

# ***Headquarters U.S. Air Force***

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## **10109 - Environmental Hazard Analysis – Task 210 in the Change to MIL-STD-882D**

**Year of the Air Force  
Family**



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# Report Documentation Page

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# ***Link to OSD Acquisition ESOH Presentation***

- **Use the System Safety methodology across the ESOH disciplines to manage ESOH risks as part of the systems engineering process**
- **ESOH refers to all individual, but interrelated, disciplines that encompass environment, safety, and occupational health**
- **Use MIL-STD-882D, the DoD Standard Practice for System Safety, in all developmental and sustaining engineering activities**

**MIL-STD-882D Change 1, the DoD Standard Practice for System Safety: ESOH Risk Management**

**Change 1 seeks to be more inclusive of the E in ESOH**



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- **MIL-STD-882D ESOH Risk Management**
  - **882D Change 1 Environmental Adds – Task 210**
  - **Task 210 Example of an Environmental Hazard**



# MIL-STD-882D

## ESOH Risk Management

1. Document the System Safety approach (**PESHE**)
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 PRECEDENCE

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**



# MIL-STD-882D ESOH Risk Assessment Matrix

RISK ASSESSMENT MATRIX				
SEVERITY	Catastrophic (1)	Critical (2)	Marginal (3)	Negligible (4)
PROBABILITY				
Frequent (A)	High	High	Serious	Medium
Probable (B)	High	High	Serious	Medium
Occasional (C)	High	Serious	Medium	Low
Remote (D)	Serious	Medium	Medium	Low
Improbable (E)	Medium	Medium	Medium	Low
Eliminated (F)	Eliminated			



# 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.

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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

Note: Severity generally does not change unless a design change is made



# ESOH Risk - Probability

PROBABILITY LEVELS			
Description	Level	Specific Individual Item <sup>1,2</sup>	Fleet or Inventory <sup>2</sup>
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 <sup>3</sup>	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.

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# ***882D Change 1 Environmental Adds***

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- **882D 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 – HMMP**
  - **Task 210 – Environmental Hazard Analysis**



- **Task 210: Environmental Hazard Analysis**
- **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**



# *Identifying Environmental Requirements*

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- **Critical step to including requirements not directly linked to risk management**
- **Examples:**
  - **Pollution Prevention goals**
  - **Not using Ozone Depleting Substances**
  - **Not using hexavalent chrome**
- **Provides vehicle for environmental requirements to be included in system design and development**
- **Requirements need to trace to a JCIDS requirement**



# Task 210 Example of an Environmental 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/NPD ES) 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	Closed. 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	Closed. The Program verified that new Al blade design eliminated the hazard. Thus, the PM had no residual risk to accept.



# *Hazard Description*

<b>Hazard</b>	<b>Description</b>
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 effects.



# *Initial Risk Assessment*

<b>Initial Severity</b>	<b>Initial Probability</b>	<b>Initial Risk Category</b>
2	B	High



# 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.

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# What is the Probability?

PROBABILITY LEVELS			
Description	Level	Specific Individual Item <sup>1,2</sup>	Fleet or Inventory <sup>2</sup>
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 <sup>3</sup>	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.

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# Mitigations and Initial Target Risk #1

Risk Mitigation	Target Severity	Target Probability	Target Risk Category	Status
<p>100 percent capture mandate for engine wash water requiring all DoD facilities to capture, contain, and properly treat or dispose of wash water effluent.</p>	<p>3</p>	<p>C</p>	<p>Med</p>	<p>Closed. 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.</p>



# Mitigations and Final Target Risk #2

Risk Mitigation	Target Severity	Target Probability	Target Risk Category	Status
<p>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.</p>	<p>None</p>	<p>F</p>	<p>Eliminated</p>	<p>Closed. The Program verified that new Al blade design eliminated the hazard. Thus, the PM had no residual risk to accept.</p>



# Assessed Risk

RISK ASSESSMENT MATRIX				
SEVERITY	Catastrophic (1)	Critical (2)	Marginal (3)	Negligible (4)
PROBABILITY				
Frequent (A)	High	High	Serious	Medium
Probable (B)	Initial Risk → High	Serious	Medium ← Target Risk #1	Low
Occasional (C)	High	Serious	Medium	Low
Remote (D)	Serious	Medium	Medium	Low
Improbable (E)	Medium	Medium	Medium	Low
Eliminated (F)	Eliminated ← Target Risk #2			



# ***Risk Acceptance***

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- **ESOH risks must be accepted prior to exposing people, equipment, or the environment to the hazard**
  - **Current risk**
  - **Residual risk**
- **All the mitigations must be verified and validated prior to accepting final or residual risk**
- **The residual risk is often the same as the target risk category, but it can differ if mitigations were proven more or less effective than expected**

