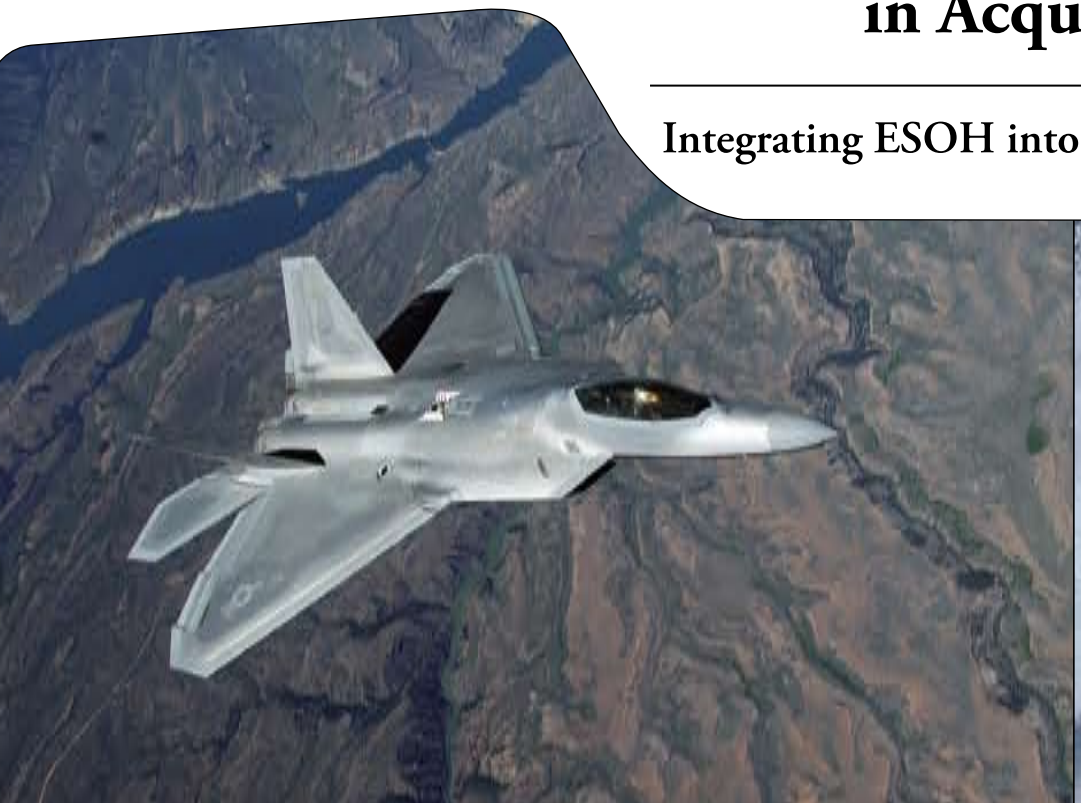
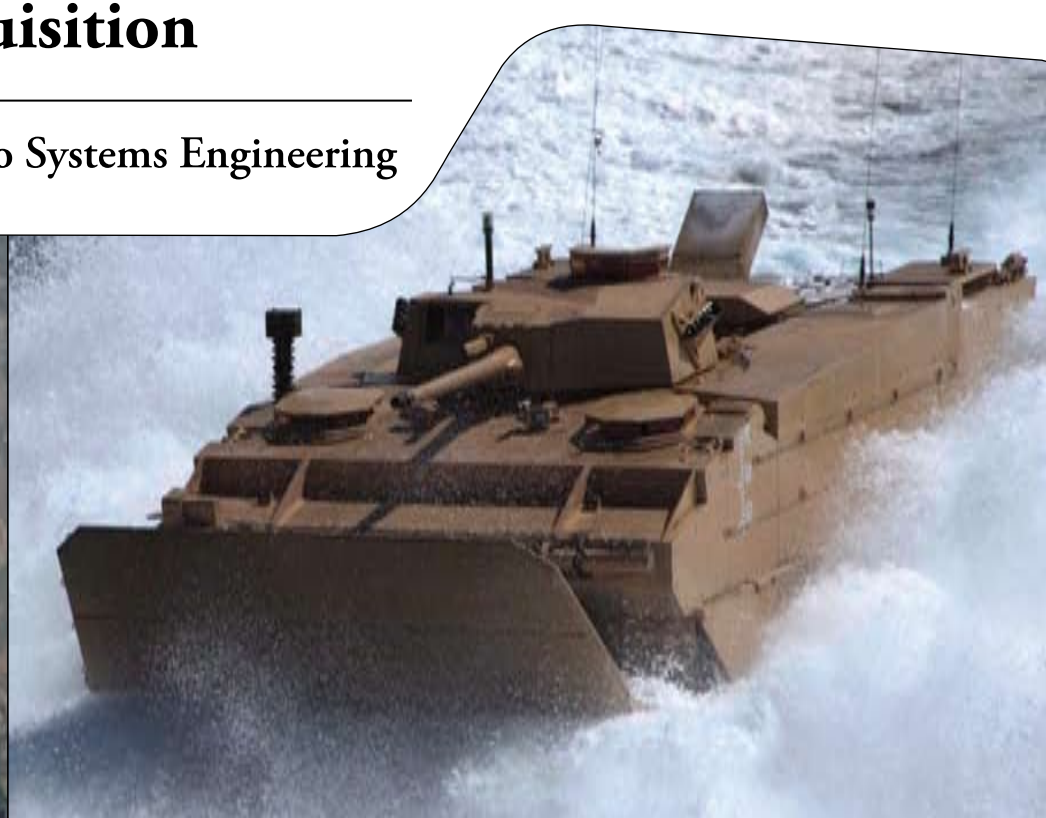
Environment, Safety, and Occupational Health (ESOH) in Acquisition

Integrating ESOH into Systems Engineering





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ESOH in Acquisition

Integrating ESOH into Systems Engineering

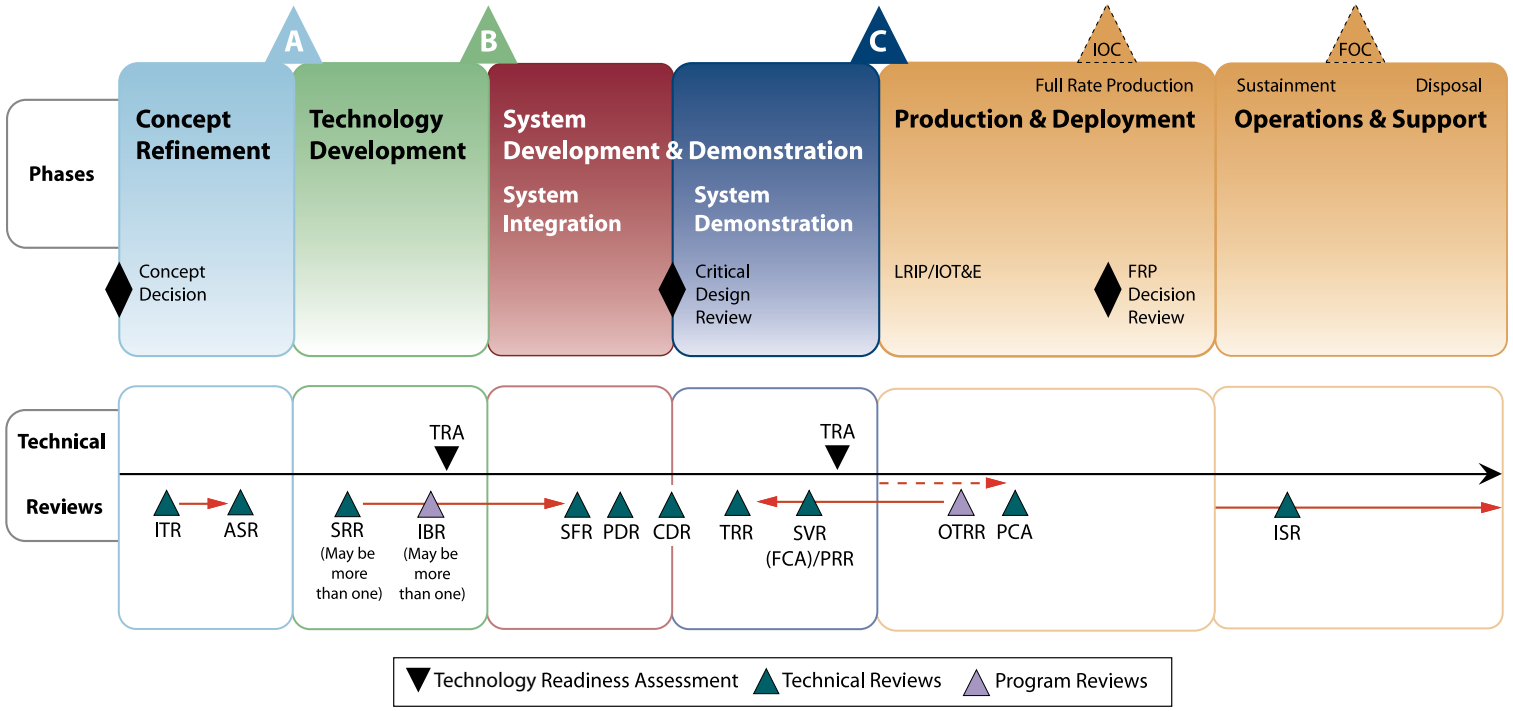
Office of the Deputy Under Secretary of Defense for Installations and Environment
and the Office of the Deputy Under Secretary of Defense for Acquisition and Technology

The Department of Defense (DoD) is committed to protecting personnel from accidental death, injury, or occupational illness; defense systems and infrastructure from accidental destruction or damage; the environment; and public property while executing its mission. As part of the systems engineering (SE) process, DoD policy requires the Program Manager to eliminate environment, safety, and occupational health (ESOH) hazards, where possible, and minimize ESOH risks throughout the system's life cycle using the methodology in the DoD Standard Practice for System Safety, Military Standard (MIL-STD)-882D. The term ESOH refers to all of the individual, but interrelated, disciplines that encompass environment, safety, and occupational health (e.g., human health, personnel safety, industrial hygiene, human factors, hazardous materials, system safety, weapons safety, space safety, nuclear safety, natural and biological, community noise, pollution, and hazardous waste). This approach supports the warfighter by enabling safe, sustainable training, operations, and combat readiness.

This guide assumes a basic understanding of DoD SE and ESOH principles and practices, and is prepared to depict when ESOH activities should be performed to influence system design throughout the SE process. This guide also incorporates the ESOH Management Evaluation Criteria which are focused on assessing an acquisition program's overall management of ESOH as an integral part of the SE process throughout the system's life cycle.

ESOH considerations are integral to the DoD SE process, as illustrated in the five SE V-Charts—one for each phase of the system's life cycle. The following pages illustrate the ESOH activities that support the development of each life cycle phase's Inputs and Outputs. Following each SE V-Chart is a list of the ESOH activities that are completed during that phase. These ESOH activities correspond to each step in the SE V-Chart.

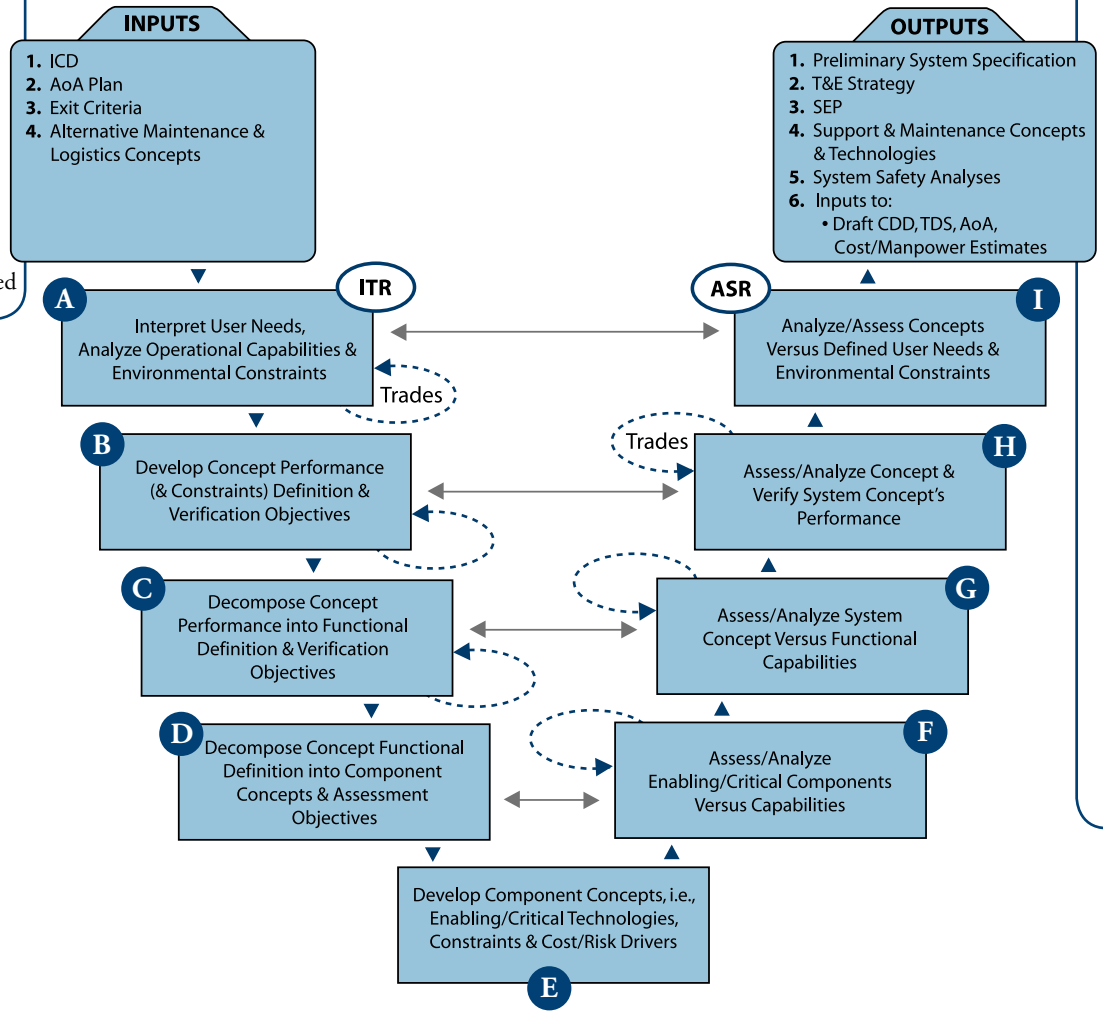
NOTE: Acronyms are only defined in the Abbreviations and Acronyms list on page 24.



Concept Refinement

ESOH Activities for each Input:

1. Provide ESOH characteristics as part of the capability definition
2. Participate in AoA development
3. Provide the following exit criteria:
   - PHL
   - Strategy for integrating ESOH risk management into the SEP
4. Provide ESOH inputs, as requested



ESOH Activities for each Output:

1. • Provide PHL and ESOH criteria
   - Identify ESOH requirements, constraints, and performance attributes for the system
   - Incorporate ESOH requirements, as applicable
2. • Provide approach to ESOH planning and the NEPA/EO 12114 Compliance Schedule
   - Provide ESOH hazard risk mitigation test and verification methodologies, and approach towards obtaining safety release(s) and ESOH risk acceptance
3. • Participate in developing the strategy for integrating ESOH risk management into SE using MIL-STD-882D
   - Identify responsibilities for ESOH integration into SE
4. Identify potential ESOH operations and maintenance issues, and identify emerging ESOH technologies and hazards
5. Ensure PHL has been completed for each system concept
6. Provide ESOH inputs, as required

NOTES: The numbers in the ESOH Activities boxes correspond to the numbers in the Inputs and Outputs boxes.

"Environmental constraints" refer to the environment in which the system is to be employed and the limitations that environment places on the system.

A
- Review the System Threat Assessment
- Identify applicable ESOH criteria and asset requirements

B
- Assess each system concept against identified ESOH criteria and requirements

C
- Translate concept-level ESOH criteria (e.g., air emissions, noise, hazardous materials (HM), effluents, and discharges) into functional requirements
- Identify applicable verification objectives

D
- Initiate the PHL

E
- Prepare the PHL
- Initiate identification of component ESOH constraints
- Recommend ESOH input into projected system attrition rates
- Review historical ESOH information (e.g., successes, mishaps, and lessons-learned) from similar or related legacy systems

F
- Identify ESOH requirements against critical component capabilities
- Evaluate component test results against identified system constraints

NOTE: The letters on this page correspond with the letters on the previous page and are associated with the respective SE step boxes.

G
- Evaluate ESOH functional requirements for the system concept based on component test and analysis results

H
- Evaluate the system concept's ability to meet performance capability requirements within identified ESOH constraints

I
- Finalize the PHL for each system concept
- Recommend the preferred ESOH approach for system concept

ITR
- Identify applicable ESOH criteria for the system(s)

ASR
- Prepare results of the PHL for each alternative and recommend ESOH level of effort required for the Technology Development phase

Trades
- Participate in trade studies to identify potential top-level hazards and ensure ESOH criteria are included in the trade studies throughout this phase

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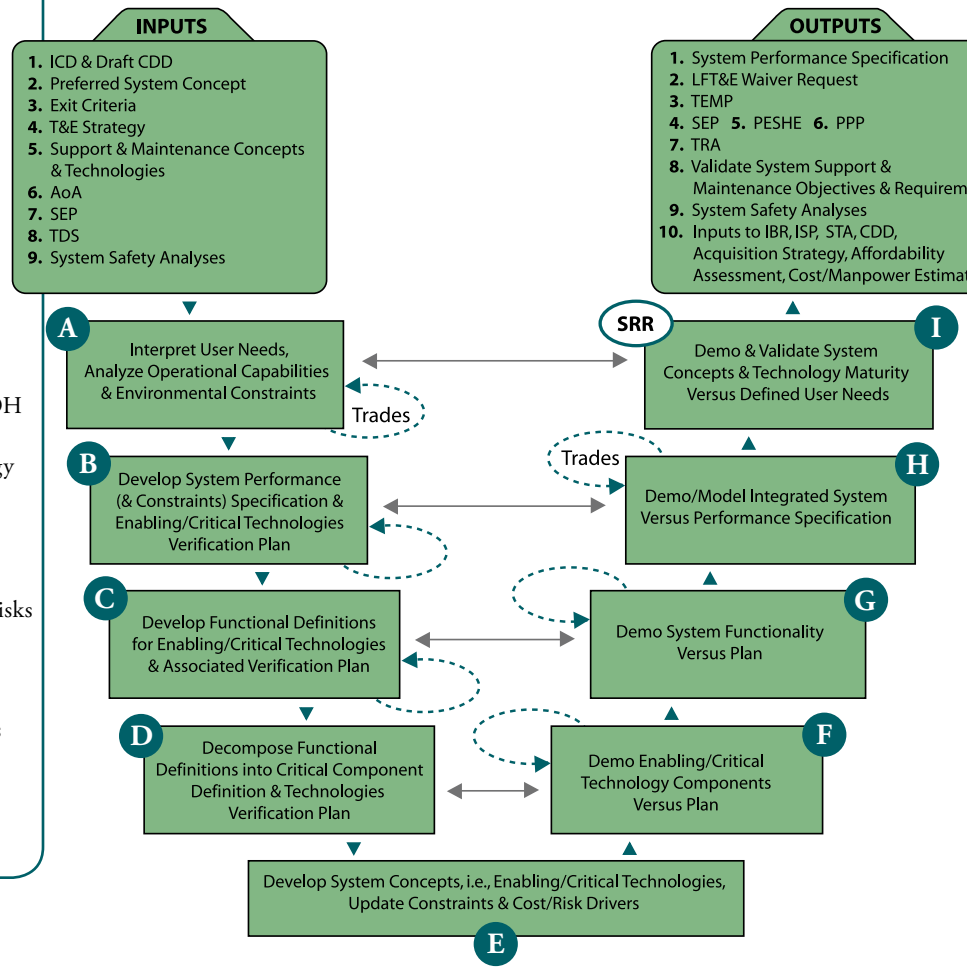
Assess ESOH efforts using the ESOH Management Evaluation Criteria for DoD Acquisition

Technology Development

ESOH Activities for each Input:

1. • Develop ESOH criteria and requirements
   • Identify ESOH constraints and performance attributes for the system
2. Evaluate the system concept against identified ESOH criteria
3. Provide the following exit criteria:
   • Updated PHL
   • Update strategy for integrating ESOH risk management into SE
4. • Incorporate ESOH hazard risk mitigation test and verification methodologies, and work towards obtaining safety release(s) and ESOH risk acceptance
   • Include the ESOH planning strategy and requirements to support T&E (to include NEPA/EO 12114 compliance)
5. Provide ESOH inputs, as requested
6. Characterize ESOH footprints and risks for AoA development
7. Update the strategy for integrating ESOH risk management into SE
8. Include a strategy to identify hazards and needed ESOH technology development
9. Initiate SRCA and update PHL for preferred concept



ESOH Activities for each Output:

1. • Include ESOH criteria and requirements, SRCA data and applicable specifications
   • Require concurrence and approvals from the applicable safety boards
2. • Evaluate ESOH risk implications for not conducting LFT&E
3. • Document safety release(s) and specific ESOH test requirements to include verification of risk mitigation measures and risk acceptance
   • Include ESOH planning strategy and requirements to support T&E to include NEPA/EO 12114 compliance
4. Update strategy for integrating ESOH risk management into SE
5. • Develop PESHE to include: preliminary ESOH risks (including HM), the strategy for integrating into SE, ESOH responsibilities, method for tracking hazard progress, and NEPA/EO 12114 Compliance Schedule
   • Identify applicable safety boards and processes for concurrence and approval
   • Ensure ESOH effort is resourced
6. Provide ESOH inputs, as requested
7. Update ESOH risk mitigation technology readiness levels
8. Provide preliminary ESOH requirements for system support and maintenance
9. Ensure completion of preliminary SRCA and updated PHL
10. • Provide ESOH hazard mitigation, IM, mishap reduction, and safety technology requirements
    • Incorporate NEPA/EO 12114 Compliance Schedule and summary of the PESHE in the AS
    • Identify ESOH requirements, constraints, and attributes for the system

NOTES: The numbers in the ESOH Activities boxes correspond to the numbers in the Inputs and Outputs boxes.

"Environmental constraints" refer to the environment in which the system is to be employed and the limitations that environment places on the system.

A
- Update identification of ESOH constraints
- Develop ESOH criteria (e.g., air emissions, noise, HM, effluents, and discharges)
- Identify ESOH-critical technology needs

B
- Update ESOH criteria
- Include ESOH-critical specifications in the Verification Plan
- Identify ESOH requirements in any system or subsystem performance specification, solicitation, contract, and evaluation criteria

C
- Update system ESOH criteria
- Develop requirements for verification of risk mitigation measures

D
- Update system ESOH criteria
- Develop requirements for verification of risk mitigation measures

E
- Update the PHL
- Update ESOH constraints
- Identify potential operational and maintenance ESOH training and staffing requirements
- Refine ESOH Input for system attrition rates
- Identify ESOH hazard mitigation, IM, mishap reduction, and safety technology requirements

NOTE: The letters on this page correspond with the letters on the previous page and are associated with the respective SE step boxes.

F
- Evaluate enabling/critical technologies from an ESOH perspective
- Review demo results for new technology component ESOH hazards

G
- Evaluate enabling/critical technologies from an ESOH perspective
- Review demo results for new ESOH hazards

H
- Evaluate enabling/critical technologies from an ESOH perspective
- Review demo results for new ESOH hazards

I
- Evaluate enabling/critical technologies from an ESOH perspective

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SRR
- Prepare and present ESOH performance criteria at SRR

Trades
- Participate in trade studies to evaluate options against identified ESOH criteria throughout this phase

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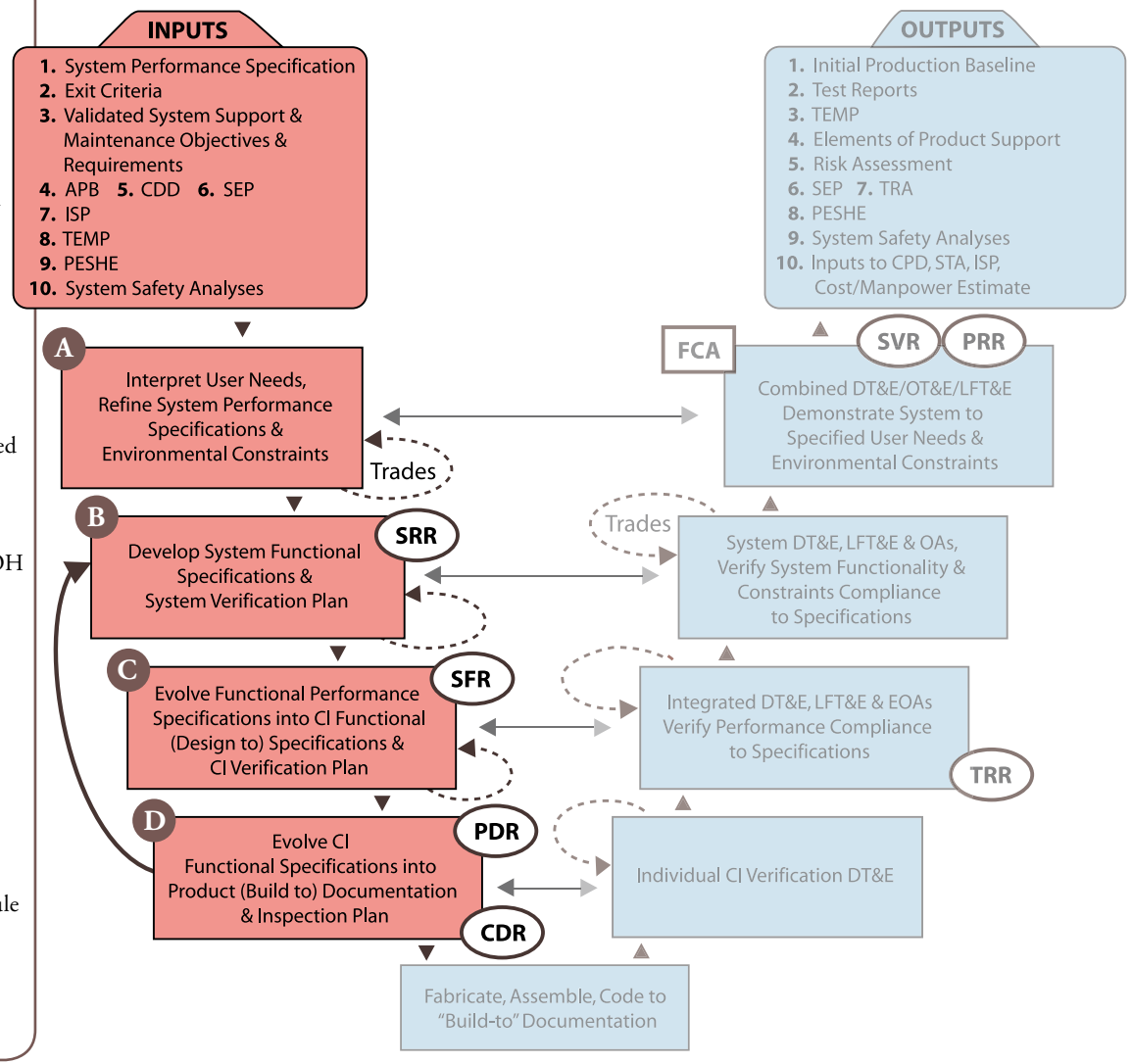
Assess ESOH efforts using the ESOH Management Evaluation Criteria for DoD Acquisition

ESOH Activities for each Input:

1. • Include the SRCA data and ESOH critical system status and asset requirements in performance specifications
   • Include applicable specifications (MIL-STDs)
2. • Document the risk status of identified ESOH hazards
   • Obtain concurrence and approval of appropriate safety boards
   • Update the PESHE
3. Identify operating, maintenance, and support ESOH hazards and risks
4. • Provide ESOH inputs, as requested
   • Ensure that ESOH efforts are resourced
5. Identify hazard mitigation, IM, mishap reduction, and safety technology requirements
6. Update the strategy for integrating ESOH risk management into SE
7. Provide ESOH inputs, as requested
8. Identify specific test and safety release requirements, ESOH risk acceptance, NEPA/EO 12114 documentation, and requirements for verification of risk mitigation measures
9. • Ensure that the PESHE includes preliminary ESOH risks (including HM), the strategy for integrating into SE, ESOH responsibilities, a method for tracking hazard progress, and the NEPA/EO 12114 Compliance Schedule
   • Identify applicable safety boards and process for concurrence and approval
10. • Ensure completion of SRCA and updated PHL



NOTES: The numbers in the ESOH Activities boxes correspond to the numbers in the Inputs and Outputs boxes.

"Environmental constraints" refer to the environment in which the system is to be employed and the limitations that environment places on the system.

A

- Develop life cycle ESOH footprint and system boundaries
- Develop more detailed ESOH criteria (e.g., air emissions, noise, HM, effluents, and discharges)
- Identify and develop ESOH-critical and asset requirements and verify they are included in requirements tracking system
- Provide ESOH activities for inclusion in IMS

B

- Initiate development of PHA and THA
- Update ESOH criteria
- Verify ESOH-critical functional specifications are included in requirements tracking system and in the System Verification Plan
- Verify NEPA and EO 12114 requirements are being met at proposed testing and training locations
- Identify ESOH requirements in any system or subsystem solicitation or contract

C

- Finalize PHA
- Update ESOH criteria for component, subsystem, and system to include test requirements
- Expand and update SRCA to include functional specifications as detailed design specifications evolve
- Verify that ESOH-critical design specifications are included in the requirements tracking system, detailed design specifications, and CI Verification Plan

NOTE: The letters on this page correspond with the letters on the previous page and are associated with the respective SE step boxes.

D

- Prepare SSHAs, SHA, and O&SHA and update the SRCA
- Update ESOH criteria for component, subsystem, and system to include test and inspection requirements
- Begin to identify ESOH input for demilitarization and disposal planning
- Identify ESOH-critical process for product build-to documentation (e.g., safety-critical items list)
- Include system ESOH-critical processes and components in inspection plan (e.g., component screening and testing)
- Participate in component design selections
- Verify that system ESOH-critical design specifications are included in the requirements tracking system and detailed design specifications, as necessary

SRR

- Present ESOH-critical requirements and risk status at SRR

SFR

- Present ESOH-critical functions and risk status at SFR

PDR

- Present PHA and identify ESOH hazards and risk status at PDR; ensure ESOH requirements are in product specifications and the IMS

CDR

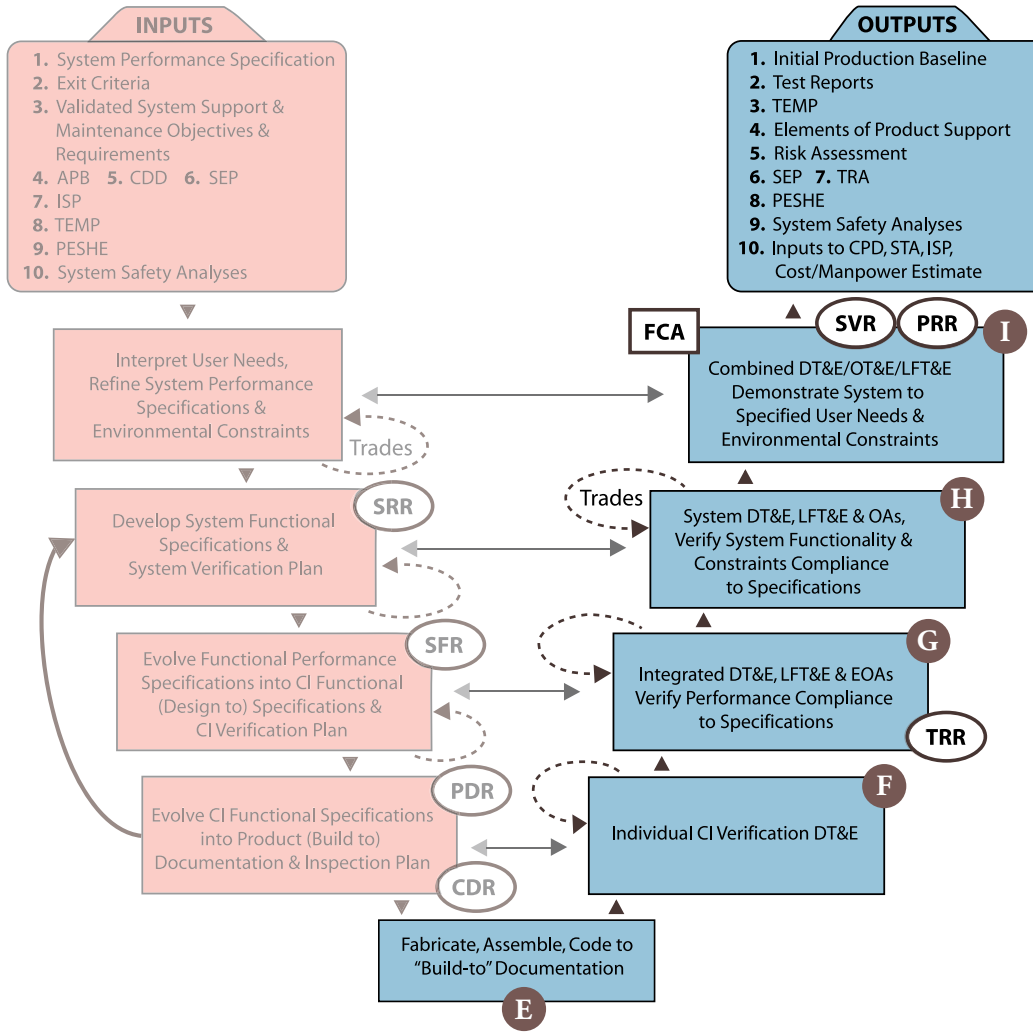
- Present ESOH hazards and risks and their acceptance status at CDR; ensure ESOH requirements are in product specifications and the IMS

Trades

- Participate in trade studies to evaluate options against established ESOH criteria throughout this phase

Assess ESOH efforts using the ESOH Management Evaluation Criteria for DoD Acquisition

System Demonstration



ESOH Activities for each Output:

1. • Ensure that ESOH-critical items and processes are included in the baseline
   • Identify inspection requirements
2. • Verify that mitigation measures reduce ESOH hazard risk effectively
   • Analyze anomalies, incidents, and mishaps
3. • Update specific test and safety release requirements based on the SAR, and include requirements for verification of risk mitigation measures
   • Validate the NEPA/EO 12114 Compliance Schedule
4. Provide the results of the preliminary O&SHA
5. • Document and report risk status and risk acceptance decisions
   • Document concurrence and approval of applicable safety boards
6. Update the strategy for integrating ESOH risk management into SE
7. Update the ESOH risk mitigation technology readiness levels
8. • Update the PESHE to include identified ESOH risks (including HM), the strategy for integrating into SE, ESOH responsibilities, the method for tracking hazard progress, and the NEPA/EO 12114 Compliance Schedule
   • Identify applicable safety boards and processes for concurrence and approval
   • Ensure ESOH efforts are resourced
9. • Ensure completion of PHA and SRCA
   • Finalize the SSHAs, SHA, and THA
   • Finalize the preliminary O&SHA
   • Identify ESOH requirements, constraints, footprint, and performance attributes
10. • Recommend operational and maintenance ESOH training and staffing requirements
    • Update system attrition rate inputs due to mishaps and ESOH hazard mitigation, IM, safety technology requirements, and mishap reduction requirements

NOTES: The numbers in the ESOH Activities boxes correspond to the numbers in the Inputs and Outputs boxes.

"Environmental constraints" refer to the environment in which the system is to be employed and the limitations that environment places on the system.

E

- Evaluate process and design changes, as necessary
- Review and recommend ESOH updates to the TEMP
- Ensure CI verification DT&E procedures include ESOH requirements and verification testing
- Initiate safety release based on the SAR and ESOH risk acceptance documentation, as appropriate

F

- Ensure that ESOH tests were conducted and test results were reviewed for effectiveness of hazard mitigation measures
- Update hazard status
- Verify that integrated DT&E, LFT&E, and EOA procedures include appropriate tests derived from system safety analyses and environmental reviews
- Recommend ESOH hazard closure based on DT&E test results, as appropriate
- Provide safety release based on the SAR and ESOH risk acceptance documentation, as appropriate
- Ensure NEPA and EO 12114 compliance is completed prior to testing

G

- Ensure that ESOH tests were conducted and test results were reviewed for effectiveness of hazard mitigation measures
- Update hazard status, hazard analyses, and THA based on configuration changes
- Assess configuration changes for test and document results, as necessary
- Continue to identify and provide ESOH input for demilitarization and disposal planning
- Verify that system DT&E, LFT&E, and EOA procedures include appropriate tests derived from system safety analyses and environmental reviews
- Recommend ESOH hazard closure based on test results
- Provide safety release based on the SAR and ESOH risk acceptance for upcoming test activities, as appropriate

NOTE: The letters on this page correspond with the letters on the previous page and are associated with the respective SE step boxes.

H

- Ensure that ESOH tests were conducted and test results were reviewed for effectiveness of mitigation measures
- Update ESOH hazard status and analyses based on configuration changes
- Assess configuration changes for testing and document results as necessary
- Verify combined DT&E/OA/LFT&E procedures include appropriate tests derived from system safety analyses and environmental reviews
- Recommend ESOH hazard closure based on test results, as appropriate
- Provide safety release based on the SAR and ESOH risk acceptance for upcoming test activities, as appropriate
- Ensure NEPA and EO 12114 compliance is completed prior to testing

I

- Ensure that tests were conducted and test results were reviewed for ESOH considerations, new ESOH hazards, and effectiveness of risk mitigation measures; recommend hazard closure, as appropriate
- Update ESOH hazard status and hazard analyses based on configuration changes
- Ensure NEPA and EO 12114 compliance is completed prior to testing
- Continue to identify and provide ESOH input for demilitarization and disposal planning

TRR

- Assess configuration for testing, document results and present at TRR; ensure all safety releases and ESOH risk acceptances are completed in support of TRR; report ESOH risks and their status at TRR; and ensure NEPA and EO 12114 compliance

PRR

- Present ESOH-critical requirements and ESOH risks and their acceptance status at PRR

SVR

- Present ESOH risk to the user at SVR

FCA

- Review the FCA for consistency with ESOH requirements

Trades

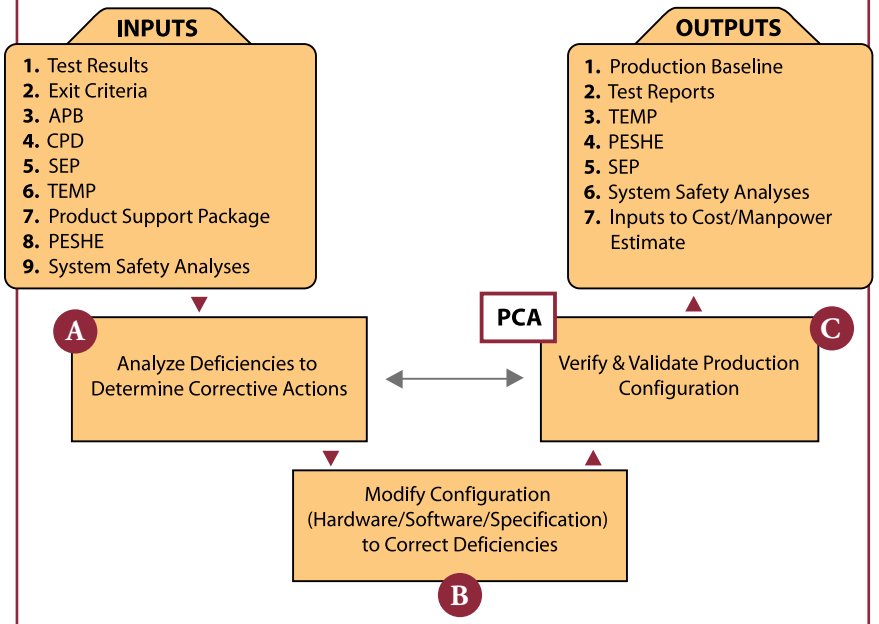
- Participate in the trade studies to evaluate options against established criteria throughout this phase

Assess ESOH efforts using the ESOH Management Evaluation Criteria for DoD Acquisition

Production and Deployment

ESOH Activities for each Input:

1. • Review IOT&E results for the effectiveness of ESOH risk mitigation measures
   • Analyze anomalies, incidents, and mishaps
   • Analyze effectiveness of recommended NEPA and EO 12114 mitigation measures and potential impacts on the natural environment
2. • Document the risk status of identified ESOH hazards
   • Obtain concurrence and approval of appropriate safety boards
   • Update the PESHE
   • Provide updated ESOH inputs for demilitarization and disposal planning
   • Ensure that all required system-related data to support NEPA and EO 12114 analysis and documentation for basing, homeporting, and fielding is completed
3. Provide ESOH inputs, as requested
4. Update ESOH requirements and performance attributes for the system (e.g., hazard mitigation, IM, safety technology, and mishap reduction requirements)
5. Update the strategy for integrating ESOH risk management into SE
6. • Update specific test and safety release requirements based on the SAR and requirements for verification of ESOH risk mitigation measures
   • Validate the NEPA/EO 12114 Compliance Schedule and identify all ESOH risks and mitigation measures
7. Include O&SHA and NEPA and EO 12114 analysis results
8. • Ensure that the PESHE includes identified ESOH risks, the strategy for integrating into SE, ESOH responsibilities, the method for tracking hazard progress, and the NEPA/EO 12114 Compliance Schedule
   • Identify applicable safety boards and processes for concurrence and approval
   • Ensure ESOH efforts are resourced
9. Update the SRCA, SSHAs, SHA, and O&SHA, as necessary



ESOH Activities for each Output:

1. • Identify ESOH-critical items and processes
   • Specify inspection requirements
   • Document concurrence and approvals of applicable safety boards
2. Document the effectiveness of risk mitigation measures; NEPA and EO 12114 mitigation measures; and findings from anomalies, incidents, and mishaps
3. Update specific test and safety release requirements based on the SAR and requirements for verification of risk mitigation measures
4. • Update the PESHE to include identified ESOH risks, the strategy for integrating into SE, ESOH responsibilities, the method for tracking hazard progress, and the NEPA/EO 12114 Compliance Schedule
   • Identify applicable safety boards and processes concurrence and approval
   • Ensure that resources are in place to continue to identify, track, and manage ESOH hazards and associated risks
   • Ensure that ESOH requirements are in place (e.g. NEPA compliance) for basing, homeporting, and fielding
5. Update the strategy for integrating ESOH risk management into SE
6. • Finalize the O&SHA
   • Update hazard analyses, as required
7. • Recommend ESOH training and staffing requirements
   • Update system attrition rate input due to mishaps

NOTES: The numbers in the ESOH Activities boxes correspond to the numbers in the Inputs and Outputs boxes.

"Environmental constraints" refer to the environment in which the system is to be employed and the limitations that environment places on the system.

A

- Review deficiency reports for ESOH implications
- Participate in the development of corrective actions
- Participate in CCB to include reviewing ECPs
- Analyze the effectiveness of recommended NEPA and EO 12114 mitigation measures and potential impacts on the natural environment
- Verify ESOH asset requirements and constraints at testing, basing, and training locations

B

- Identify ESOH-critical items (e.g., HM used for system maintenance) and inspection requirements
- Review and recommend ESOH updates to the TEMP and test plan based on system safety analyses, and provide safety release documentation, as appropriate

C

- Verify and validate ESOH-critical item configuration
- Participate in test activities, as appropriate
- Provide system ESOH criteria to engineering and logistics staff
- Identify opportunities for technology insertion to reduce ESOH risk

NOTE: The letters on this page correspond with the letters on the previous page and are associated with the respective SE step boxes.

PCA

- Review PCA to identify potential ESOH implications

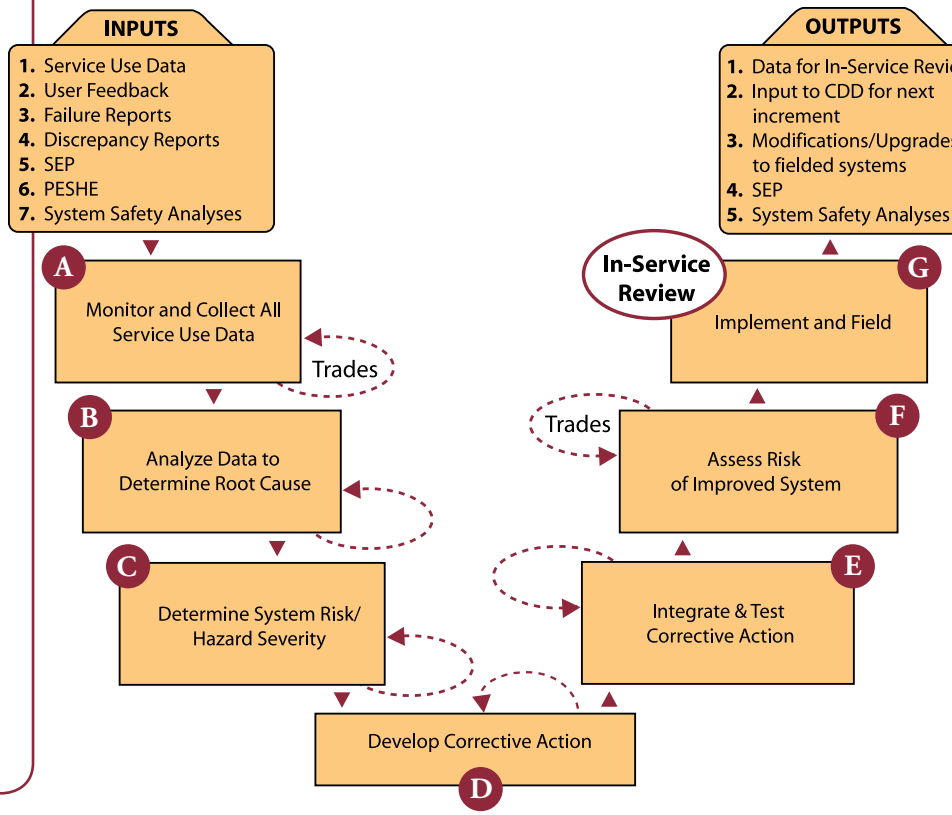
- Report the status of all high and serious ESOH risks and safety technology requirements at the OTRR

Assess ESOH efforts using the ESOH Management Evaluation Criteria for DoD Acquisition

Operations and Support

ESOH Activities for each Input:

1. Review for ESOH hazards
2. Review for ESOH hazards
3. • Review FOT&E results for ESOH implications
   • Review failure/mishap reports for causal factors or mitigation failures and recommend alternative mitigation measures
   • Assist in mishap investigations, as required
4. Review discrepancy reports for ESOH hazards
5. Update the strategy for integrating ESOH risk management into SE
6. • Ensure that the PESHE includes identified ESOH risks, the strategy for integrating into SE, ESOH responsibilities, the method for tracking hazard progress, and the NEPA/EO 12114 Compliance Schedule
   • Identify applicable safety boards and processes for concurrence and approval
7. Update ESOH hazard analyses (as appropriate) in order to maintain the current hazard tracking system



ESOH Activities for each Output:

1. Identify ESOH hazards and analyses for fielded systems and ESOH risk acceptance status, as applicable
2. Update ESOH hazard mitigation, mishap reduction, safety technology requirements, and lessons learned, as necessary
3. • Update hazard analyses, risk assessment, and risk acceptance (including user community) based on modifications and upgrades
   • Provide updated inputs for demilitarization and disposal planning
4. Update the strategy for integrating ESOH risk management into SE
5. • Sustain ESOH hazard analyses to support the fielded system, next increment, and acquisition of similar systems, as applicable
   • Identify applicable safety boards and processes for concurrence and approval
   • Maintain an ESOH hazard tracking system with focus on high and serious ESOH risk hazards and hazards whose risks have not been formally accepted
   • Monitor implementation of NEPA and EO 12114 mitigation plans

NOTES: The numbers in the ESOH Activities boxes correspond to the numbers in the Inputs and Outputs boxes.

"Environmental constraints" refer to the environment in which the system is to be employed and the limitations that environment places on the system.

A

- Provide system ESOH criteria to engineering and logistics staff
- Review data for ESOH hazards (e.g., trend analysis)
- Identify opportunities for technology insertion to reduce ESOH risk
- Track mishap rates for Class A, B, and C mishaps for the system and subsystems
- Determine whether any technical data change requests have been submitted to resolve HM or safety issues for the system
- Track open technical data change requests to resolve hazardous material or safety issues

B

- Apply appropriate system safety analysis techniques to determine the root cause of the hazard
- Evaluate data for ESOH implications
- Update ESOH hazard analyses and the tracking system/ databases, as appropriate

C

- Prioritize hazards for risk mitigation
- Update ESOH hazard analyses and the tracking system/ database, as appropriate

D

- Apply system safety order of precedence to corrective actions
- Update ESOH hazard analyses and the tracking system/ database, as appropriate
- Identify requirements for verification of risk mitigation measures

NOTE: The letters on this page correspond with the letters on the previous page and are associated with the respective SE step boxes.

E

- Evaluate test results for risk mitigation effectiveness
- Update ESOH hazard analyses and the tracking system/ database, as appropriate

F

- Update ESOH hazard analyses and the tracking system/ database, as appropriate
- Recommend ESOH hazard closure to appropriate risk acceptance authorities (updated residual risk)

G

- Track system health, mishaps, ESOH hazards, closure actions, mitigation measures effectiveness, and residual risk

In Service Review

- Provide inputs on mishaps and any newly identified ESOH hazards with assessment of risks, selected mitigation measures, verification of mitigation measures, and acceptance of risks
- Identify open HM or safety related technical data change requests
- Report on the status of all high and serious ESOH risks

Trades

- Participate in trade studies to evaluate options against established ESOH criteria throughout this phase

Assess ESOH efforts using the ESOH Management Evaluation Criteria for DoD Acquisition

ESOH in Acquisition

ESOH Management Evaluation Criteria for DoD Acquisition

DoD recognizes that an ESOH effort is critical for acquisition PMs to successfully meet objectives for total life cycle systems management. System safety, as defined by MIL-STD-882D, the Standard Practice for System Safety, is DoD's methodology for identifying ESOH hazards, eliminating hazards or mitigating the risks to an acceptable level, and accepting risks at the management levels defined in DoDI 5000.2 (see the Defense Acquisition Guidebook (DAG), chapter 4.4.11).

Under Secretary of Defense for Acquisition, Technology, and Logistics (USD AT&L) 23 Sep 04 Memorandum, *Defense Acquisition System Safety,* reinforces existing policy and provides additional direction to use of MIL-STD-882D and review of the status of ESOH risks at technical and program reviews.

The ESOH Management Evaluation Criteria are focused on assessing an acquisition program's overall management of ESOH as an integral part of the systems engineering and program management processes. They do not address specific ESOH risks associated with ESOH hazards (technical risk) as identified and managed through the methodology in MIL-STD-882D.

Use of the evaluation criteria is not mandatory; however, Milestone Decision Authorities (MDAs), Program Executive Offices (PEOs), and PMs are encouraged to utilize these criteria for all acquisition efforts - both large and small - and for all elements of a program (system, subsystem, hardware, and software). These criteria are being incorporated into the Defense Acquisition Program Support (DAPS) SE Assessment Methodology.

1. Key Terms, Descriptions, and Principles

1.1 ESOH Objective

The PM shall eliminate ESOH hazards where possible, and minimize ESOH risks where they cannot be eliminated. PMs accomplish this through SE using the system safety methodology as defined in MIL-STD-882D.

1.2 Key Terms

1.2.1 ESOH - The term ESOH refers to all of the individual, but interrelated, disciplines that encompass environment, safety, and occupational health. The system safety methodology is used across the ESOH disciplines to identify hazards and mitigate risks through the systems engineering process.

1.2.2 PESHE - The PESHE is the Program Office's acquisition documentation of the ESOH aspects of a Program. The PESHE is required at Program Initiation for Ships, Milestone B, Milestone C, and Full-Rate Production Decision Review. The PESHE includes the following:

- Identification of ESOH responsibilities
- Strategy for integrating ESOH considerations into SE process
- Identification of ESOH risks and their status
- Description of the method for tracking hazards throughout the life cycle of the system
- Identification of HMs, wastes, and pollutants (discharges/emissions/ noise) associated with the system and plans for their minimization and/or safe disposal
- Compliance Schedule covering all system related activities for the NEPA and EO 12114

1.2.3 System Safety - The application, throughout all phases of the system life cycle, of engineering and management principles, criteria, and techniques to achieve acceptable risk, within the constraints of operational effectiveness and suitability, time, and cost. This is DoD's approach for eliminating ESOH hazards or minimizing ESOH risks across the entire system life cycle.

1.2.4 Systems Engineering - The overarching process that a program team applies to transition from a stated capability to an operationally effective and suitable system. SE encompasses the application of SE processes across the acquisition life cycle (adapted to each and every phase) and is intended to be the integrating mechanism for balanced solutions addressing capability needs, design considerations and constraints, as well as limitations imposed by technology, budget, and schedule. The SE processes are applied early in concept definition, and then continuously throughout the total life cycle.

1.2.5 Systems Engineering Plan - A description of the program's overall technical approach including processes, resources, metrics, applicable performance incentives, and the timing, conduct, and success criteria of technical reviews.

2. ESOH Management Evaluation Criteria

These criteria provide MDAs, PEOs, and PMs a method to evaluate a program's progress in implementing DoD acquisition ESOH policy and guidance. The evaluation criteria assess the following four basic categories of ESOH effort:

- ESOH Planning;
- ESOH Hazard Identification, Analysis, and Risk Acceptance;
- ESOH Requirements for the System and Associated Infrastructure; and
- Personnel and Funding for ESOH.

For each category in each life cycle phase, the criteria represent a single effort that is a strong indicator of the health of the management of the ESOH effort. The criteria selection is based upon DoD policy and guidance and the Defense Acquisition University (DAU) "System Safety in Systems Engineering" course. The criteria describe the activities associated with each of the four categories, and the metrics enable the assessment of progress in completing activities.

The criteria are structured in the form of questions that identify the key ESOH activities (See pages 18-21). The questions support assessment of a program's progress in completing the activities and the answers result in a color-coded rating (Green/Yellow/Red). This color-coded rating is the assessment of the category for its life cycle phase. For example, in System Development and Demonstration (SDD), a program could have the following ratings: ESOH Planning - Red; ESOH Hazard Identification, Analysis, and Risk Acceptance - Yellow; ESOH Requirements for the System and Associated Infrastructure - Green; and Personnel and Funding for ESOH - Yellow.

The criteria also provide a mechanism, described in section 3 below, for combining the four category metrics into a single overall ESOH Management Rating for a specific life cycle phase. In order to do so, each of the four category metrics is weighted and the overall rating is calculated using the figures and equation in section 3. For example, for the above combination of SDD ratings, the overall SDD ESOH Management Rating would be 1.91, Red. Section 3 also provides a detailed example of the calculation methodology.

ESOH Planning

Concept Refinement	Technology Development	System Development and Demonstration	Production and Deployment	Operations and Support
Does the Systems Engineering Plan (SEP), Technology Development Strategy (TDS), and Test and Evaluation (T&E) Strategy address integration of environment, safety, and occupational health (ESOH) considerations into the systems engineering process, using MIL-STD-882D?	Is the Programmatic ESOH Evaluation (PESHE) completed per DoD Instruction (DoDI) 5000.2, does the SEP and Acquisition Strategy (AS) include a current ESOH integration strategy, and does the Test and Evaluation Master Plan (TEMP) include ESOH considerations to support Milestone (MS) B?	Is the PESHE updated per DoDI 5000.2 to support MS C; does the Integrated Master Schedule (IMS) include ESOH activities (e.g., reviews, approvals, certifications, analyses, safety releases, and NEPA and E.O. 12114 analyses and documentation); and are ESOH considerations included in demilitarization and disposal plans?	Does the Total System Product Support Package address system ESOH risks?	What are the mishap rates for class B and C mishaps during the reporting period, and how many class A mishaps for the system or subsystem occurred during the current calendar year?
Green – Yes, addressed in two or more documents	Green – Yes	Green – Yes	Green – Yes	Green – No class A mishaps; and no increase in mishap rates for either class B or C as compared to the prior calendar year
Yellow – Only addressed in one of the three documents	Yellow – The PESHE is complete, but ESOH considerations have been incorporated into only two of the other three documents	Yellow – The PESHE is updated, but ESOH considerations have been incorporated into only one of the other two documents	Yellow – Not all the applicable documents include the appropriate ESOH risks	Yellow – No class A mishaps; however, the mishap rate is increasing for either class B or C mishaps as compared to the prior calendar year
Red – Not addressed in any of the three documents	Red – The PESHE has not been completed. Alternately, if the PESHE has been completed, ESOH considerations have not been incorporated into the SEP, AS, or the TEMP	Red – The PESHE has not been updated, or, even if the PESHE has been updated, ESOH considerations have not been incorporated into either the IMS or the demilitarization and disposal plans	Red – No	Red – One or more class A mishaps were reported in the current calendar year

ESOH Hazard Identification, Analysis, and Risk Acceptance

Concept Refinement	Technology Development	System Development and Demonstration	Production and Deployment	Operations and Support
Is there a Preliminary Hazard List (PHL) developed for each concept and is it used in developing the Analysis of Alternatives (AoA)?	Does the updated PHL evaluate enabling/critical technologies?	Are the appropriate levels of hazard analyses completed and presented at each major design review? For example, is the Preliminary Hazard Analysis (PHA) completed and status of hazards presented at Preliminary Design Review (PDR), the majority of hazard analyses completed and presented at Critical Design Review (CDR), and the status of ESOH risks presented at the Production Readiness Review (PRR) and System Verification Review (SVR)?	Has the program (1) continued to evaluate the system's test and operational performance to identify new hazards, (2) continued to track all hazards, and (3) obtained formal acceptance, at the appropriate management levels (including user representative concurrence for high and serious risks), of all ESOH risks and communicated those risks to the receiving activities?	What is the highest risk category, are there any system level hazards with formally accepted high risks, and are there any system level hazards without formal risk acceptance?
Green – Yes	Green – Yes	Green – Yes	Green – Yes	Green – No hazards with formally accepted high risks and no hazards without formal risk acceptance
Yellow – Incomplete PHL or complete PHL, but not used to influence the AoA	Yellow – Some, but not all, of the enabling/critical technologies have been assessed for ESOH hazards	Yellow – Not all of the necessary hazard analyses have been completed, or presented at the design reviews	Yellow – Two of the three criteria were satisfied	Yellow – One or more hazards with formally accepted high risks, or any hazards with medium and low risks that have not been formally accepted
Red – No	Red – No	Red – No. Hazard analyses have not been completed in time to influence the design review process	Red – One or none of the three criteria were satisfied	Red – One or more hazards with serious or high risks that have not been formally accepted

ESOH Requirements for the System and Associated Infrastructure

Concept Refinement	Technology Development	System Development and Demonstration	Production and Deployment	Operations and Support
Are the (1) applicable system ESOH criteria and (2) associated ESOH asset requirements per DoD Directive (DoDD) 4715.1E and CJCSM 3170.01C being identified?	Are ESOH criteria and requirements identified in the System Performance Specification for inclusion in future Statement of Objectives, solicitations, and contracts?	Are ESOH critical system requirements and related ESOH asset requirements included in requirements tracking and verification systems, detailed design specifications, test plans and procedures, the inspection plan, maintenance concepts, and the Total Systems Product Support Package?	Are ESOH asset requirements for testing and basing, homeporting, and fielding being met as scheduled?	How many open technical data change requests (e.g., technical orders and technical manuals) have been submitted through the formal technical data change system to resolve hazardous material or safety issues for the system?
Green – Yes, both (1) and (2) are being identified	Green – Yes	Green – Yes	Green – Yes	Green – All open requests were received during the last six months
Yellow – Only one of the two are being identified	Yellow – ESOH criteria and requirements have been identified but are not fully incorporated into the System Performance Specification	Yellow – ESOH critical system and asset requirements have been identified but are not incorporated into all appropriate documentation	Yellow – The requirements are being met but are behind schedule, or new requirements have been identified and not met	Yellow – One or more requests has been open for six to twelve months
Red – Neither is being identified	Red – No	Red – ESOH critical system and asset requirements have not been identified	Red – No	Red – One or more requests have remained open for more than one year

ESOH Management Evaluation Criteria

Personnel and Funding for ESOH

Concept Refinement	Technology Development	System Development and Demonstration	Production and Deployment	Operations and Support
Is the responsibility assigned for ESOH integration into systems engineering?	Are the ESOH requirements, analyses, and documentation resourced?	Are the ESOH activities identified on the IMS resourced to a level necessary to meet the schedule?	Are there resources in place to continue to identify, track, and manage ESOH hazards and associated risks to impact system design?	What is the level of effort (LOE) in man-years (recurring) expended by the program (organic, matrix, and contract) for ESOH management?
Green – Yes	Green – Yes	Green – Yes	Green – Yes	Green – Constant LOE compared to the prior fiscal year
Yellow – Not formally assigned	Yellow – Partially resourced	Yellow – Partially resourced	Yellow – Partially resourced	Yellow – Decreasing LOE compared to the prior fiscal year
Red – No	Red – No	Red – No	Red – No	Red – Zero LOE

3. Calculating the Overall ESOH Management Rating

The criteria provide a mechanism for combining the four individual category ratings (Green/Yellow/Red) into a single overall ESOH Management Rating for a specific life cycle phase. Figure 1 illustrates the equation used to calculate the overall numerical ESOH Management Rating for a given life cycle phase. The color-coded ratings for each category are assigned a constant numeric value of Red=4, Yellow=2, and Green=1; this metric score is represented as M in the equation. The relative importance of each category per life cycle phase in relation to the overall ESOH effort is weighted; this value is represented as W in the equation. Figure 2 defines the relative life cycle phase weighting assigned to each category metric.

Figure 1
ESOH Management Rating Equation

$$SSE_{LCP} = \sum_{N=1}^{4} (W_{LCP\text{-}N} * M_{LCP\text{-}N})$$

Where:
SSE: System Safety-ESOH Evaluation Management Rating (a numerical value)

LCP: Life Cycle Phase ((Concept Refinement (CR), Technology Development (TD), SDD, Production and Development (P&D), and Operations and Support (O&S))

N: Metric Category, from 1 to 4, whereby 1 = Planning; 2 = Hazard; 3 = Requirements; 4 = Funding

M: Metric score for a given LCP, where Red = 4, Yellow = 2, and Green = 1

W: Weight assigned to a given metric score, from 0 to 1.0

Figure 2
Metric Weighting Matrix

		Life Cycle Phase				
		CR	TD	SDD	P&D	O&S
Category	Planning	.4	.25	.14	.25	.4
	Hazards & Risks	.3	.1	.38	.25	.4
	Requirements	.1	.4	.37	.25	.1
	Funding	.2	.25	.11	.25	.1

To calculate the overall ESOH Management Rating during a particular life cycle phase, insert the appropriate numerical values into the equation from Figure 1. Individual category ratings should be assigned the appropriate constant value M, and the appropriate category weighting for the phase from Figure 2 should be applied. The final numeric value derived from the equation is then cross-referenced using Figure 3 to obtain the color-coded (Green/Yellow/Red), overall ESOH Management Rating for that life cycle phase.

Figure 3
Numeric/Color Ratings and Roll-Up Summary Evaluation Designations

Concept Refinement SSE
Green: 0.00 – 1.30
Yellow: 1.31 – 2.00
Red: 2.01+

Technology Development SSE
Green: 0.00 – 1.30
Yellow: 1.31 – 2.00
Red: 2.01 +

System Development and Demonstration SSE
Green: 0.00 - 1.33
Yellow: 1.34 – 1.85
Red: 1.86 +

Production and Deployment SSE
Green: 0.00 -1.25
Yellow: 1.26 – 1.74
Red: 1.75 +

Operations and Support SSE
Green: 0.00 – 1.30
Yellow: 1.31 – 2.00
Red: 2.01+

The following example illustrates the equation for a program during the O&S life cycle phase:

Single ESOH Management Rating During O&S = (0.4 * Q#1 numeric value color rating) + (0.4 * Q#2 numeric value color rating) + (0.1 * Q#3 numeric value color rating) + (0.1 * Q#4 numeric value color rating)

As shown in Figure 2, each ESOH metric [question (Q) #1-4] for the O&S phase is weighted as follows: Q#1 -=40%, Q#2 -=40%, Q#3 –=10%, and Q#4 = 10%. The Red/Yellow/Green ratings are each assigned a numerical value as follows: Red = 4, Yellow = 2, and Green = 1. For each of the four metrics, multiply the question weighting factor by the numeric color rating and add the product of each metric together. Cross-reference the final numeric value derived from the equation using Figure 3 to obtain the color-coded (Green/Yellow/Red), overall ESOH Management Rating for that life cycle phase.

For this example, Q #1 = Red; Q #2 = Green; Q #3 = Green; and Q #4 = Green. Using the above formula, values, and weights, the single, overall ESOH Management Rating for O&S would be determined as follows:

(.4 * 4) + (.4 * 1) + (.1 * 1) + (.1 * 1) = 2.2 which correlates to an overall ESOH Management Rating of Red based on Figure 3.

Abbreviations and Acronyms

AoA Analysis of Alternatives
APB Acquisition Program Baseline
AS Acquisition Strategy
ASR Alternative Systems Review
CCB Configuration Control Board
CDD Capabilities Development Document
CDR Critical Design Review
CI Configuration Item
CPD Capabilities Production Document
CR Concept Refinement
DAG Defense Acquisition Guidebook
DAPS Defense Acquisition Program Support
DAU Defense Acquisition University
DoD Department of Defense
DoDD Department of Defense Directive
DoDI Department of Defense Instruction
DT&E Developmental Test and Evaluation
ECP Engineering Change Proposal
EO Executive Order
EOA Early Operational Assessment
ESOH Environment, Safety, and Occupational Health
FCA Functional Configuration Audit
FOC Full Operational Capability
FRP Full Rate Production
HM Hazardous Materials
IBR Initial Baseline Review
ICD Initial Capabilities Document
IM Insensitive Munitions
IMS Integrated Master Schedule
IOC Initial Operational Capability
IOT&E Initial Operational Test and Evaluation
ISP Information Support Plan
ISR In-Service Review
ITR Initial Technology Review
LFT&E Live Fire Test and Evaluation
LOE Level of Effort
LRIP Low Rate Initial Production
MIL-STD-882D DoD Standard Practice for System Safety
MDA Milestone Decision Authority
MS Milestone
NEPA National Environmental Policy Act
O&SHA Operating and Support Hazard Analysis
OA Operational Assessment
O&S Operations and Support
ODUSD(I&E) Office of the Deputy Under Secretary of Defense for Installations and Environment
OSD Office of the Secretary of Defense
OT&E Operational Test and Evaluation
OTRR Operational Test Readiness Review
P&D Production and Deployment
PCA Physical Configuration Audit
PDR Preliminary Design Review
PEO Program Executive Office
PESHE Programmatic ESOH Evaluation
PHA Preliminary Hazard Analysis
PHL Preliminary Hazard List
PM Program Manager
PPP Program Protection Plan
PRR Production Readiness Review
SAR Safety Assessment Report
SDD System Development and Demonstration
SE Systems Engineering
SEP Systems Engineering Plan
SFR System Functional Review
SHA System Hazard Analysis
SRCA Safety Requirements/Criteria Analysis
SRR System Requirements Review
SSHA Subsystem Hazard Analysis
STA System Threat Assessment
SVR System Verification Review
T&E Test and Evaluation
TD Technology Development
TDS Technology Development Strategy
TEMP Test and Evaluation Master Plan
THA Threat Hazard Analysis
TRA Technology Readiness Assessment
TRR Test Readiness Review
USD(AT&L) Under Secretary of Defense for Acquisition, Technology, and Logistics

Office of the Deputy Under Secretary of Defense for Installations & Environment
and the Office of the Deputy Under Secretary of Defense for Acquisition & Technology

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