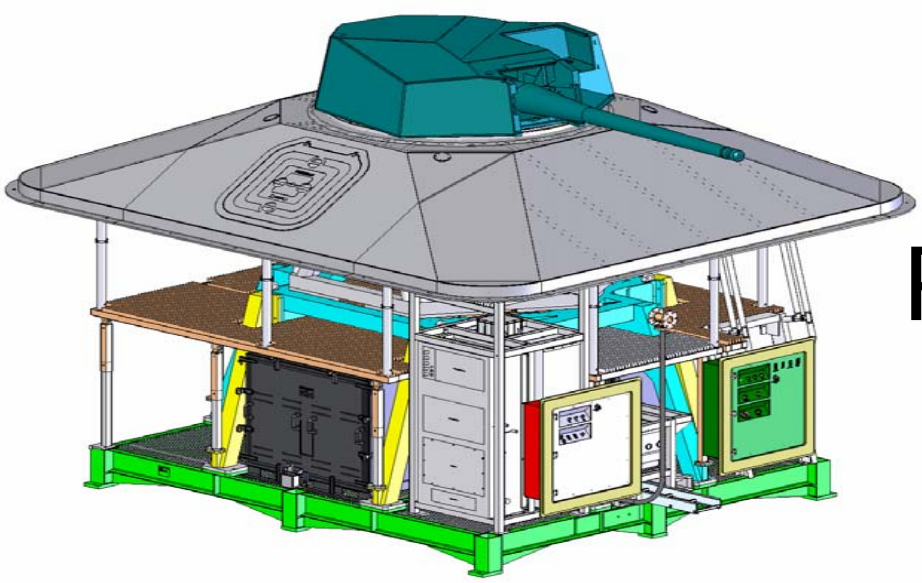

Safety Process For Navy Gun and Ammunition Systems

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Agenda

- Purpose
- Policies
- Define Safety
- Gun System Safety Process
  - Hardware
  - Software
- Ammunition Safety
- Hazards
  - Identification
  - Mitigation
  - Risk Acceptance
- Independent Review
- Summary

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Purpose

- Identify safety processes involved in the qualification of all gun systems and their associated ammunition for U.S. Navy
  - Gun System
    - Gun Mount (GM)
    - Fire Control System (FCS)
    - Associated Systems
  - Ammunition Safety
    - Fuze
    - Energetic
    - Transportation and Storage

System Safety Program Plan Developed for all Gun and Ammunition Systems

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Safety Process

- All Gun Systems and Ammunition Need to go Through a Rigorous Safety Process Before Deployment
  - Gun Systems for Navy Platforms
    - New Development
    - Previously Developed Systems
  - New Ammunition for New or Existing Gun Systems
  - Updates/Upgrades to Deployed Systems
  - Deployment of Existing Gun Systems on New Platforms

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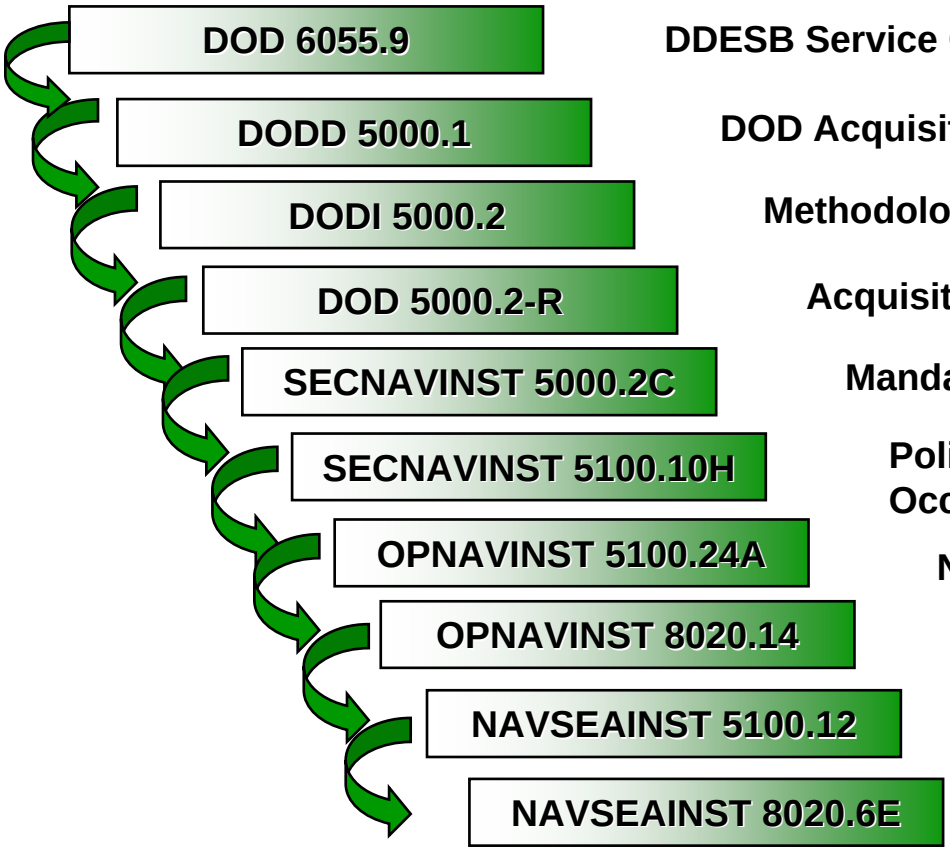
Government and Navy Safety Policy



DDESB Service Component Explosives Safety Oversight

DOD Acquisition Process

Methodology for Implementing 5000.1

Acquisition Procedures Guidebook

Mandatory Procedures for Implementation

Policy for Safety, Mishap Prevention, Occupational Health, and Fire Prevention

Navy System Safety Program

Explosives Safety Policy

Requirements for System Safety Program

Department of the Navy Weapon Systems Explosives Safety Review Board

Implementation of Government Safety Policies Ensures Safety of System Onboard Ship

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System Safety Defined

- What exactly IS a System Safety Issue?
  - –A situation in which own-platform, own-platform personnel, or friendly assets are at risk from onboard equipment / systems.
    - Personnel
    - Own-Ship Damage
    - Friendly Asset
    - Environment
- What exactly IS NOT a System Safety Issue?
  - –Operational Effectiveness and Survivability Issues
    - Operational Effectiveness
    - Survivability

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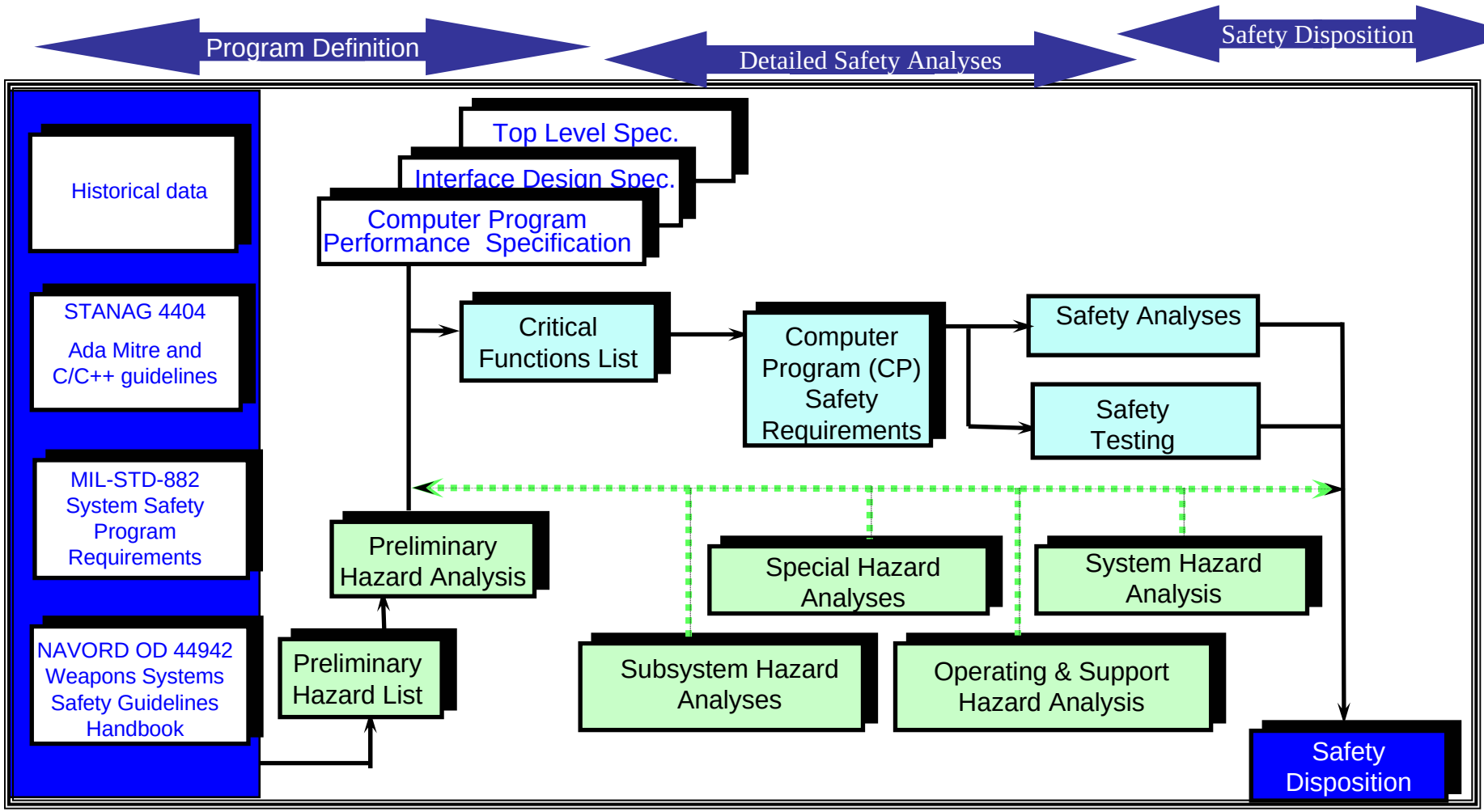
Gun System Safety Analysis Process



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Gun System Hardware Safety

- Apply General Guidelines for Electronic Equipment *(MIL-HDBK-454)*.
- Inspect hardware for validation of hardware safety requirements (regardless of design phase).
- Analyze equipment motion
- Identify sources of radiated energy

System Control Software Safety

Main emphasis of gun system safety.

- Analyze Software IAW NATO Standardization Agreement (STANAG) 4404.
- Apply lessons learned from previous like systems.
- Adhere to C++ safety coding guidelines
- Address Safety Concerns with
  - Java
  - Operating System
  - Middleware
  - Firmware
  - Development tools
- Analyze test environment
- Determine the Level of Rigor of Software testing

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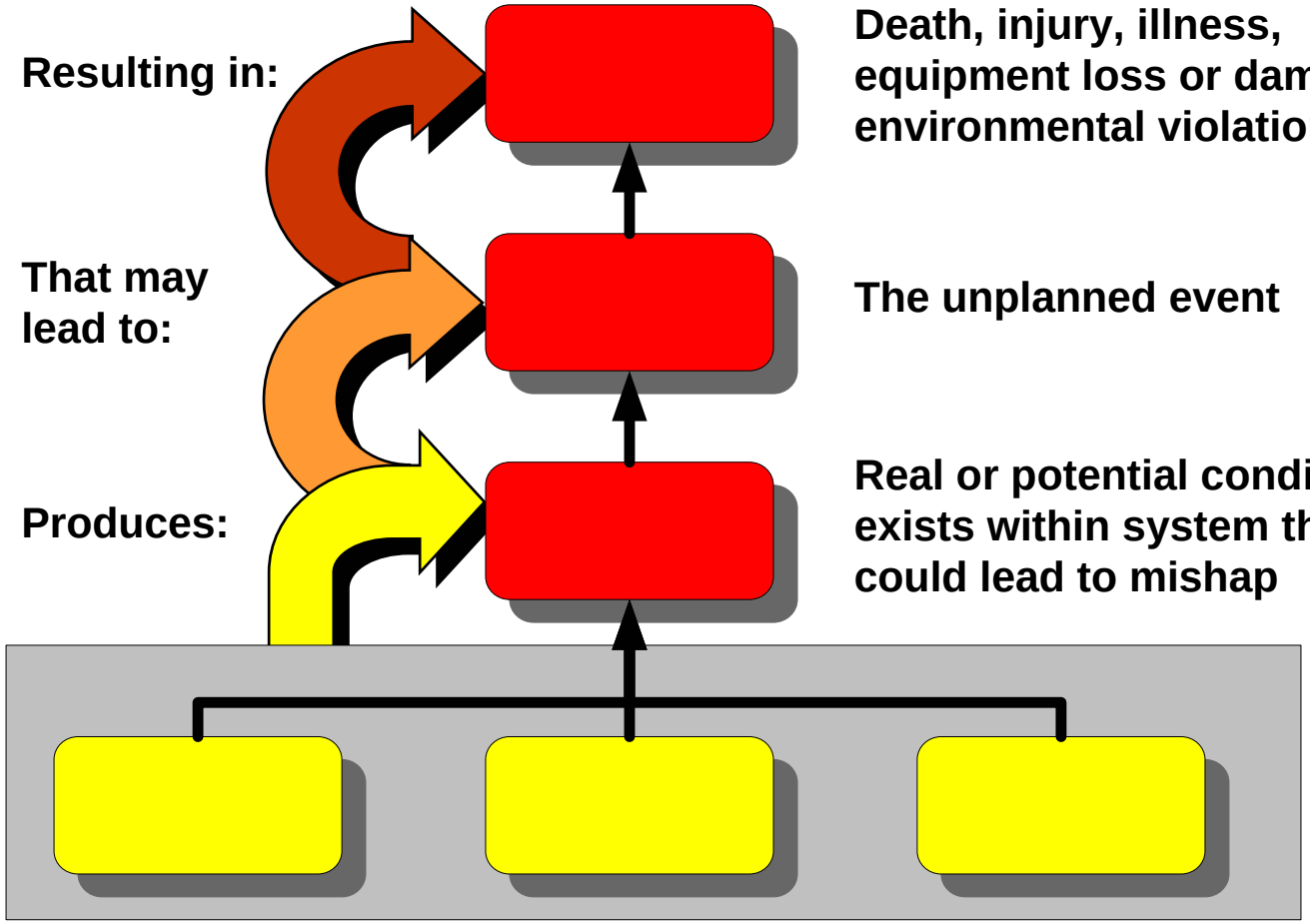
Ammunition Safety

- Design to Proven Standards
  - Fuze design *MIL-STD-1316*
  - Electronic Safe & Arm Device (ESAD) *WSESRB TM*
  - Ignition Design *MIL-STD-1901*
  - Initiator *MIL-DTL-23659*
- Ensure that the Energetic Compounds are Stable
  - *NAVSEAINST 8020.5* and *STANAG 4170*
- Analyze Design to Mitigate Hazards
  - Eliminate Single Point Failures
  - MIL-STD-882D Safety Analyses
  - Special Safety Analyses
  - Structural Analyses

Ammunition Tests

- Analyze for a variety of environments
  - Transportation (Land, Sea, Air)
  - Storage
  - Handling by service personnel
  - Drop
  - Combat or Terrorist Threats
  - Fire
  - Shock and Vibration
  - Radiation
- Test
  - ESD / HERO: *MIL-STD-464*
  - Insensitive Munitions: *MIL-STD-2105*
    - *Associated STANAG*
  - Shipboard Shock: *MIL-S-901*
  - Fuze: MIL-STD-331C
  - Hot Gun Cook-off: *NAVSEA SW300-BC-SAF-010*

Identify and Categorize Mishaps and Causal Factors



CAUSAL FACTORS
Elements within the system design, implementation, or operation that lead to, or contain, a hazard.

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Hazard Mitigation

- Mitigation Methods (In order of precedence)
  - Design out hazard
  - Incorporate safety devices
  - Provide warning devices
  - Develop procedures and training

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Mishap Risk Acceptance Matrix

FREQUENCY OF OCCURRENCE	MISHAP SEVERITY CATEGORIES			
	1 CATASTROPHIC	2 CRITICAL	3 MARGINAL	4 NEGLIGIBLE
A – FREQUENT	1	3	7	13
B – PROBABLE	2	5	9	16
C – OCCASIONAL	4	6	11	18
D – REMOTE	8	10	14	19
E – IMPROBABLE	12	15	17	20

Cells:	Risk Level & Acceptance Authority:
1-5:	HIGH (UNACCEPTABLE) – Acceptance of risk by Component Acquisition Executive.
6-9:	SERIOUS (UNDESIREABLE) – Acceptance of risk by the Program Executive Officer.
10-17:	MEDIUM (Acceptable with review) – Acceptance of risk by the Program Manager.
18-20:	LOW (Acceptable with review) – Acceptance of risk by the Program Manager.

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Navy Safety Review Boards

- **Weapon System Explosives Safety Review Board (WSESRB)**
  - **SECNAVINST 5000.2C**
    - Establishes the WSESRB as the Navy's independent agent for reviewing weapon system safety programs
  - **OPNAVINST8020.14/MCO P8020.11**
    - Specifies requirements for WSESRB review
  - **NAVSEAINST 8020.6E**
    - Establishes WSESRB policies and procedures
  - **Software System Safety Technical Review Panel (SSSTRP)**
    - Established by WSESRB to review software safety
    - More thorough review by technical experts
  - **Fuze & Initiation Safety Technical Review Panel (FISTRP)**
    - Established by WSESRB to review fuze/initiation systems safety
    - More thorough review by technical experts
  - **Lithium Battery Review Board**
- **Insensitive Munition Review Board (IMRB)**
- **Ordnance Hazard Evaluation Board (OHEB)**
- **Bureau of Medicine (BUMED)**
  - Laser Safety Review Board (LSRB)

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Safety Process Summary

- **Apply Mandated Policies**
- **Follow System Safety Program Plan**
- **Identify, Mitigate and Accept risk**
- **Present Safety Process to Safety Review Board**
- **Present Analysis to Safety Review Board**

All Gun Systems and Ammunition Need to go Through a Rigorous Safety Process Before Deployment.

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BACK UP

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Web Site for Further Interest

- Digital Engineering Institute
  - www.klabs.org/DEI/References/Military_Specifications.htm
- System Safety Handbook
  - www.asy.faa.gov/risk/SSHandbook/Contents.htm
- Joint Weapon Safety Review Process for USSOCOM Program
  - www.acq.osd.mil/atptf

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Ammunition Qualification Tests

PVAT
Sequential Environment
- 28-Day Temperature and Humidity (T&H)
- Transportation Vibration
- Shipboard Vibration
- 4-Day T&H

Fast Cook-Off
Slow Cook-Off
Bullet Impact
Fragment Impact
Sympathetic Detonation
Shaped Charge Jet Impact
Salt Fog
Sand and Dust
Arena
5-Foot Drop
40-Foot Drop
Shipboard Shock
Waterproof
Energetics Qualification
Function and Casualty
Fuze Function
Fuze Arming Distance
Jumble
Jolt
Missing Interrupter
Thermal Shock
Detonator Safety
Lead Azide
HERO
ESD
EMV
Lightning
Progressive Arming
Primary Explosive Component Safety Test
Bonfire Test
Stack Test
POP
Unit Load

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Joint Systems

- ***JOINT WEAPON SYSTEMS HAVE JOINT REVIEWS***
- **Office of the Secretary of Defense (OSD)**
  - **Joint Weapon, Munitions, and Laser SOCOM Weapon Safety Review Process**
    - **USD AT&L Memo implementing the Joint USSOCOM Process, 9 November 07**
    - **MEMORANDUM OF AGREEMENT AMONG United States Special Operations, Command (USSOCOM), OSD AT&L, OSD Environmental Readiness and Safety, Department of the Army, Department of the Navy, Department of the Air Force**
    - **In support of USSOCOM Acquisitions**
      - **Collaborative process supported by each Service's CAE and Safety review authorities**
      - **Convenes as necessary to review Joint USSOCOM Weapon Programs**
    - **Incorporates the Joint Laser Safety Review Board (JLSRB)**
- ***Participants***
  - ***Navy WSESRB***
  - ***USAF NON-NUCLEAR MUNITIONS SAFETY BOARD (NNMSB)***
  - ***US ARMY FUZE SAFETY REVIEW BOARD (AFSRB)***
    - MEMBERS OF EACH BOARD HAVE PARTICIPATED IN MEETINGS OF THE OTHER BOARD

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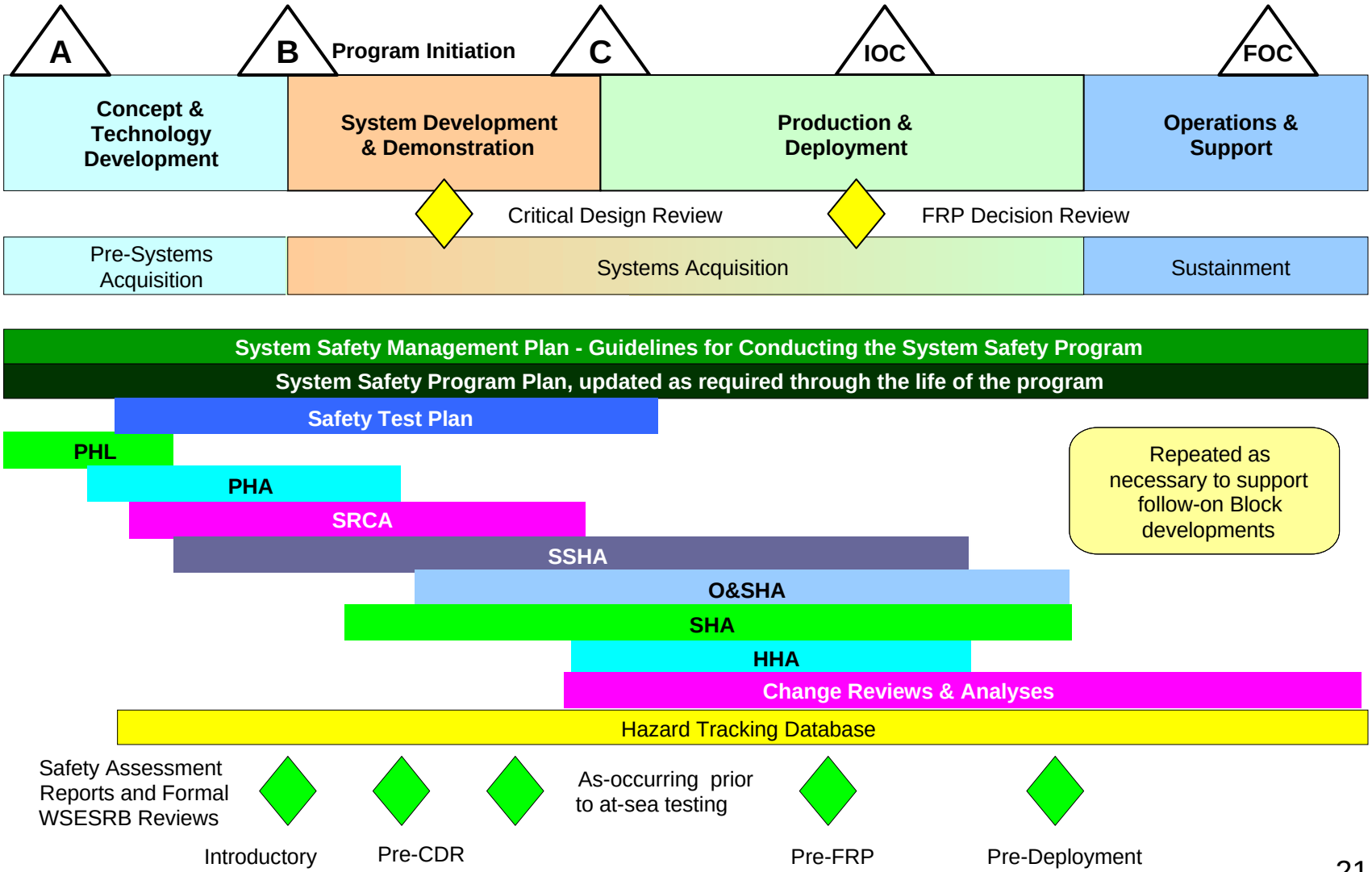
System Acquisition & System Safety



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MIL-HDBK-454

- Electromagnetic environment effects
- Shipboard bonding and grounding
- Laser safety requirements
- Human engineering
- Hazardous Materials
- Radiation protections and signs
- Radio frequency protections and signs
- Safety colors
- Other safety signs, labels, and barriers
- Safety tags