NDIA Environment, Energy Security & Sustainability Symposium Presentation

12467 – Environmental Hazard Analysis – Task 210

Part of Upcoming Change to MIL-STD-882D

U.S. AIR FORCE

New Orleans, LA
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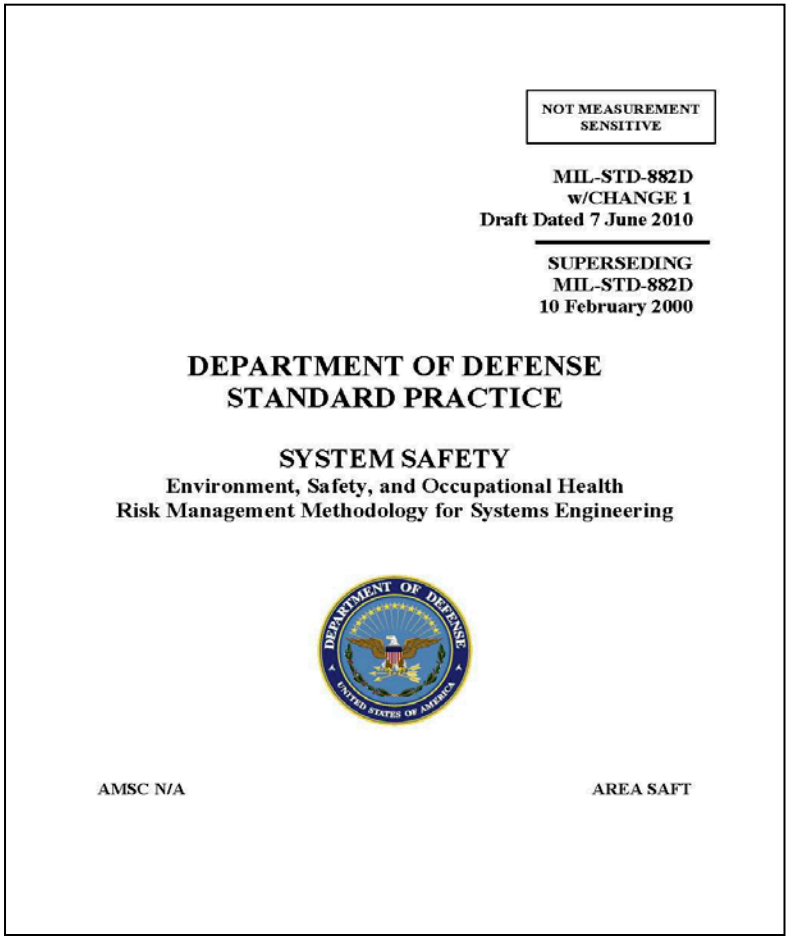
Bottom Line Up Front

- MIL-STD 882 is the DoD Standard Practice for System Safety
- DoDI 5000.02 requires programs to use MIL-STD 882 system safety process to integrate ESOH considerations into Systems Engineering
- When issued, the new MIL-STD-882E will include task descriptions that can be placed on contract with the Original Equipment Manufacturer/Prime Contractor
- Task 210 describes how the contractor should use the MIL-STD 882E system safety risk management process for Environmental Hazard Analysis

Overview

- Introduction
- Background
  - MIL-STD 882 System Safety Process
  - Risk Assessment Matrix
  - Severity
  - Probability
- Task 210
  - Purpose and Structure
  - Example Hazard
- Risk Acceptance



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MIL-STD-882D
10 February 2000

DEPARTMENT OF DEFENSE
STANDARD PRACTICE

SYSTEM SAFETY
Environment, Safety, and Occupational Health
Risk Management Methodology for Systems Engineering

AMSC N/A

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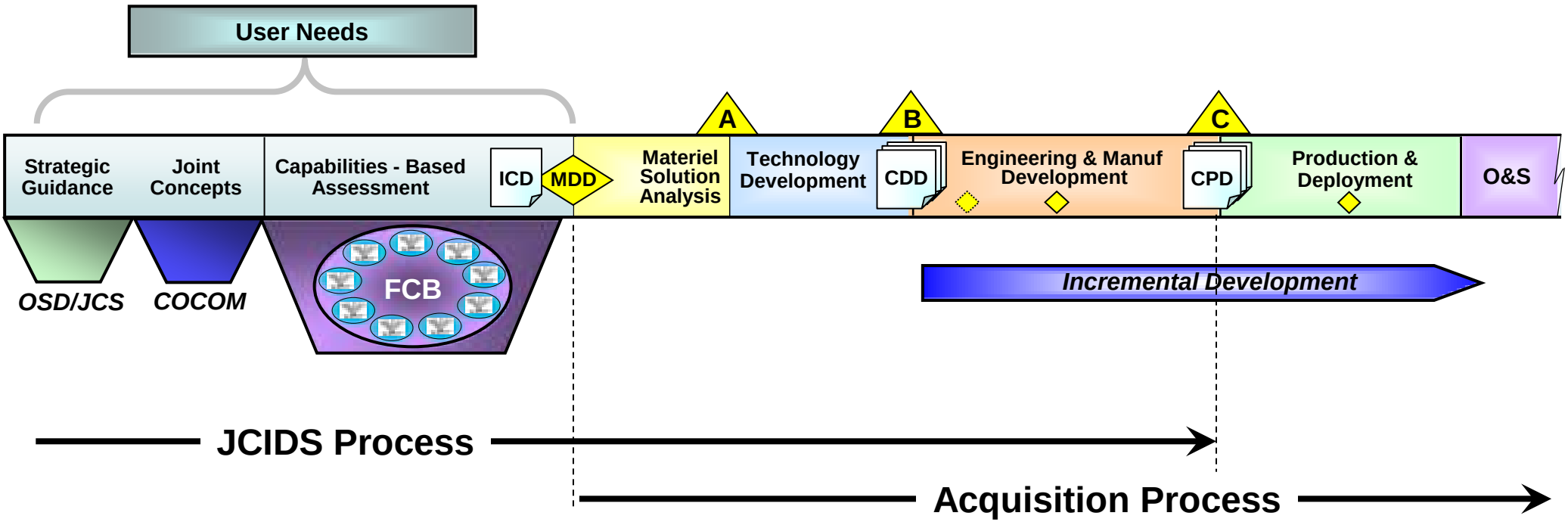
Introduction - Defense Acquisition Management System



Introduction - DoD 5000.02 Acquisition ESOH Policy

- Use MIL-STD-882D, DoD Standard Practice for System Safety
  - In all developmental and sustaining engineering activities
  - To manage ESOH risks as part of the systems engineering process
  - Across the Acquisition Life cycle

ESOH refers to all individual, but interrelated, disciplines that encompass environment, safety, and occupational health

Background - MIL-STD-882D System Safety Process

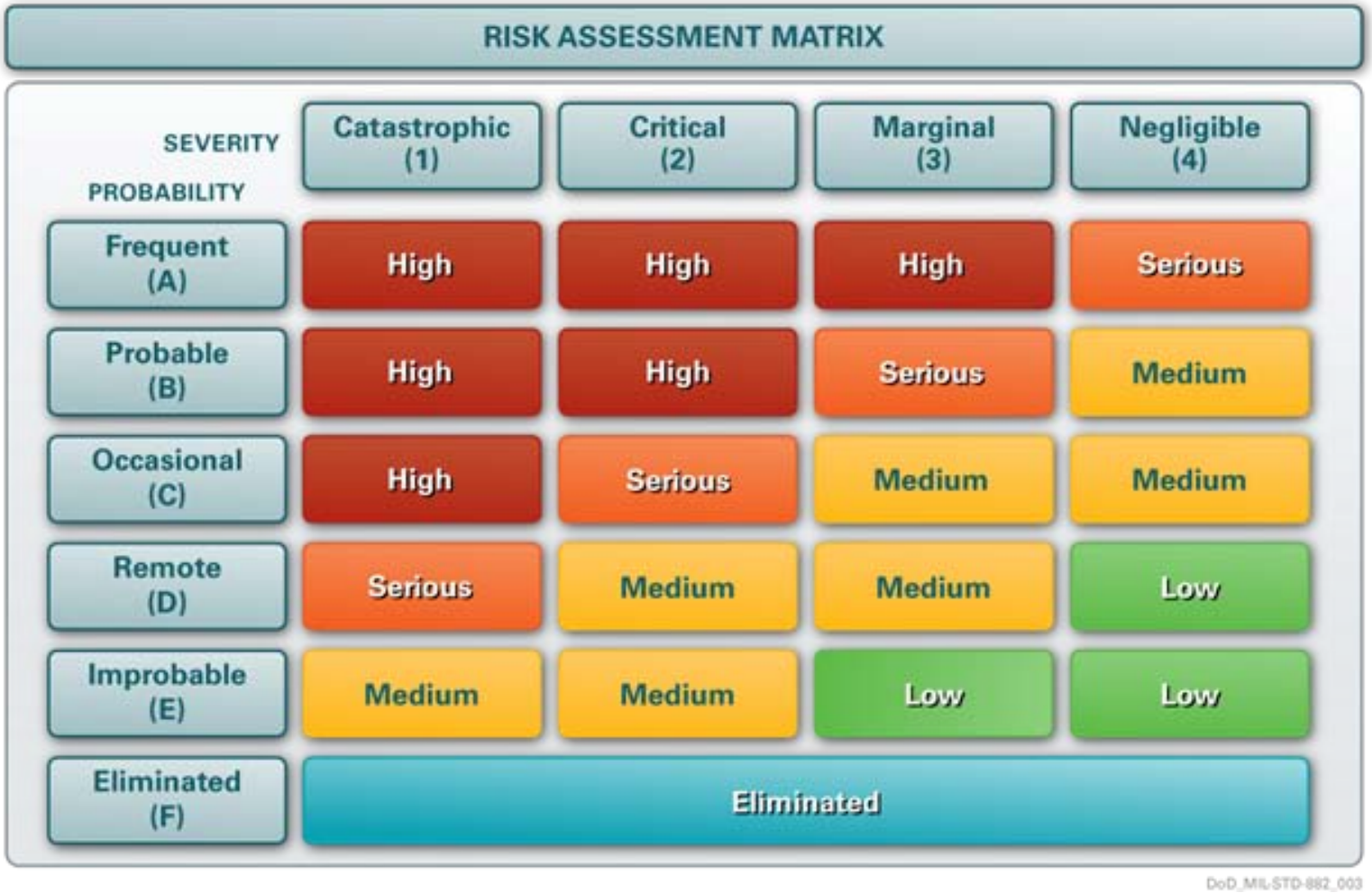
1. Document the system safety approach
2. Identify hazards
3. Assess risk
4. Identify mitigation measures
5. Reduce risk
6. Verify risk reduction
7. Accept risk
8. Manage life-cycle risk

SYSTEM SAFETY ORDER OF PRECIDENCE

1. Eliminate hazards through design selection
2. Reduce risk through design alteration
3. Incorporate engineered features or devices
4. Provide warning devices
5. Develop procedures and training

Risk = Severity x Probability

Background - The Risk Assessment Matrix



Background - ESOH Risk: Severity

SEVERITY CATEGORIES		
Severity Category	**Severity Level**	**Environment, Safety, and Occupational Health Mishap Result Criteria**
Catastrophic	1	Could result in one or more of the following: death, permanent total disability, irreversible significant environmental impact, or loss exceeding $10M.
Critical	2	Could result in one or more of the following: permanent partial disability, injuries or occupational illness that may result in hospitalization of at least three personnel, reversible significant environmental impact, or loss exceeding $1M but less than $10M.
Marginal	3	Could result in one or more of the following: injury or occupational illness resulting in 10 or more lost work days, reversible moderate environmental impact, or loss exceeding $100K but less than $1M.
Negligible	4	Could result in one or more of the following: injury or illness resulting in less than 10 lost work days, minimal environmental impact, or loss less than $100K.

DoD_MIL-STD-882_001

Mishap. An unplanned event or series of events resulting in death, injury, occupational illness, damage to or loss of equipment or property, or damage to the environment. For the purposes of this document, the term “mishap” includes negative environmental impacts from planned and unplanned events and accidents

Severity generally does not change unless an engineering design change is made

Background - ESOH Risk: Probability

PROBABILITY LEVELS			
Description	**Level**	**Specific Individual Item[1,2]**	**Fleet or Inventory[2]**
Frequent	A	Likely to occur often in the life of an item; with a probability of occurrence greater than 10^{-1} in that life.	Continuously experienced.
Probable	B	Will occur several times in the life of an item; with a probability of occurrence less than 10^{-1} but greater than 10^{-2} in that life.	Will occur frequently.
Occasional	C	Likely to occur sometime in the life of an item; with a probability of occurrence less than 10^{-2} but greater than 10^{-3} in that life.	Will occur several times.
Remote	D	Unlikely, but possible to occur in the life of an item; with a probability of occurrence less than 10^{-3} but greater than 10^{-6} in that life.	Unlikely but can reasonably be expected to occur.
Improbable	E	So unlikely, it can be assumed occurrence may not be experienced in the life of an item; with a probability of occurrence of less than 10^{-6} in that life.	Unlikely to occur, but possible
Eliminated[3]	F	Incapable of occurrence in the life of an item. This category is used when potential hazards are identified and later eliminated.	Incapable of occurrence within the life of an item. This category is used when potential hazards are identified and later eliminated.

DoD_MIL-STD-882_002

Background - Revision of MIL-STD 882D Underway

- 882 already provides a methodology for risk management
- Revising MIL-STD-882D to be better suited for Managing Environmental Issues as part of the Systems Engineering Process
- Tasks are being added to address environmental considerations
  - Task 105 – Hazard Tracking System
  - Task 107 – Hazardous Materials Management Plan (HMMP)
  - Task 210 – Environmental Hazard Analysis

Making MIL-STD 882 more "User Friendly" for Environmental Professionals

Task 210 – Purpose and Structure

- Purpose: Use System Safety process to identify environmental hazards, assess the associated risk, identify potential mitigation measures, implement chosen measures, reassess the risk, and obtain formal risk acceptance

- Task Structure:

  210.1 Purpose

  210.2 Task Description
  - Using system safety process and risk matrix
  - Identifying Environmental Requirements and Hazards
  - Environmental analysis considerations
  - Reporting Requirements

  210.3 Details to be Specified
  - Added by Government to Contract Scope to Bound the Analysis

Task 210 – Example Hazard

Example – Contaminated Wash Water from Nickel-Cadmium Plated Compressor Blades on T-56 Turboprop Engine									
Hazard	**Description**	**Initial Severity**	**Initial Prob.**	**Initial Risk Category**	**Risk Mitigation**	**Target Severity**	**Target Prob.**	**Target Risk Category**	**Status**
Contaminated wash water from Ni-Cd Plated Compressor Blades	Cadmium contaminated wash water effluent a NPS water pollutant in violation of State law (regulation of storm water discharge/NPDES) with potential for citations with fines, and civil and/or criminal liability for improper disposal of hazardous waste. Cadmium contaminated drinking water can result in acute and chronic health efforts.	2	B	High	100 percent capture mandate for engine wash water requiring all DoD facilities to capture, contain, and properly treat or dispose of wash water effluent.	3	C	Med	This Program implemented this risk mitigation measure, verified its effectiveness in reducing the risk, and the PM accepted the FRC. However, the PM directed that during subsequent rework/upgrade of the T-56 turboprop engine an alternative risk mitigation measure must eliminate the hazard.
		2	B	High	Develop new compressor blades made of aluminum to replace the Ni-Cd plated blades. New blade design will eliminate the possibility of Cd leaching into the wash water effluent by eliminating the use of a hazardous material.	None	None	None	The Program verified that new Al blade design eliminated the hazard. Thus, the PM had no risk to accept.

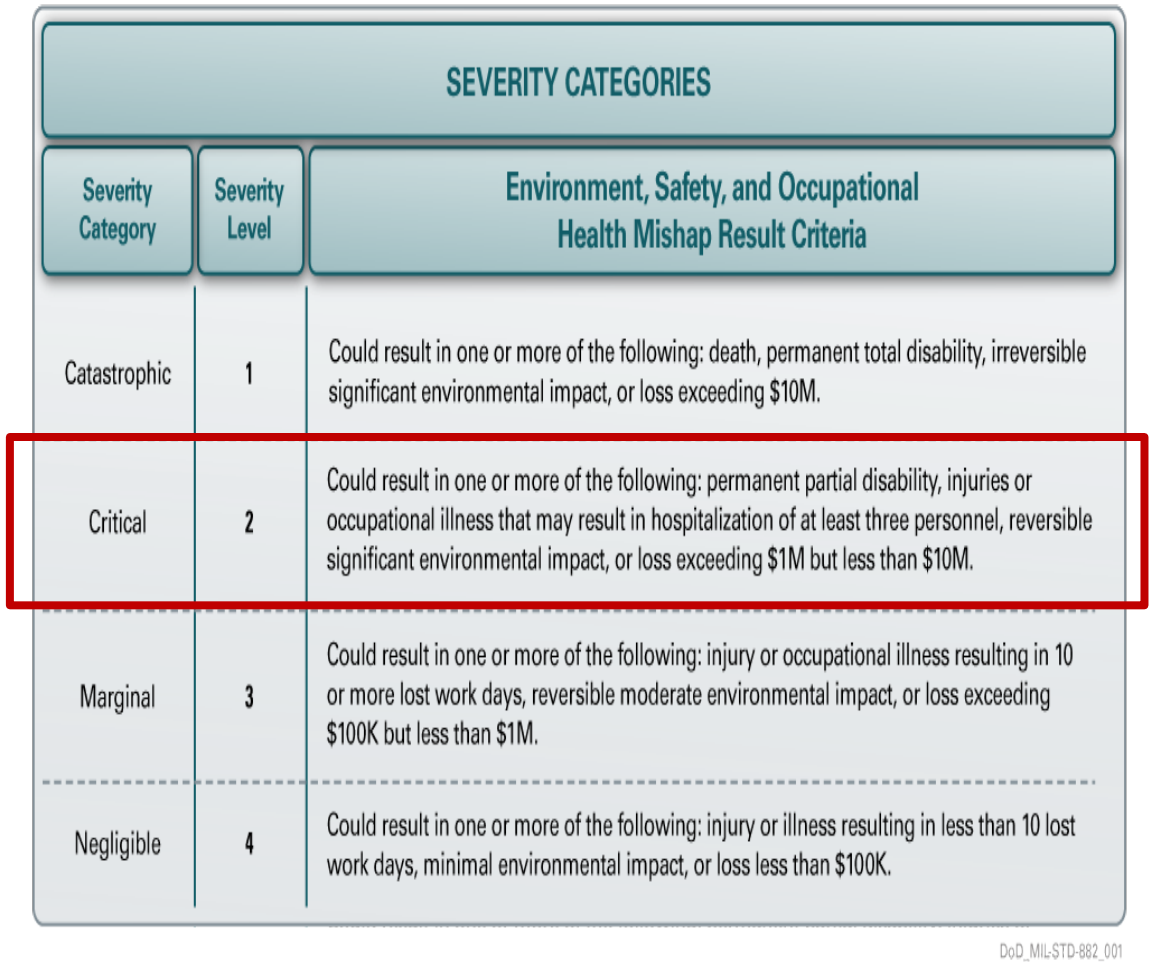
Task 210 – Example: Hazard Description

Hazard	Description
Contaminated wash water from Ni-Cd Plated Compressor Blades	Cadmium contaminated wash water effluent a NPS water pollutant in violation of State law (regulation of storm water discharge/NPDES) with potential for citations with fines, and civil and/or criminal liability for improper disposal of hazardous waste. Cadmium contaminated drinking water can result in acute and chronic health efforts.

Task 210 – Example: Initial Risk Assessment

Initial Severity	Initial Probability	Initial Risk Category
2	B	High

Task 210 – Example: What is the Severity?



SEVERITY CATEGORIES		
Severity Category	Severity Level	Environment, Safety, and Occupational Health Mishap Result Criteria
Catastrophic	1	Could result in one or more of the following: death, permanent total disability, irreversible significant environmental impact, or loss exceeding $10M.
Critical	2	Could result in one or more of the following: permanent partial disability, injuries or occupational illness that may result in hospitalization of at least three personnel, reversible significant environmental impact, or loss exceeding $1M but less than $10M.
Marginal	3	Could result in one or more of the following: injury or occupational illness resulting in 10 or more lost work days, reversible moderate environmental impact, or loss exceeding $100K but less than $1M.
Negligible	4	Could result in one or more of the following: injury or illness resulting in less than 10 lost work days, minimal environmental impact, or loss less than $100K.

DoD_MIL-STD-882_001

Task 210 – Example: What is the Probability?

PROBABILITY LEVELS			
Description	**Level**	**Specific Individual Item[1,2]**	**Fleet or Inventory[2]**
Frequent	A	Likely to occur often in the life of an item; with a probability of occurrence greater than 10^{-1} in that life.	Continuously experienced.
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Eliminated[3]	F	Incapable of occurrence in the life of an item. This category is used when potential hazards are identified and later eliminated.	Incapable of occurrence within the life of an item. This category is used when potential hazards are identified and later eliminated.

DoD_MIL-STD-882_002

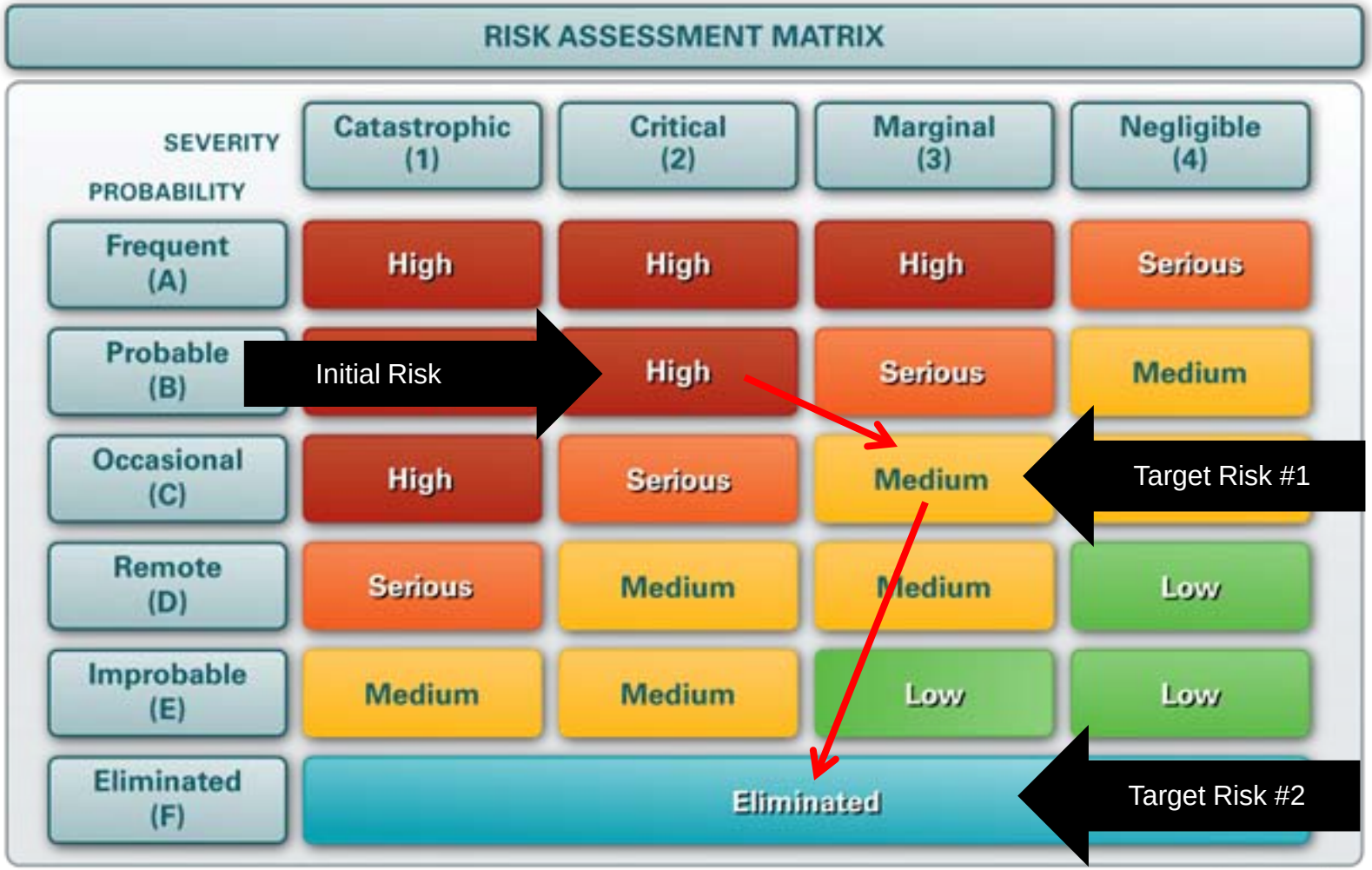
Task 210 – Example: Mitigations and Target Risk #1

Risk Mitigation	Target Severity	Target Probability	Target Risk Category	Status
100 percent capture mandated for engine wash water requiring all DoD facilities to capture, contain, and properly treat or dispose of wash water effluent.	3	C	Med	This Program implemented this risk mitigation measure, verified its effectiveness in reducing the risk, and the PM accepted the Final Risk Category (FRC). However, the PM directed that during subsequent rework/upgrade of the T-56 turboprop engine an alternative risk mitigation measure must eliminate the hazard.

Task 210 – Example: Mitigations and Target Risk #2 (Program Manager's Preference)

Risk Mitigation	Target Severity	Target Probability	Target Risk Category	Status
Develop new compressor blades made of aluminum to replace the Ni-Cd plated blades. New blade design will eliminate the possibility of Cd leaching into the wash water effluent by eliminating the use of a hazardous material.	None	F	Eliminated	The Program verified that new Al blade design eliminated the hazard. Thus, the PM had no risk to accept.

Task 210 – Example: Assessed Risk



Risk Acceptance

- ESOH Risk must be accepted prior to exposing people, equipment, or the environment to the hazard
  - All the mitigations must be verified effective and the associated risk is accepted (by appropriate authority)

Questions

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BACK UP CHARTS

Background

- System environmental risks could result in mission and operational constraints and compliance burdens for receiving installations, training ranges, and operational units

- Influencing design decisions is typically the most cost-effective means of effecting change to a system
  - It is important to consider potential environmental impacts during system design to eliminate the hazard vice manage them as operational constraints

    Restricted times / intervals of operation

    Restrictions on locations of operation

    Negative impact of the environment

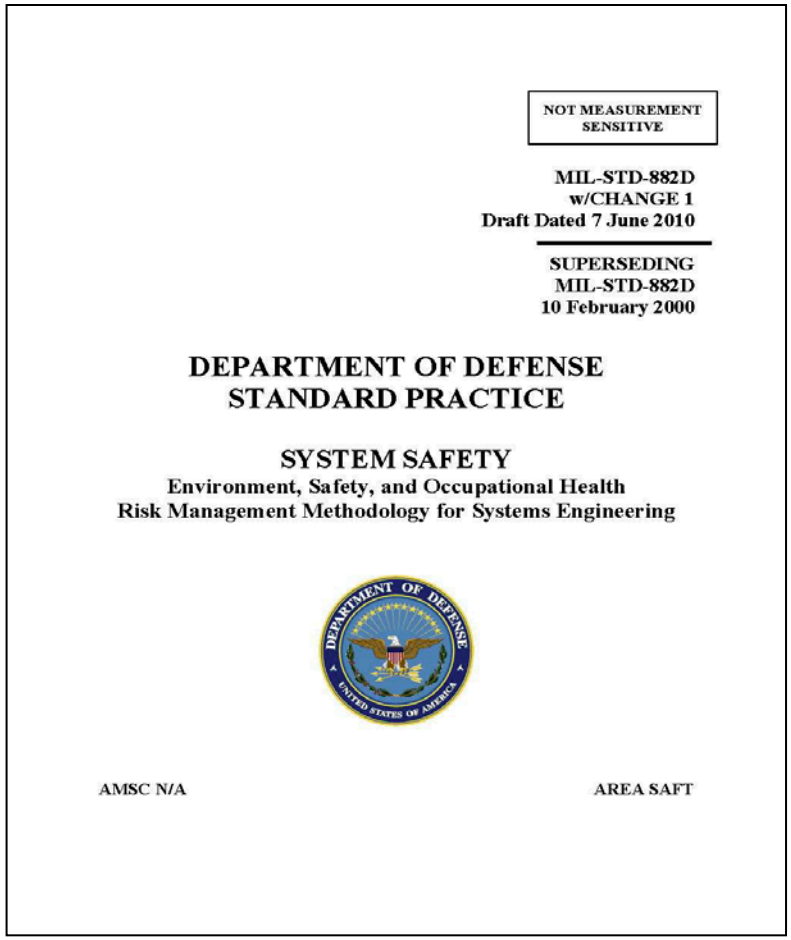
    Fines and costs to manage/mitigate impacts

Background

- Early identification and resolution of environmental hazards through the systems engineering process
  - Bring environmentally-driven requirements to the table early in the process
  - Provides decision makers with a more complete and relevant picture of the potential risks associated with test, operation, sustainment, and disposal of the system

    Advocate for funds for design changes or plan for operational mitigations
  - Helps mitigate the risk of unplanned technical, schedule, and cost impacts

DoD Standard Practice for System Safety



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Draft Dated 7 June 2010

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DEPARTMENT OF DEFENSE
STANDARD PRACTICE

SYSTEM SAFETY
Environment, Safety, and Occupational Health
Risk Management Methodology for Systems Engineering

AMSC N/A

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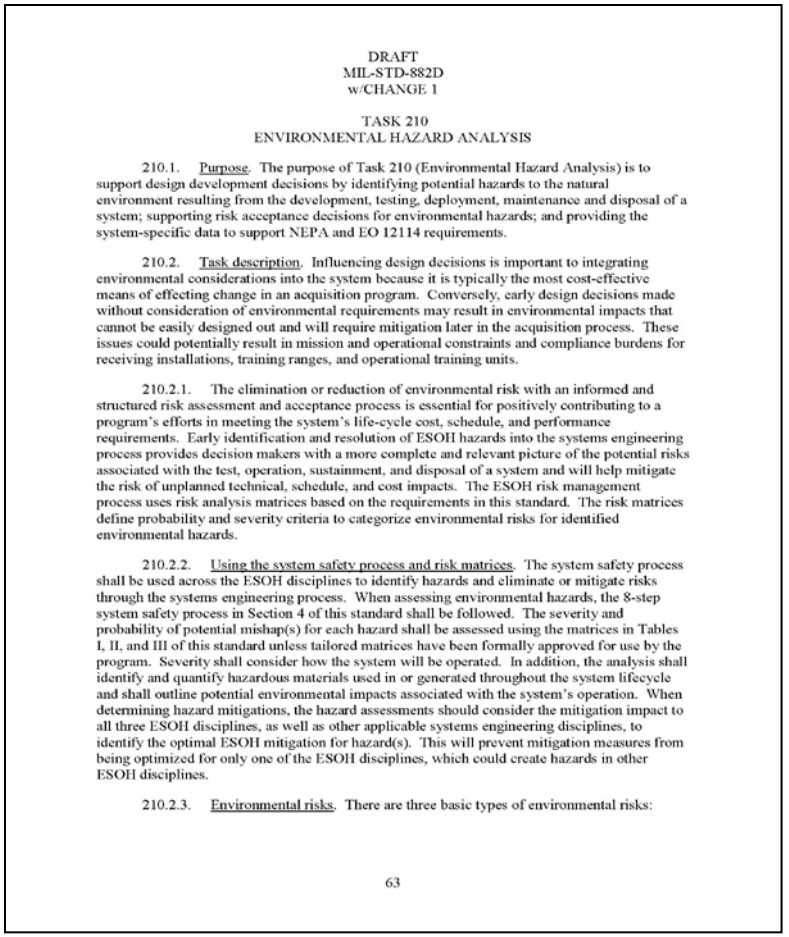

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MIL-STD-882D
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TASK 210
ENVIRONMENTAL HAZARD ANALYSIS

210.1. Purpose. The purpose of Task 210 (Environmental Hazard Analysis) is to support design development decisions by identifying potential hazards to the natural environment resulting from the development, testing, deployment, maintenance and disposal of a system; supporting risk acceptance decisions for environmental hazards; and providing the system-specific data to support NEPA and EO 12114 requirements.

210.2. Task description. Influencing design decisions is important to integrating environmental considerations into the system because it is typically the most cost-effective means of effecting change in an acquisition program. Conversely, early design decisions made without consideration of environmental requirements may result in environmental impacts that cannot be easily designed out and will require mitigation later in the acquisition process. These issues could potentially result in mission and operational constraints and compliance burdens for receiving installations, training ranges, and operational training units.

210.2.1. The elimination or reduction of environmental risk with an informed and structured risk assessment and acceptance process is essential for positively contributing to a program's efforts in meeting the system's life-cycle cost, schedule, and performance requirements. Early identification and resolution of ESOH hazards into the systems engineering process provides decision makers with a more complete and relevant picture of the potential risks associated with the test, operation, sustainment, and disposal of a system and will help mitigate the risk of unplanned technical, schedule, and cost impacts. The ESOH risk management process uses risk analysis matrices based on the requirements in this standard. The risk matrices define probability and severity criteria to categorize environmental risks for identified environmental hazards.

210.2.2. Using the system safety process and risk matrices. The system safety process shall be used across the ESOH disciplines to identify hazards and eliminate or mitigate risks through the systems engineering process. When assessing environmental hazards, the 8-step system safety process in Section 4 of this standard shall be followed. The severity and probability of potential mishap(s) for each hazard shall be assessed using the matrices in Tables I, II, and III of this standard unless tailored matrices have been formally approved for use by the program. Severity shall consider how the system will be operated. In addition, the analysis shall identify and quantify hazardous materials used in or generated throughout the system lifecycle and shall outline potential environmental impacts associated with the system's operation. When determining hazard mitigations, the hazard assessments should consider the mitigation impact to all three ESOH disciplines, as well as other applicable systems engineering disciplines, to identify the optimal ESOH mitigation for hazard(s). This will prevent mitigation measures from being optimized for only one of the ESOH disciplines, which could create hazards in other ESOH disciplines.

210.2.3. Environmental risks. There are three basic types of environmental risks:

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