentation for main charge and booster explosives**
 - **Advisory Processing/Handling Statements**
 - **Final Hazard Classification**
 - **THA (Optional)**
 - **Technical Report**
 - **IM Compliance Statement**

MANDATORY FINAL (TYPE) QUALIFICATION TESTS

TESTS	HIGH EXPLOSIVES				PROPELLANTS	PYROTECHNICS	CARTRIDGE	CAD, PAD EXPLOSIVE
	PRIMARY		BOOSTER	MAIN CHARGE	SOLID ROCKET, GAS GENERATOR & SOLID GUN			
	SYSTEM LEVEL (1)	COMPONENT LEVEL (2)						
TEMPERATURE AND HUMIDITY (3)	X	X	X	X	X	X	X	X
VIBRATION	X	-	X	X	X	X	X	X
40 FOOT DROP	X	X (4)	X	X	X	X	X	X
5 FOOT DROP (5)	-	X (4)	-	-	-	-	-	X (5)
FAST COOK-OFF	X (6)	-	X (7)	X	X	X	X (7)	X (7)
SLOW COOK-OFF(3)	-	X (8)	X (7)	X	X	X	X (8)	X (8)
BULLET IMPACT (3)	-	-	X (7)	X	X	X	-	-
JOLT	X	X (4)	X	-	-	X	X	X (9)
JUMBLE (9)	X	-	X	-	-	X	X	X
FRAGMENT IMPACT (11)	-	-	X	X	X	-	X	X
SYMPATHETIC DETONATION (11)	X (10)	-	X	X	X	-	X	X
SPALL IMPACT (9,11)	-	-	X	X	X	-	X	X
SHAPED CHARGE JET IMPACT (9,11)	-	-	X	X	X	-	X	X
CHEMICAL AND PHYSICAL COMPATIBILITY	X	X	X	X	X	X	X	X
LOW TEMP/HUMIDITY AGING (12)	-	X	X	X	X	X	X	X

(1) FUZES, EXPLODERS, SAFETY AND ARMING DEVICE, ETC.

(2) DETONATOR, PRIMER, SQUIB, ETC.

(3) MAY BE PERFORMED ON SUB-SYSTEMS (REFERENCE (A))

(4) CONDUCTED IN HARDWARE SIMULATING END ITEM

(5) SIX-FOOT DROP TEST FOR CARTRIDGES, CADS, AND PADS. 3-FOOT DROP TEST FOR PADS PER MILP-83126A

(6) ASSESSMENT OF RESPONSE IN ALL-UP-ROUND FOR PRIMARY HIGH EXPLOSIVES

(7) CONDUCTED IN INERT ALL-UP-ROUND AS REQUESTED BY NAVORDSAFSECACT CODE N6 ON A CASE-BY-CASE BASIS

(8) ISOTHERMAL TESTS LISTED IN REFERENCE (I) AND MIL-D-21625 MAY BE SUBSTITUTED

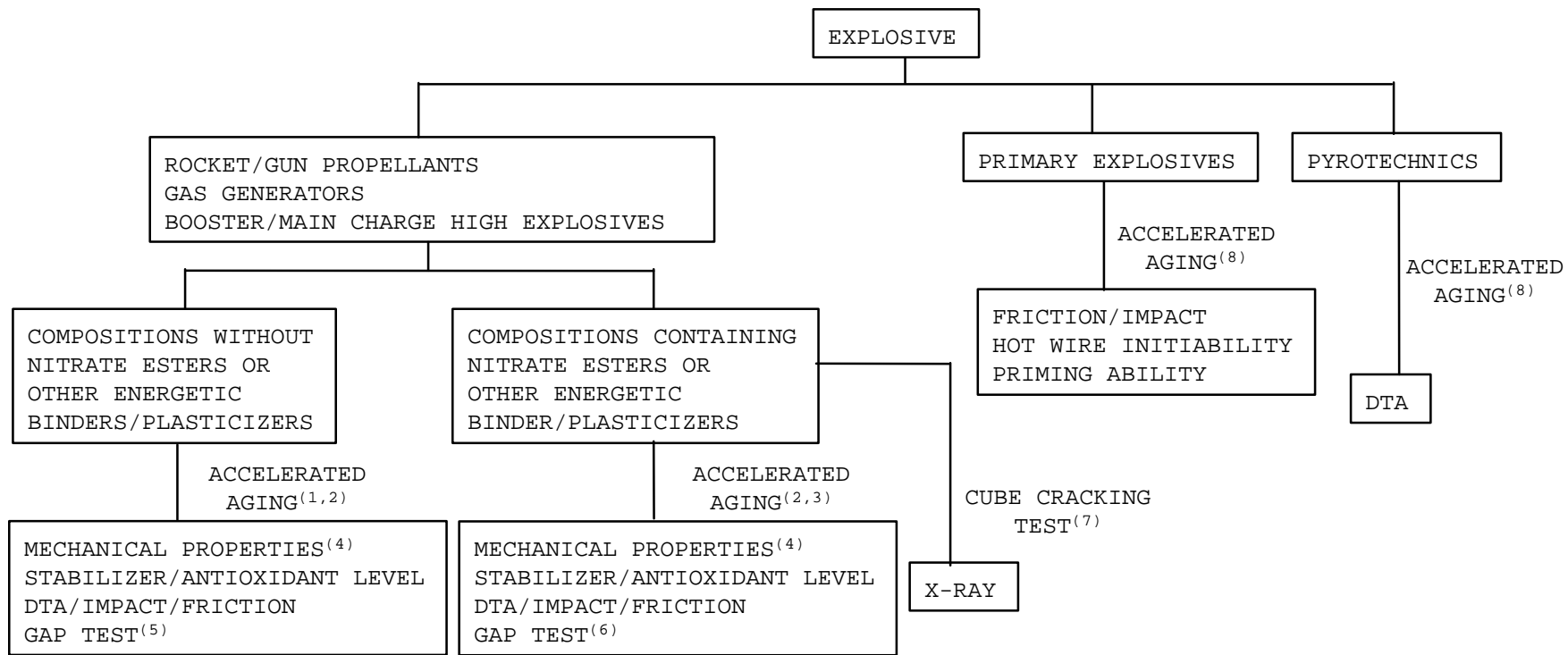
(9) ONLY IF INDICATED BY THREAT HAZARD ANALYSIS

(10) FOR SYSTEMS WHICH HAVE A STOWAGE CONFIGURATION AND THE PRIMARY IS NOT OUT-OF-LINE WITH LEADS OR BOOSTERS

(11) TEST PERFORMED IN STOWAGE/STORAGE CONFIGURATION FOR BOOSTER AND MAIN CHARGE HIGH EXPLOSIVES, PROPELLANTS AND CARTRIDGE EXPLOSIVES

(12) SEE ENCLOSURE (3), PARAGRAPH 3.d. AND ENCLOSURE (4), PARAGRAPH 3.f.

AGING PROTOCOL FOR EXPLOSIVES



⁽¹⁾ 60°C - 1,2,4,6,8 MONTHS, SEALED CONTAINERS
 70°C - 1,2,4,6 MONTHS, SEALED CONTAINERS
 25°C, 30%RH - UNTIL FINAL (TYPE) QUAL

⁽²⁾ COMPOSITIONS BASED ON POLYESTER BINDERS
 WILL BE AGED UNDER CONTROLLED HUMIDITY
 (30%RH)

⁽³⁾ 50°C - 1,3,6,9,12 MONTHS, SEALED CONTAINERS
 60°C - 1,2,4,6,8 MONTHS, SEALED CONTAINERS
 25°C, 30%RH - UNTIL FINAL (TYPE) QUAL

⁽⁴⁾ HIGH RATE COMPRESSIVE STRENGTH FOR GUN
 PROPELLANTS. ALL OTHERS UNIAXIAL AT
 THREE TEMPERATURES.

⁽⁵⁾ 60°C - 8 MONTHS
 70°C - 6 MONTHS
 25°C, 30%RH - UNTIL FINAL (TYPE) QUAL
 GUN PROPELLANTS EXCLUDED

⁽⁶⁾ 50°C - 12 MONTHS
 60°C - 8 MONTHS
 25°C, 30%RH - UNTIL FINAL (TYPE) QUAL
 GUN PROPELLANTS EXCLUDED

⁽⁷⁾ 60°C
 3" CUBE FOR BOOSTER COMPOSITION
 6" CUBE FOR OTHERS
 GUN PROPELLANTS EXCLUDED

⁽⁸⁾ 70°C - 6,12 MONTHS, SEALED
 CONTAINERS
 25°C, 30%RH - UNTIL FINAL (TYPE)
 QUAL

NOTE: UNLESS OTHERWISE STATED, NO
 HUMIDITY CONTROL