Headquarters U.S. Air Force

Integrity - Service - Excellence

28 Oct 2010 Track 9 – ESOH 11129 – Environmental Hazard Analysis, Task 210, Draft Revision to MIL-STD-882D

U.S. AIR FORCE

Sherman G. Forbes
SAF/AQRE
Life Cycle Systems Engineering Integration
Phone: 703-254-2480
E-mail: sherman.forbes@us.af.mil

U.S. AIR FORCE

BLUF

- DoD Acquisition ESOH IPT revising MIL-STD-882D, the DoD Standard Practice for System Safety
- DoDI 5000.02 mandates use of MIL-STD-882D as the methodology for managing ESOH risks
- Revision to MIL-STD-882D designed to
  - Incorporate necessary updates to align with DoDI 5000.02
  - Add mandatory standardized definitions, e.g., ESOH
  - Incorporate Software System Safety
  - Restore the task descriptions
  - Make 882 more user friendly for the environmental engineer
- Task 210 provides contractual tool for government program office environmental engineers to use to manage environmental hazards

BLUF = Bottom Line Up Front

U.S. AIR FORCE

Link to DoD Acquisition ESOH

- ESOH is an acronym for the commonly used terms environment, safety, and occupational health
- In the context of the DoD 5000 Acquisition Systems Engineering process, ESOH refers to those system design characteristics that could cause harm to people, equipment, or the environment
- Use the System Safety Methodology to manage ESOH risks as part of the systems engineering process
- Work throughout the Acquisition Life Cycle Framework
- Use MIL-STD-882D, DoD Standard Practice for System Safety, in all developmental and sustaining engineering activities

U.S. AIR FORCE

Revised 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**

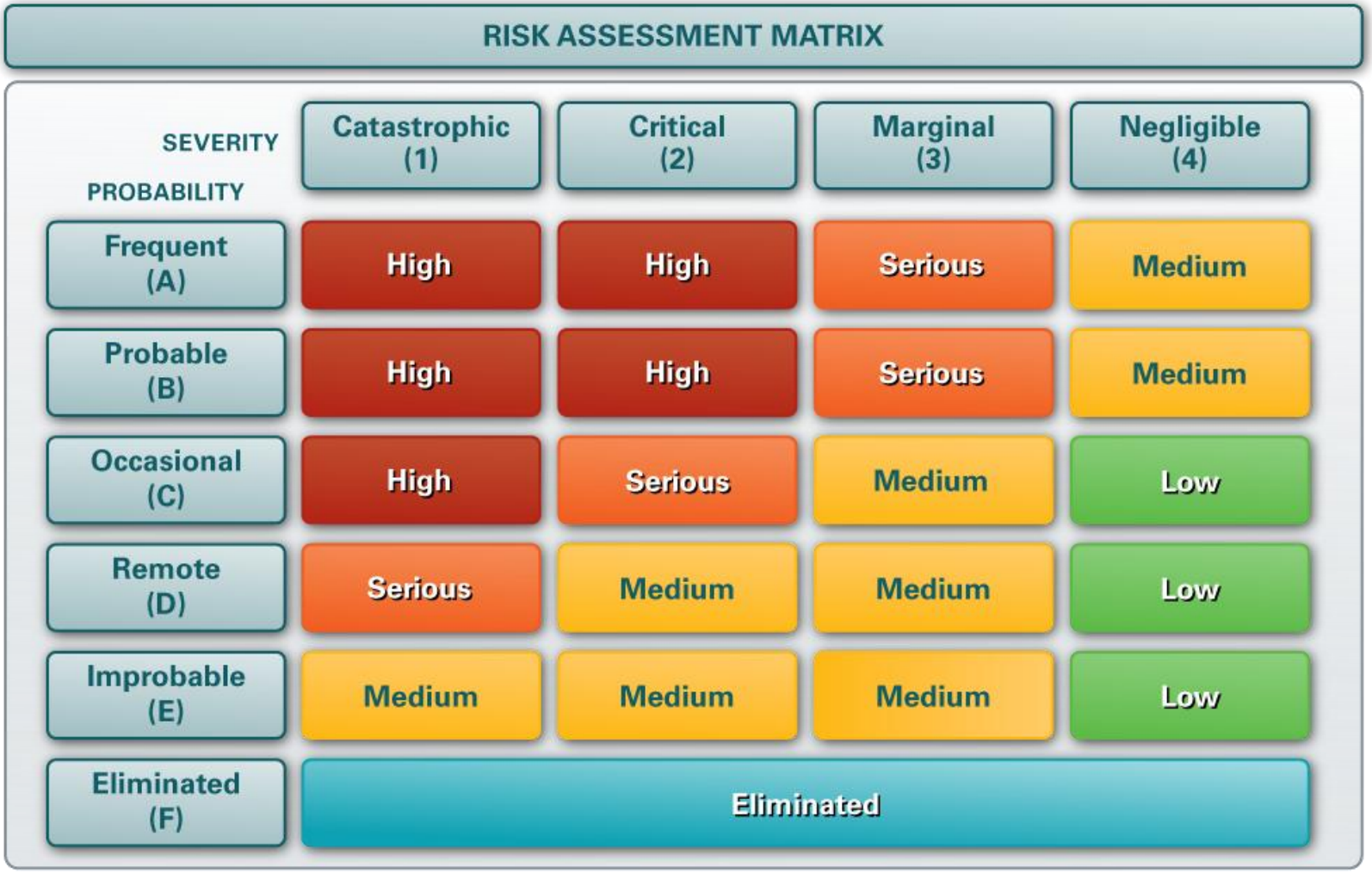
SYSTEM SAFETY ORDER OF PRECIDENCE

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

U.S. AIR FORCE

The Risk Assessment Matrix



DoD_MIL-STD-882_003

U.S. AIR FORCE

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 engineered design change is made

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

U.S. AIR FORCE

Revised 882D Link to ESOH

- 882D already provides a methodology for risk management
- Revising MIL-STD-882D to be better suited for managing environmental hazards as part of the Systems Engineering Process
- Tasks added to address environmental hazards
  - Task 105 – Hazard Tracking System
  - Task 107 – Hazardous Materials Management Process
  - Task 210 – Environmental Hazard Analysis

U.S. AIR FORCE

Task 210

- **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**

U.S. AIR FORCE

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.	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.
	Cadmium contaminated drinking water can result in acute and chronic health efforts.	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.

U.S. AIR FORCE

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.

U.S. AIR FORCE

Initial Risk Assessment

Initial Severity	Initial Probability	Initial Risk Category
2	B	High

U.S. AIR FORCE

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

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.
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

U.S. AIR FORCE

Mitigations and Target Risk #1

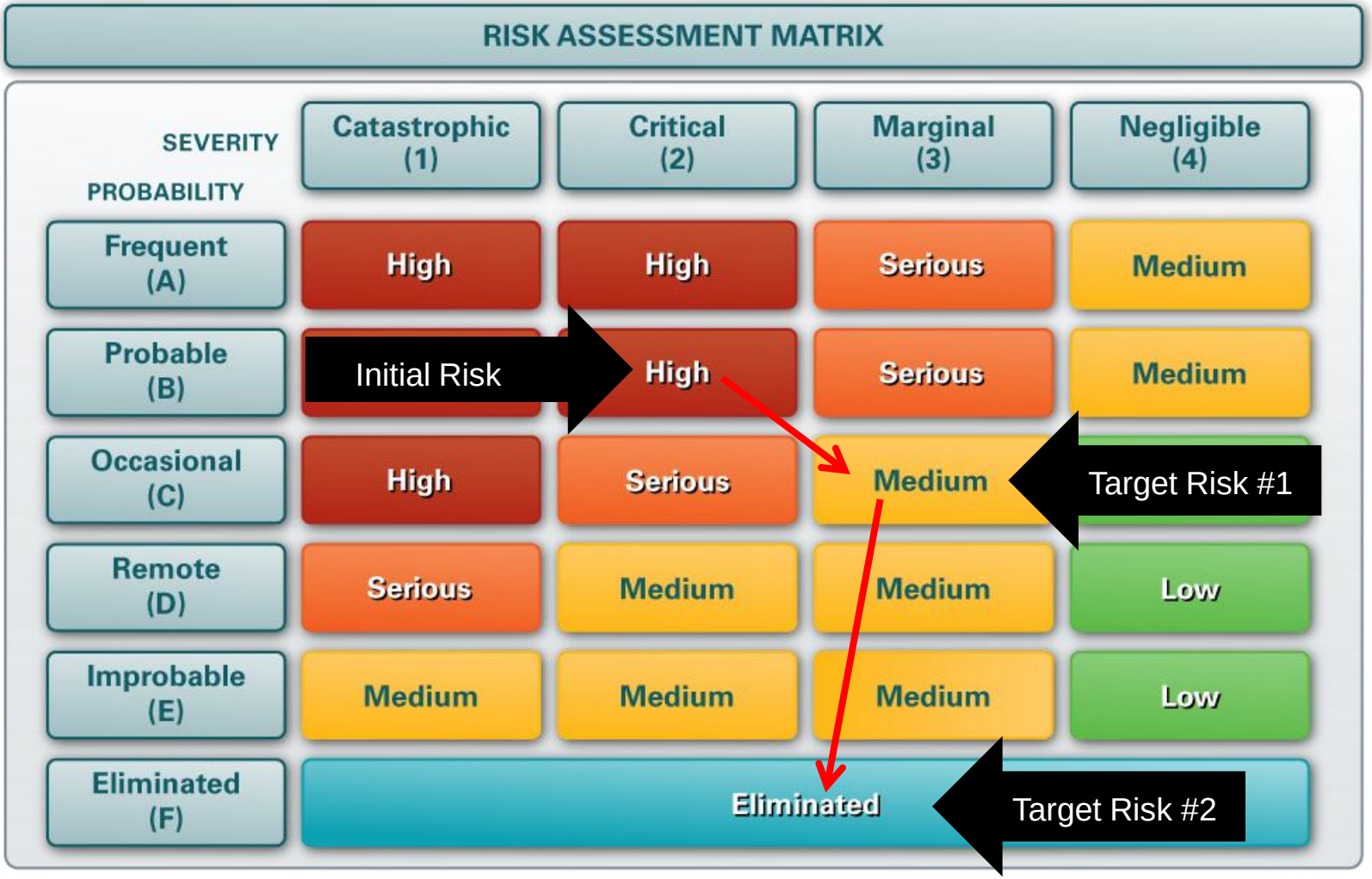
Risk Mitigation	Target Severity	Target Probability	Target Risk Category	Status
100 percent capture mandate for engine wash water requiring all DoD facilities to capture, contain, and properly treat or dispose of wash water effluent.	3	C	Med	Closed. This Program implemented this risk mitigation measure, 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.

U.S. AIR FORCE

Mitigations and Target Risk #2

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	Closed. The Program verified that new Al blade design eliminated the hazard. Thus, the PM had no residual risk to accept.

Assessed Risk



DoD_MIL-STD-882_003

U.S. AIR FORCE

Risk Acceptance

- Risk must be accepted prior to exposing people, equipment, or the environment to the ESOH hazard
  - Event risk
  - Residual risk
- Event risk = current risk at the time of the event, e.g., developmental testing
- Residual risk
  - All the mitigations must be verified effective
  - Mitigations must be implemented across the fleet
- The residual risk is often the same as the target risk, but it can differ if mitigations are more or less effective than expected

BLAB

- DoD Acquisition ESOH IPT revising MIL-STD-882D, the DoD Standard Practice for System Safety
- DoDI 5000.02 mandates use of MIL-STD-882D as the methodology for managing ESOH risks
- Revision to MIL-STD-882D designed to
  - Incorporate necessary updates to align with DoDI 5000.02
  - Add mandatory standardized definitions, e.g., ESOH
  - Incorporate Software System Safety
  - Restore the task descriptions
  - Make 882 more user friendly for the environmental engineer
- Task 210 provides contractual tool for government program office environmental engineers to use to manage environmental hazards

BLAB = Bottom Line At Back

U.S. AIR FORCE

Questions?