Waterfront Organizations, Work Controls, and Safety

SEAPOWER THROUGH ENGINEERING

TOPIC LEARNING OBJECTIVES

Upon successful completion of this topic, the student will be able to:

1. Recognize the mission and major functions of the Naval Reactors Representative's Office (NRRO).
2. Recognize the general responsibilities of the Reactor Plant Contractor's Office (RPCO).
3. Relate the THRESHER, GUITARRO, and MIAMI accidents to the resulting improvements to ship safety during maintenance.
4. Recognize the purpose and the general requirements of the Submarine Safety (SUBSAFE) Program
5. Recognize the purpose and the general requirements of the Deep Submergence Systems (DSS) Program
6. Recognize the major requirements of the Industrial Ship Safety Manual for Submarines (6010 Manual).
7. Recognize the major requirements of the Industrial Ship Safety Manual for Fire Prevention and Response (8010 Manual).
8. Recognize the two requirements to perform work on a ship or submarine (Technical Work Document (TWD) and authorization).
9. Recognize the special considerations for Tag-Outs in a maintenance environment (divers, barrier criteria, Repair Activity Representative).

STUDENT PREPARATION

Student Support Material

1. None

Primary References

1. NAVSEA 0924-062-0010 Submarine Safety (SUBSAFE) Requirements Manual
2. NAVSUP/NAVSEAINST 4440.16, Level I/SUBSAFE Stock Program
3. SS800-AG-MAN-010/P-9290 System Certification Procedures and Criteria Manual for Deep Submergence Systems
4. NAVSEA T9044-AD-MAN-010, Requirements Manual for Submarine Fly-By-Wire Ship Control Systems
5. NAVSEA 0905-LP-485-6010 Industrial Ship Safety Manual for Submarines COMFLTFORCOMINST 4790.3 (series) Joint Fleet Maintenance Manual
6. Tag-Out User's Manual S0400-AD-URM-010/TUM
7. S0570-AC-CCM-010/8010 Industrial Ship Safety Manual for Fire Prevention
8. S9002-AK-CCM-010/6010 Industrial Ship Safety Manual for Submarines

Additional References

1. Manual for the Control of Testing and Plant Conditions
2. Manual for the Control of Refueling

Waterfront Topics

- The majority of products a SYSCOM (NAVSEA, NAVAIR, NAVWAR, NAVSUP, NAVFAC) provides to the Warfighter get installed on the waterfront (new construction or overhaul/repair periods)
- You need to know some of the waterfront's key players, the rules for safe installation and the significant events that shape their thinking and culture
  - Safety of the people, equipment, facilities
- Program managers (PM) need to be aware of the rules and, in some cases, be held accountable to them

Overview

- Waterfront players at the Naval (Public) Shipyards:
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- Tag-Outs (nuclear and conventional)

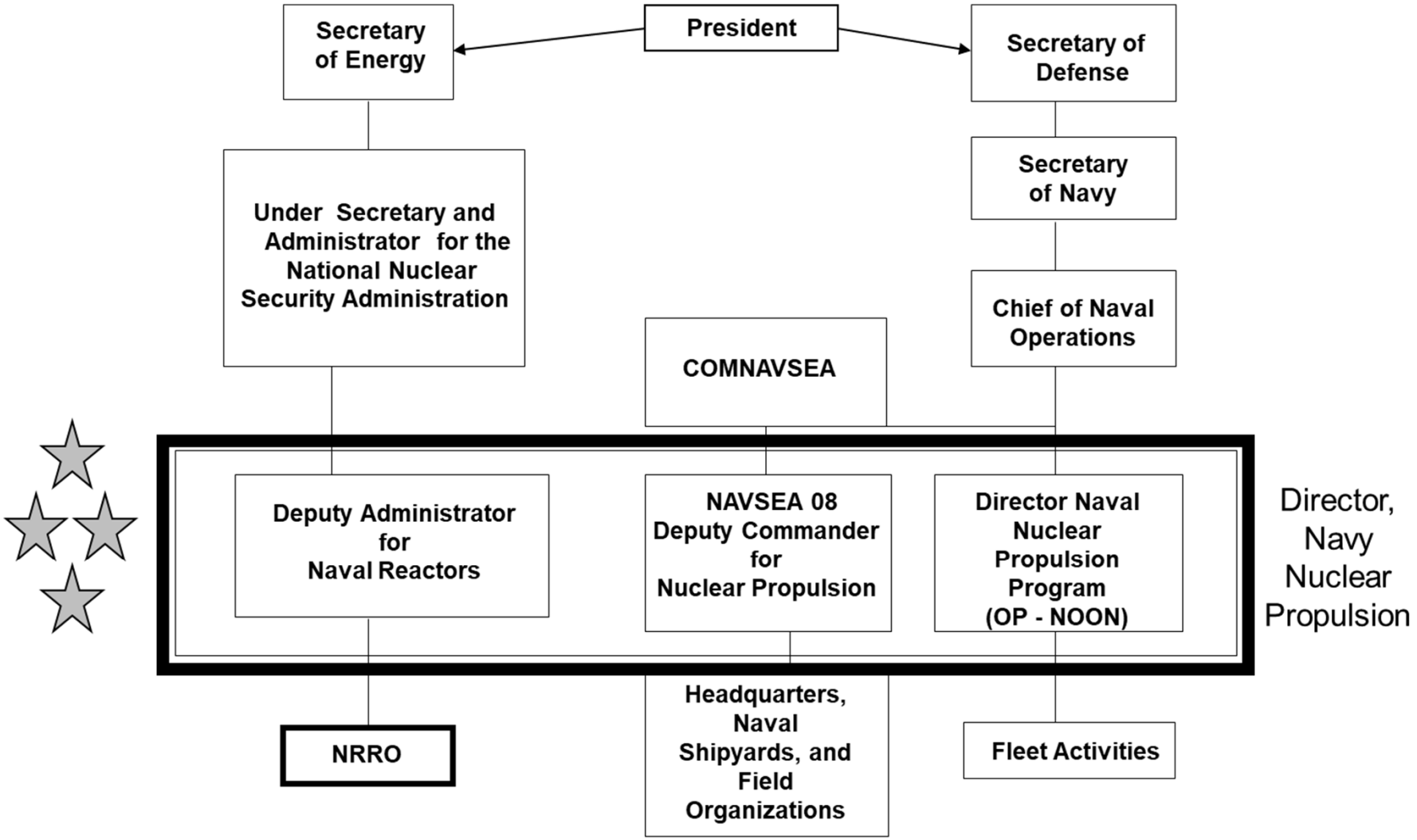
Naval Nuclear Propulsion Program

- Atomic Energy Act of 1954 set up the Naval Nuclear Propulsion Program as a joint program in both the now Dept. of Energy, National Nuclear Security Agency, and the Navy

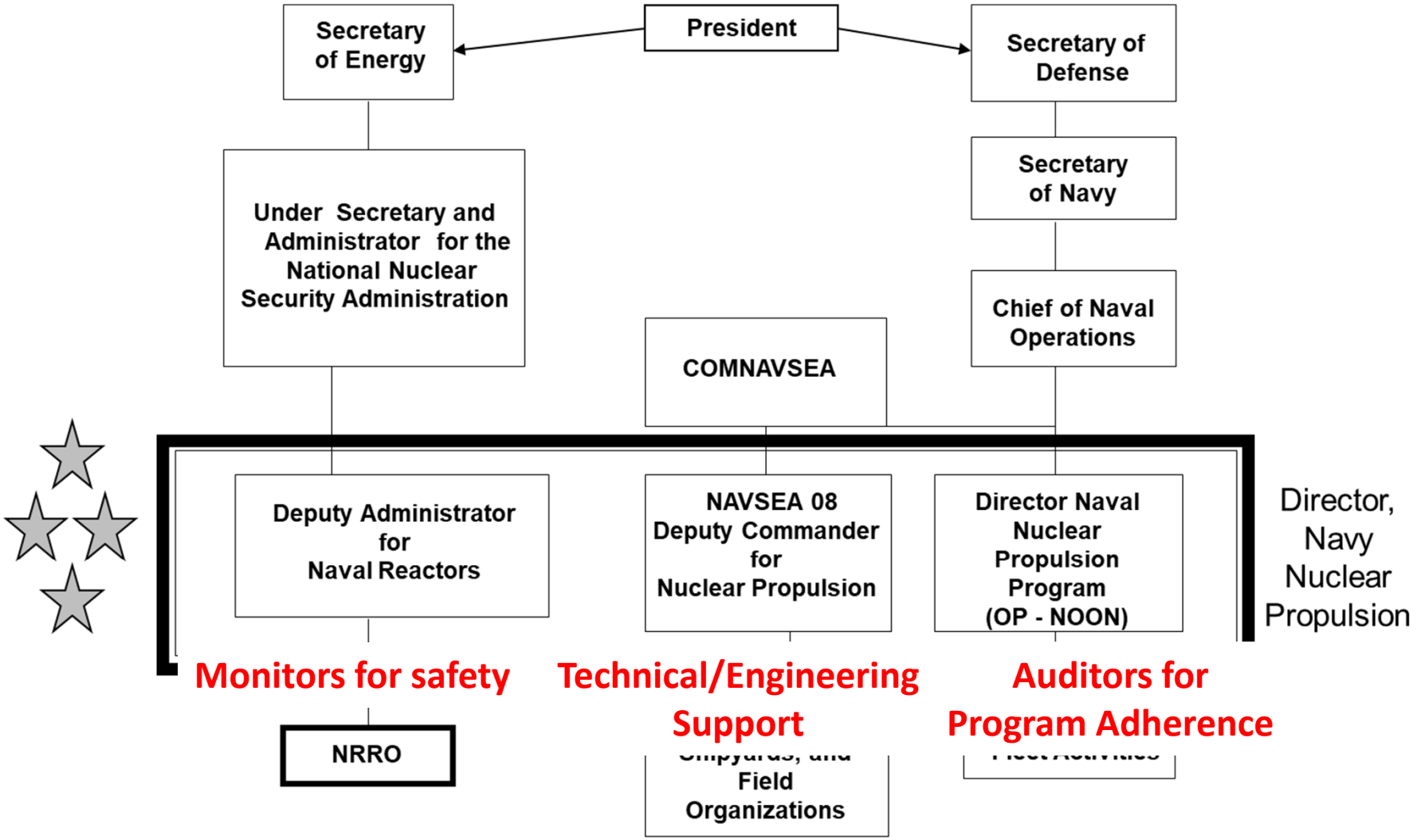
- Executive Order 12344 of 1 February, 1982, as set forth in Public Law 98-525, established the responsibilities of the Director, Naval Nuclear Propulsion Program

- National Defense Authorization Act for Fiscal Year 2000, Public Law 106-65, relocates the Office of Naval Reactors from the Office of Nuclear Energy, Science, and Technology to the National Nuclear Security Administration

Naval Nuclear Propulsion Program



Naval Nuclear Propulsion Program



Naval Reactors Representative Office (NRRO)

- Mission Statement: As representatives of Naval Reactors, ensure that the reactor safeguards measures, including design, procedure control, radiological control, quality control, and other elements on which reactor safety is dependent, are not compromised

- Mission accomplished through:
  - Rigorous enforcement of program standards
  - Independent assessment
  - Keeping Naval Reactors informed

NRRO

- Primary mission – Reactor Safety to ensure longevity of the Naval Nuclear Propulsion Program
- Oversight responsibility for nearly all aspects of shipyard operation
  - Execution of availabilities – Part of the Nuclear Joint Test Group
  - Safety and environmental performance – Monitoring agents
  - Security – NOFORN and NNPI
  - Public affairs – Casualty response; usually side-by-side with the Shipyard CO
- Major Functions
  - Department of Energy Representative to the Nuclear Joint Test Group
  - Department of Energy Representative to the Joint Refueling Group
  - Oversight of all radiological and nuclear work and testing
  - Authority to stop work, operations, or testing when they consider conditions to be unsafe
  - Provide external vantage point to shipyard leadership of potential concerns

Reactor Plant Contractors Office (RPCO)

General Responsibilities

- Who are they: Employees of the Naval Nuclear Laboratory (NNL) representing both NNL & Bechtel Plant Machinery Inc. (BPMI)
- Participation in Test Groups:
  - Joint Refueling Group (JRG)
  - Joint Test Group (JTG)
- The Resident Manager, Reactor Plant Contractors Office has the authority to stop work, operations, or testing when they consider conditions to be unsafe
- Represent and consult with Prime Contractors
- Provide technical advice and support to the Naval Reactors Representative

RPCO General Responsibilities

- Oversee technical aspects of Naval nuclear work and evolutions to ensure they are conducted safely
- Provide timely technical assistance to the shipyard and forces afloat
- Raise appropriate technical concerns with the shipyard or Prime Contractor
- Within their authority, locally resolve problems associated with the reactor plant and Government furnished equipment
- Identify and recommend improvements in naval nuclear work or evolutions

Joint Test Groups

- Nuclear and Non-Nuclear Joint Test Groups ensure that testing is conducted safely (with respect to people and equipment), in accordance with applicable instructions/directives, and coordinated with other work/activities
  - Naval Supervising Activity Chief Test Engineer (Chairperson)
    - Nuc (C/2340)
    - Non-Nuc (C/246)
  - Gov't regulator (a.k.a. the oversight)
    - NRRO
  - Ship's Force
    - Nuc (always the ENG/Reactor Officer)
    - Non-Nuc (usually the WEPS/Non-Nuc Primary Assistant (PA))
  - Prime Contractor (Reactor Plant Contractor's Office, mostly for nuclear technical advice)

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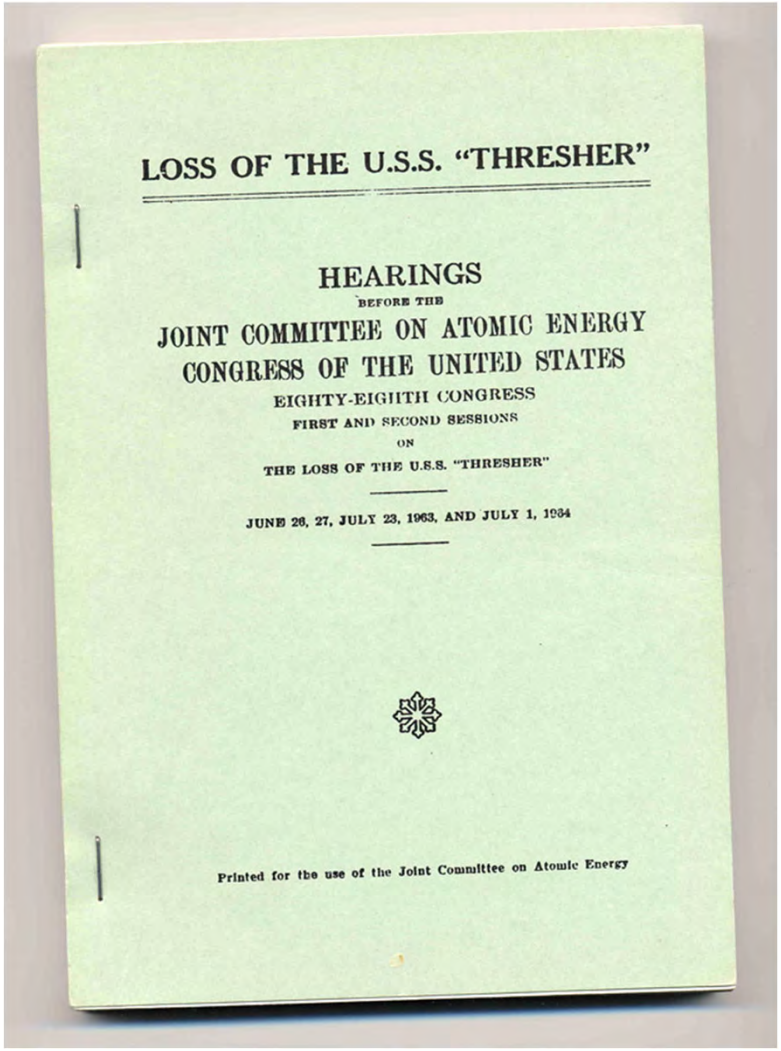
Origins of the SUBSAFE & Deep Submergence System Safety Programs

Loss of USS THRESHER (SSN 593) & USS Grayback (SS-574)

- Loss of the USS THRESHER led to the establishment of the Submarine Safety (SUBSAFE) Program

- Loss of the USS Grayback led to the establishment of the Deep Submergence Systems (DSS) Program

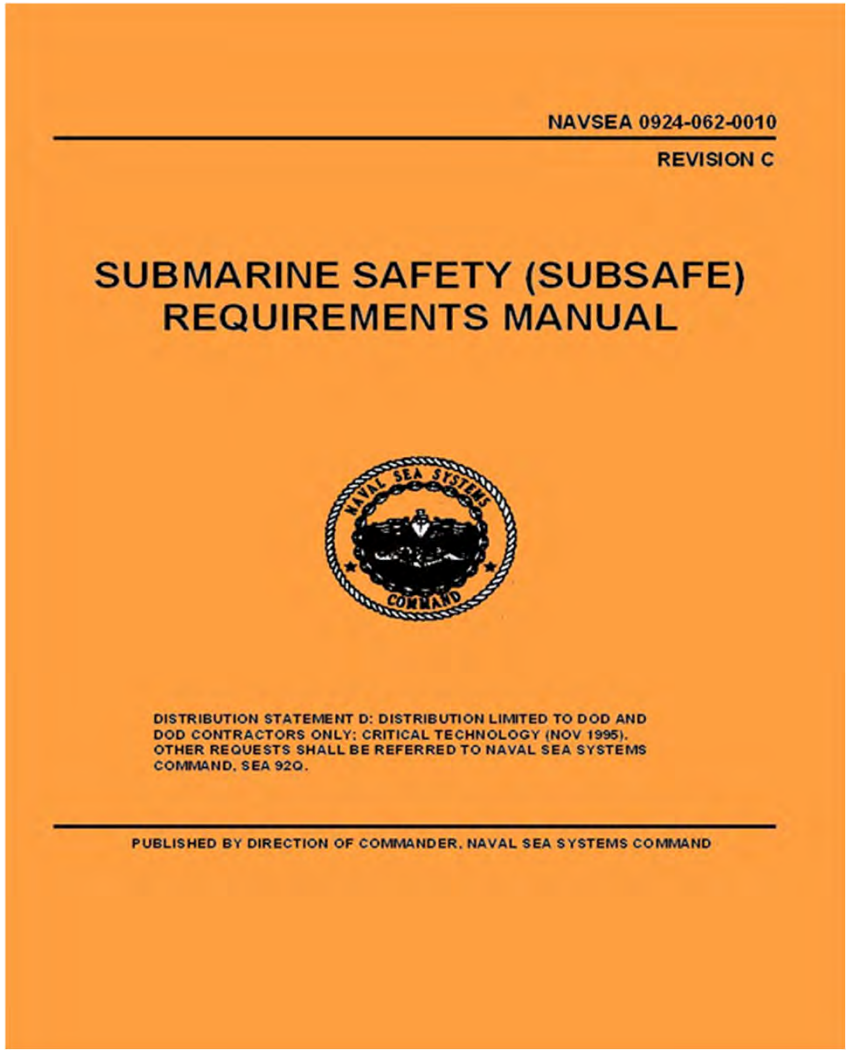

LOSS OF THE U.S.S. "THRESHER"

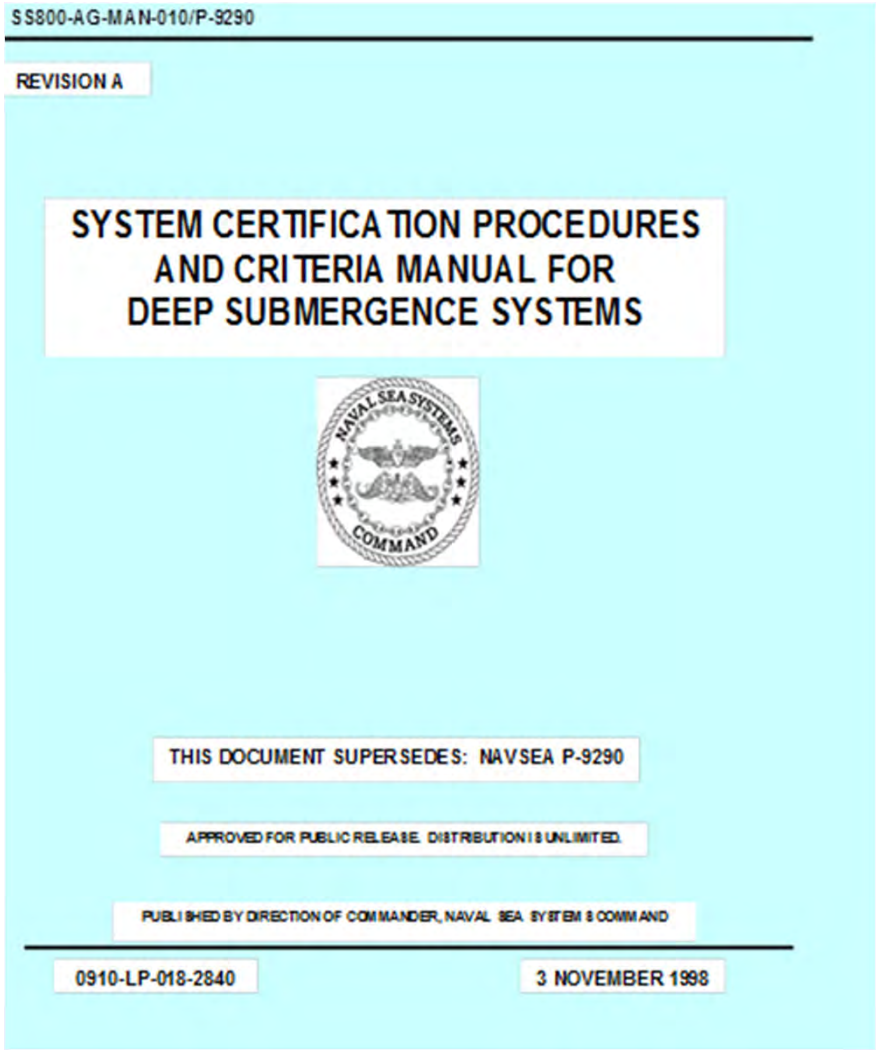
HEARINGS
BEFORE THE
JOINT COMMITTEE ON ATOMIC ENERGY
CONGRESS OF THE UNITED STATES
EIGHTY-EIGHTH CONGRESS
FIRST AND SECOND SESSIONS
ON
THE LOSS OF THE U.S.S. "THRESHER"

JUNE 26, 27, JULY 23, 1963, AND JULY 1, 1964

Printed for the use of the Joint Committee on Atomic Energy

SUBSAFE and DSS Governing Documents





Purpose of the SUBSAFE Program

- The purpose of the SUBSAFE Program is to provide maximum reasonable assurance of
  - Hull integrity, in order to preclude flooding
  - Operability and integrity of critical systems and components to control and recover from a flooding casualty

SUBSAFE Program Fundamentals

- Work discipline
  - Knowledge of requirements
  - Compliance with requirements
- Material control
  - Correct & traceable material installed
  - From purchase to final installation, everything involved in ensuring the correct material is installed
- Documentation
  - Design products (specs, drawings, maintenance standards)
  - Objective Quality Evidence (OQE), Re-Entry Control (REC), Quality Assurance (QA) forms from Joint Fleet Maintenance Manual (JFMM)
- Compliance verification
  - Inspections, surveillance, technical reviews, audits, certification

SUBSAFE General Requirements

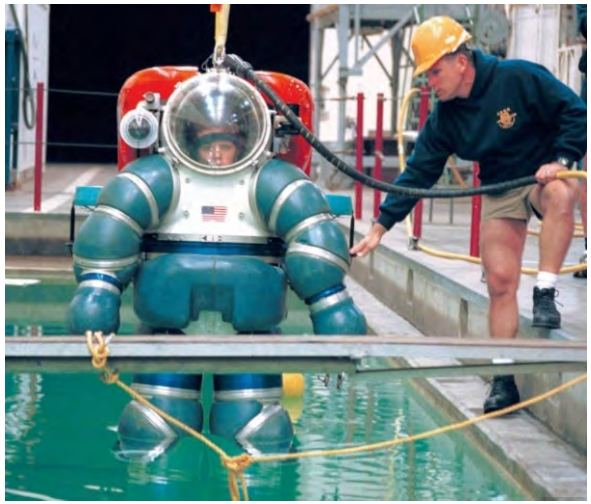
- SUBSAFE certification is maintained throughout the life of a submarine
  - Initial certification at new construction is coordinated through the cognizant Supervisor of Shipbuilding (SUPSHIP) office
  - After initial certification, the SUBSAFE boundary integrity is maintained through:
    - Re-Entry Control (REC)
    - Unrestricted Operations Maintenance Requirements Card (URO MRC) Program
    - SUBSAFE Audits
      - Certification audits
      - Functional audits

Level I Material Identification And Control (MIC)/ SUBSAFE Stock Program

- Level I is a designation assigned to both nuclear and non-nuclear systems and components installed in critical Navy surface ship and submarine applications that require a high degree of assurance that the chemical and mechanical properties of the installed material meet specified requirements. Component and/or system criticality is determined by evaluating the effect of material failure on factors such as ship control, propulsion, recoverability, and safety
- Testing: Raw materials intended for eventual use in Level I applications are tested by the original manufacturing mill or an independent laboratory to ensure conformance with specification requirements
- Traceability: Level I material is marked after it is manufactured to identify the lot number from which it was fabricated
  - Level I material must always remain traceable to the original test reports that prove the acceptability of the material
- Receipt Inspection: Level I material must be receipt inspected by a NAVSEA-approved certifying activity (normally the procuring activity) to validate material conformance

Deep Submergence Systems (DSS) Program

- Purpose: To provide maximum reasonable assurance that a material or procedural failure that can imperil the operators or occupants (of Deep Submergence Systems) will not occur



Scope of Certification for the DSS Program

- Manned noncombatant submersibles
- Submarine oriented DSS including diving systems
- Man-rated portions of handling systems for above systems and submersibles
- Applicable when:
  - Navy personnel (civilian or military) use any DSS
  - Any personnel use a Navy-owned DSS

Fly-By-Wire Program

- Similar to SUBSAFE and DSS-SOC programs
- Provides maximum reasonable assurance that a submarine fly-by-wire control system will not cause or impede recovery from a jam dive casualty
- Requires re-entry controls for any work performed within the Submarine Flight Critical Component (SFCC) boundary
  - NSWC Carderock is the In-Service Engineering Agent (ISEA) for all SFCC work

NAVSEA T9044-AD-MAN-010, Requirements Manual for Submarine Fly-By-Wire Ship Control Systems

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USS GUITARRO (SSN 665) Sinking

- The sinking of the USS GUITARRO at the pier in Mare Island Naval Shipyard on 15 May 1969 led to the *Manual for the Control of Testing and Ship Conditions* – the "6010" Manual

Sinking of GUITARRO

- 4:00PM: Nuc group began an instrumented calibration of certain tanks located aft of the ship's pivot point (filling tanks with water)
- 4:30PM: Non-nuc group began an evolution to reduce the ship's trim angle by filling tanks forward of the ship's pivot point
- 4:30 to 7:50PM: Nuc group kept adding water to the after tanks
- 4:30 to 7:45PM: Non-nuc group kept adding water to the forward tanks
- 7:00 to 7:30PM: A security watch warns the non-nuc group several times that river water is starting to wash into openings in the ship. Warnings go unheeded
- 7:45PM: Non-nuc group stops adding water and breaks for lunch
- 7:50PM: Nuc group finishes the calibration and starts to empty the aft tanks
- 8:30PM: Nuc group completes draining the aft tanks and the ship has a down angle (negative trim)
- 8:45PM: Non-nuc group returns from lunch to find river water gushing into all the forward openings in the ship. Hatches are fouled and can't be closed

Sinking of GUITARRO

"At approximately 8:30 PM (Pacific Daylight Time), Thursday May 15, 1969, the nuclear powered attack submarine Guitarro (SSN-665) sank while tied up to the dock at the Mare Island site of the San Francisco Bay Naval Shipyard. The ship had been under construction since August 1965, and was due to be commissioned in January 1970. Sinking was caused by uncontrolled flooding within the forward part of the ship. It was refloated at 11:18 AM (PDT), Sunday, May 18, and after inspection damages were estimated at between $15.2 million and $21.85 million."

Source: U.S. Congress, House Committee on Armed Services. Armed Services Investigating Subcommittee. The Sinking of the USS Guitarro. 91st Cong., 1st sess., 1 July 1969. Washington, DC.

Sinking of GUITARRO

"The Guitarro should not have sunk. It was not overwhelmed by cataclysmic forces of nature or an imperfection in design or an inherent weakness in its hull. Rather, it was sent to the bottom by the action, or inaction, of certain construction workers who either failed to recognize an actual or potential threat to the ship's safety or assumed that it was not their responsibility."

Source: U.S. Congress, House Committee on Armed Services. Armed Services Investigating Subcommittee. The Sinking of the USS Guitarro. 91st Cong., 1st sess., 1 July 1969. Washington, DC.

Industrial Ship Safety Manual for Submarines
(6010 Manual)

- Purpose and applicability:
  - Provides specific requirements for nuclear submarines for the control of work and testing which could affect ship conditions
  - Especially applicable during high-risk evolutions during periods of construction, conversion, overhaul, and other availabilities in shipyards
  - Applies to naval nuclear plant evolutions that affect Buoyancy, List, Trim, Watertight Integrity and Stability (BLTWS)
    - Example: Rx Comp shielding is on the Ship Safety Plan of the Day (POD)

- Ship conditions: Buoyancy, List, Trim, Watertight Integrity and Stability
  - "BLT with Salt"

Major Requirements of the Industrial Ship Safety Manual for Submarines

- Establishes the Ship Safety Organization, including the Ship Safety Officer, Ship Safety Council, and Ship Safety Watch
- Establishes the Ship Test Organization, including Chief Test Engineers, Shift Test Engineers, and the non-nuclear Joint Test Groups:
  - Joint Test Group-Hull, Propulsion and Auxiliaries (JTG-HP&A)
  - Joint Test Group-Weapons (JTG-W)
- Establishes controlling documents, including the Safety Plan of the Day (SPOD), Daily Test Schedule (DTS), and Prerequisite Lists for High-Risk Evolutions
- Establishes flooding & fire prevention and control procedures

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MIAMI Fire Background

- USS MIAMI (SSN 755)
  - Completed two months of a 20-month Engineered Overhaul (EOH) at Portsmouth Naval Shipyard (PNSY)
- Boat was in dry dock
- Habitability disestablished
- All weapons removed
- Sonar, fire control, and electronic equipment spaces depopulated
- Battery was removed
- Reactor plant shut down since availability start

MIAMI Fire Background

- Major fire occurred in forward compartment
  - Date: 23 May 2012
  - Time: approximately 1730
  - Duration: 10 hours
  - Location: Wardroom Stateroom One (WRSR1)
  - Middle level – hard to access
  - Cause: arson
  - Initial Source: combustible material in WRSR1
  - Damage: over $750M to repair

MIAMI Major Lessons Learned

- Industrial environment complicates fire and response
  - Crew and Damage Control (DC) gear moved off-hull due to lack of habitability
  - Hull cut provided air to fuel the fire
  - Hatches and temporary services impeded access by emergency responders
- Early detection and rapid response extremely important
  - Fire set in out of way area
  - Initial report of location confused due to heavy black smoke
- Extended response capabilities are crucial
  - Requires integrated Command and Control (C2) structure, interoperable radios, and coordinated firefighting strategy
  - Required 20 mutual aid fire departments and Fire and Emergency Services (F&ES) personnel to augment PNSY resources

Lessons relate to all ship classes in Public and Private Shipyards

USS BONHOMME RICHARD

- Major fire started on USS BONHOMME RICHARD on 12 July 2020 and burned for 5 days
- Navy convened the PACFLT command investigation on USS BONHOMME RICHARD
- There were four categories of causal factors that allowed for the accumulation of significant risk and led to an ineffective fire response:
  - Material condition of the ship
  - Training and readiness of the ship's crew
  - Integration between the ship and supporting shore-based firefighting organizations
  - Oversight by commanders across multiple organizations

- The command investigation also concluded "a lack of familiarity with requirements and procedural noncompliance at multiple levels of command" contributed to the loss of ship

8010 Background

- Single source document for fire prevention and response in the industrial environment
  - Recommended by the U.S. Fleet Forces Command (USFFC) MIAMI Fire Flag Review Panel
  - Institutionalizes the Fire Lessons Learned and Corrective Actions
  - Integrates with existing fire safety requirements from General Specifications for Overhaul of Surface Ships (GSO), Deep Diving General Overhaul Specifications (DDGOS), Industrial Ship Safety Manual for Submarines (6010 Manual), Joint Fleet Maintenance Manual (JFMM), Naval Ships Technical Manuals (NSTMs). Duplicative requirements in process of removal
- Approved by COMNAVSEA on 6 February 2014
- 8010 Rev 1 approved on 30 August 2023 revised the original version of the 8010 to clarify processes and make understanding easier. It also added flexibility to develop mitigations for strict procedural compliance, shifting to a principle based document

8010 Overview

- Applicability
  - ***Applicable to all Ship Repair and/or Construction Activities (SRCAs)/Naval Supervisory Authorities (NSA) and to all ship availabilities***
    - Naval Supervisory Authority (NSA) is the single naval activity responsible for the integration, oversight and verification of all work done by all activities (e.g., U.S. Navy shipyards, regional maintenance centers (RMC), SUPSHIP, and Trident Refit Facility) during maintenance availabilities. (8010 Rev 1 para 2 page 1-7)
  - Implements a Memorandum of Agreement (MOA) to document basic requirements for the prevention of, detection of, and response to fires onboard Navy vessels during industrial work to ensure safety of equipment and personnel during CNO Availabilities as required by reference 8010 Rev 1. This MOA designed to ensure that each organization agrees with, understands how the requirements to be implemented, is aware of, and acknowledges their assigned roles and responsibilities
- Major lessons learned and corrective actions
  - Establishes the right standards and capabilities to improve fire prevention, detection, immediate response, and extended response
  - Demonstrates capabilities with large scale, complex periodic fire drills

8010 Implementation

- Use of judiciousness and flexibility during implementation
  - Balance costs and risks associated with requirements during implementation
  - Require MOA to document agreements on how to implement for each ship availability
- Execution of requirements and technical authority
  - Prior to start of availability – MOAs between Ship, SRCA/NSA, and ISIC/TYCOM on how to implement requirements locally
  - During availability - Fire Safety Councils (FSC) established. The FSC is a term used to describe collectively the persons assigned by their parent organizations to take required local approval actions for each specific ship on work, schedules, hull cuts, fire zones, access/egress routes, alarms, firefighting systems, temporary services routing, etc., that affect the maintenance of ship fire safety.
    - FSC membership must include (at a minimum) the Fire Safety Officer (FSO), a vessel representative, and an engineering representative. The FSC is responsible for ensuring compliance with fire safety requirements contained in this manual. This includes but is not limited to oversight, reviewing, and approving risk mitigations, and conducting inspections. (8010 Rev 1 Para 4 page 1-8)

8010 Implementation

- Execution of requirements and technical authority
  - Established 8010 implementation working group to address requirement interpretation questions and discuss change requests
  - Technical issues requiring Departures from Specification (DFS) should be submitted per engineering change and non-conformance process detailed in NAVSEAINST 5400.95, Waterfront Engineering and Technical Authority Policy
  - Formal manual change requests submitted as a Technical Manual Deficiency/Evaluation Report (TMDER)

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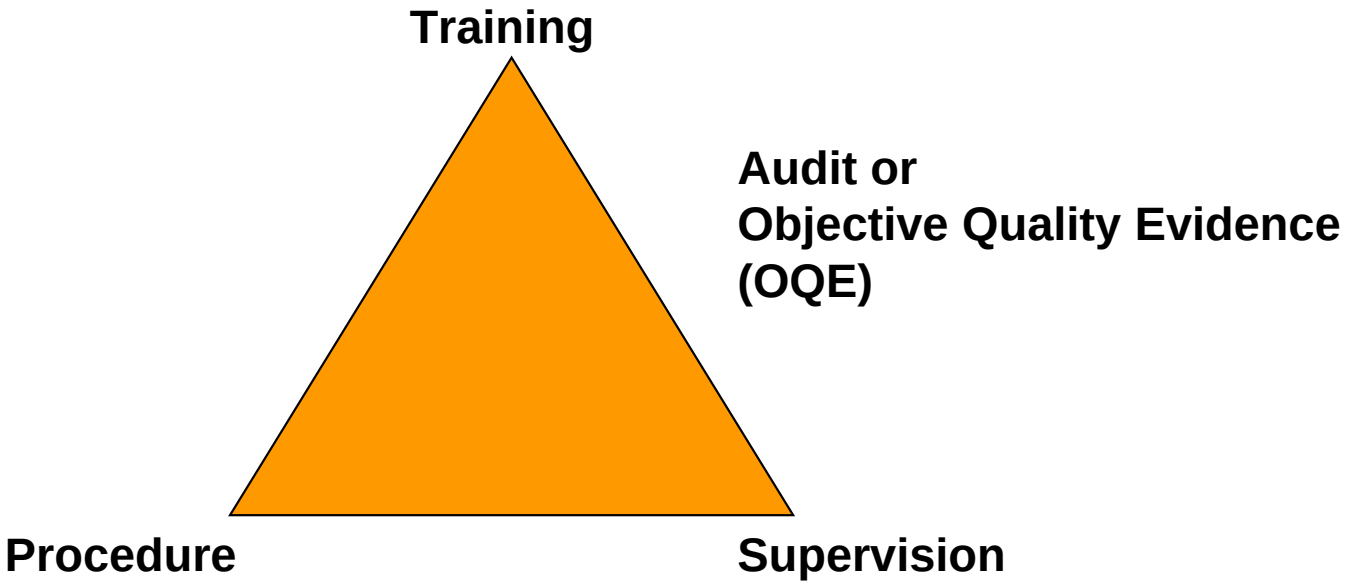
Work Authorization and Control

- The basic idea: The complexity/criticality of the work to be performed determines the level of “control” required

- The Work Control Triangle



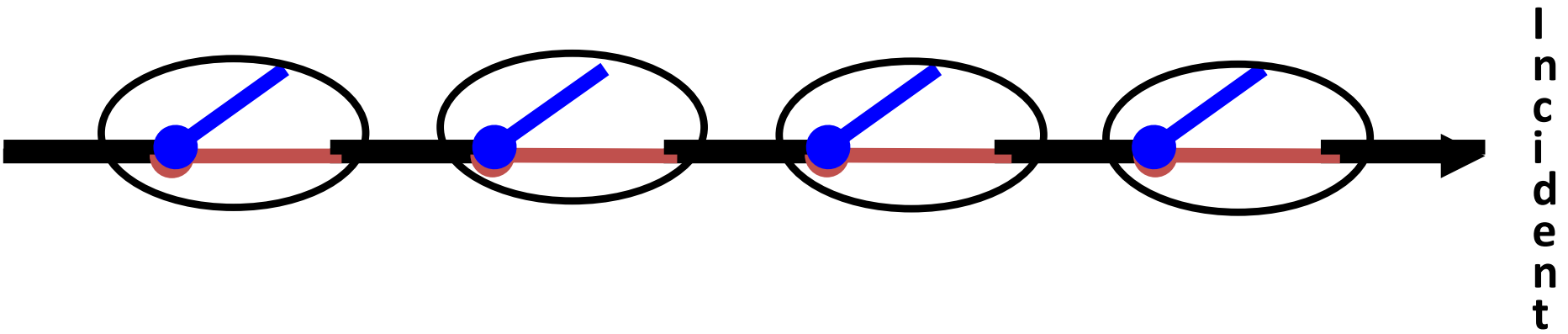
Applications of the Work Control Model

- Before you start work
  - Two basic questions
    - What's the probability that "it" could go wrong
    - What are the impacts if "it" does go wrong (severity)
  - Add controls if the risks are considered excessive

ORM

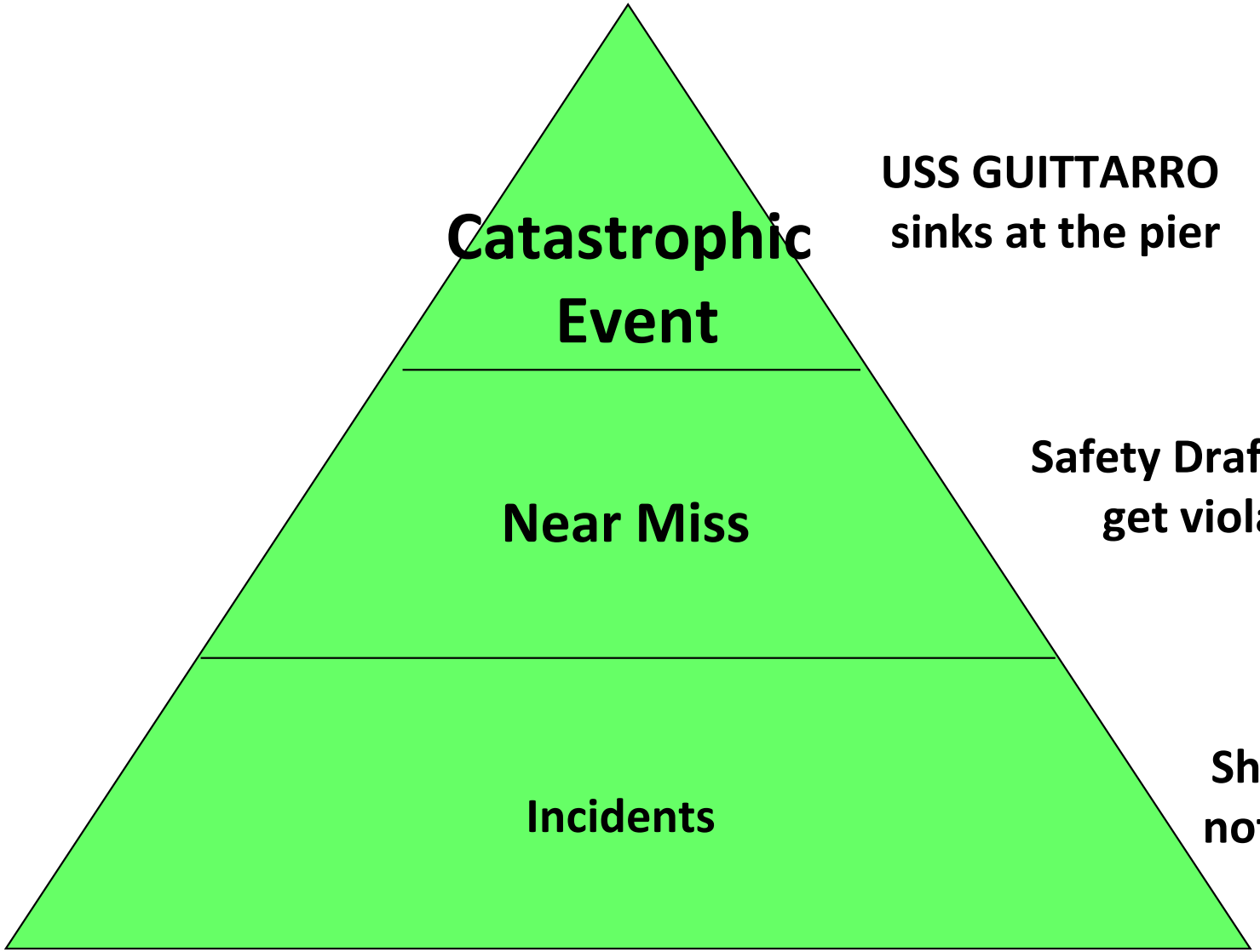
- If an unplanned event occurs
  - Hold the Team Learning Session (TLS)(Submarines) or Critique (Surface)
    - Short and long-term corrective actions
    - Root cause analysis
    - Bridging actions
  - Was the severity of the unplanned event unacceptable?
    - If yes, then review the adequacy of the in-place controls (supervision, training, procedure, audit, etc.) and modify the work control triangle to your oversight/process as necessary

Switch Theory
(Why we hold critique or TLS)



- When problems occur, there are many contributing factors (i.e., many switches must close)
- Human nature causes us to focus on the last switch, because it is the obvious cause (the factor closest to the event)
- A self-critical organization will look for all of the causes, or switches that closed
- Candid and open discussions are required to identify all facts and problems

Problems and Their Severity

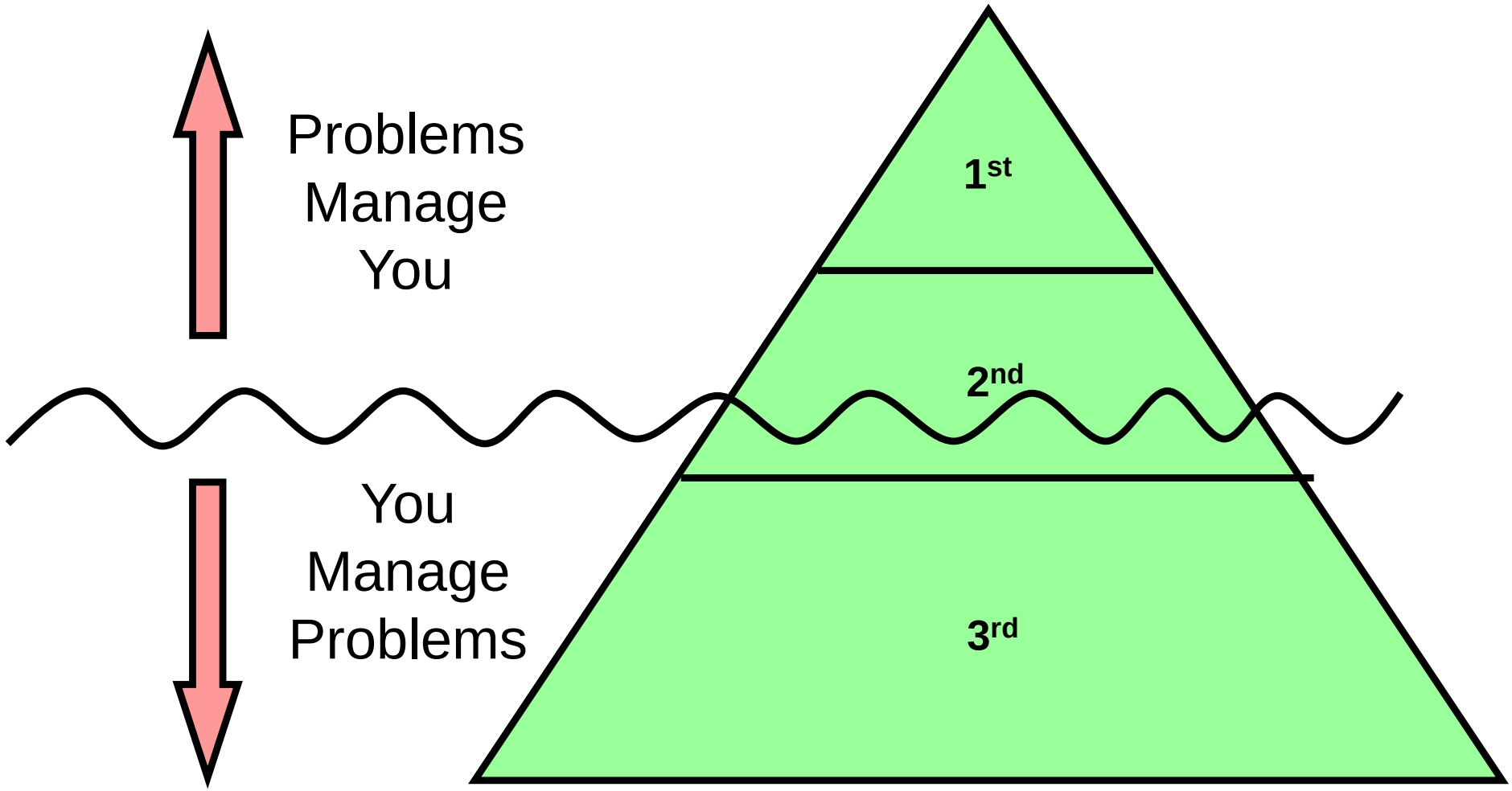


USS GUITTARRO sinks at the pier

Safety Draft Marks get violated

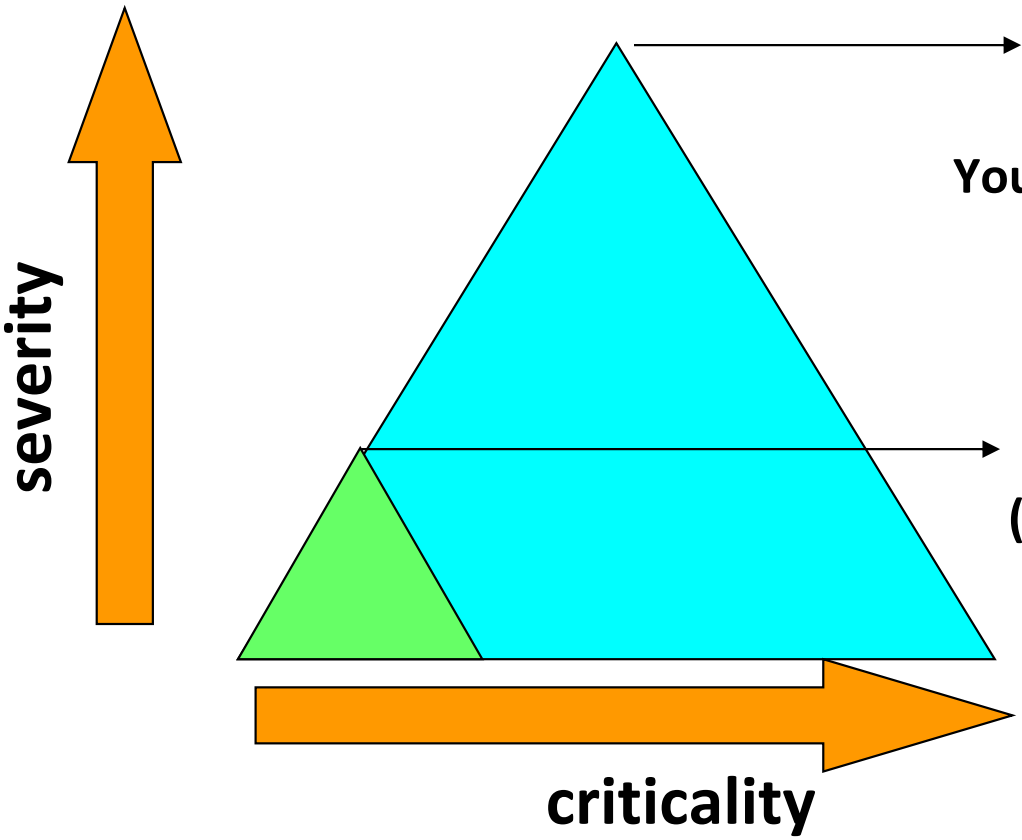
Ship Safety Evolution not listed on the SPOD

When do you still have control?



Prevent big problems by working hard on the small ones

Work to Eliminate the Small Events



Pinnacle event
(Mass Casualty)
You are working to prevent

Less severe event
(Loss of single life, loss of limb, etc.)
all procedures aligned to prevent

The theory is that the pinnacle event will never happen if the less severe event is your control point

Work Authorization and Control

- Minimum requirements to perform any work on ships and submarines
  - A valid ***Technical Work Document*** (TWD)

    and

  - Permission to perform work (***authorization***)

Work Authorization and Control

- Technical Work Documents (TWD)
  - 3 types (listed in increasing levels of control and complexity)
    - Maintenance Procedure
    - Formal Work Package
    - Controlled Work Package
  - How to decide which one to use?
    - Reference: Joint Fleet Maintenance Manual (JFMM)
    - Consider the following:
      - Complexity of task
      - Knowledge of craftsmen performing work
      - Higher need for Objective Quality Evidence (OQE)

Work Authorization and Control

- Process to authorize work on ships and submarines
  - Reference: JFMM VOL 4 CH.10
  - All outside activity work requires formal authorization through a Work Authorization Form (WAF)
    - To ensure work is authorized and controlled to meet personnel and ship safety standards
  - Applies to commissioned U.S. Navy ships in all maintenance availabilities (public and private)

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Special Considerations for Tag-Outs in a Maintenance Environment

- Reference: Tag-Out Users Manual (TUM)
  - Repair Activity Responsibilities and Representatives (Para 1.3.3)
  - Barrier criteria (Appendix G)
  - Divers' tags (Appendix E)
  - Common tag-out situations for industrial maintenance periods (Appendix F)
  - 6010 tag-out process amplifications (Appendix H)
  - Shift Operations Management System (SOMS) (Appendix I)

- New construction (private shipyard)
  - Contractors use Occupational Safety and Health Administration (OSHA) mandated processes for work isolation
  - TUM requirements begin when the pre-commissioning crew moves aboard or, for nuclear work, when the crew takes control of a system

Special Considerations for Tag-Outs in a Maintenance Environment

- Repair Activity (RA) responsibilities
  - Ensure you have TUM qualified people
  - Ensure your personnel understand the Tag-Out (T/O)
  - Ensure accuracy and adequacy of the T/O
  - Sign the T/O as the RA representative
  - Ensure that when the T/O is no longer needed, sign for their removal
- Divers' tags
  - RA representative will be the diving activity. If not, a MOA is required and proposed divers T/O out will be reviewed by the diving activity supervisor and RA
  - If T/O effects multiple tag-out logs, each line item will be referenced on the WAF
  - Diving activity supervisor will be briefed on the T/O, work area isolation devices, and/or other operations that could affect the T/O
  - TUM Appendix E lists minimum equipment required to be tagged-out
  - Inter-department T/O required for sea chests that provide common suction for more than one pump

Tag-Outs: Double Barrier Protection

- High temperature (200°F or more)
- High pressure (1000 psi or greater)
- All sea connected systems, except lines less than 1/2-inch Nominal Pipe Size (NPS) inboard of the backup valves
- All hull penetrations below the maximum anticipated waterline, except mechanical and electrical penetrations designed for single closure (e.g., shaft or cable penetrations)
- Fluids with flash point below 200°F
- Oxygen
- Hazardous, toxic vapor (dry cleaning fluid, photo-chemical fluids, and phosphate ester hydraulic fluid)

Summary

- What is the primary mission of Naval Reactors?
- Who does RPCO report to?
- What event resulted in SUBSAFE and DSS programs?
- What event led to 6010 manual requirements?

Summary

- What event led to 8010 manual requirements?
- What two things are required to perform work on a ship?
- What are conditions requiring double-barrier protection?