

Supplement to Benchmarking the Department of Energy Integrated Safety Management System to External Safety Management Systems

Safety Management System Summaries





Office of Environment, Health, Safety and Security

INTRODUCTION

This supplement contains summaries of safety management systems (SMS) based on a literature review of U.S. Federal Agencies and Departments, international organizations, consensus standards, and Department of Energy. The reviews are based solely on publicly available documentation from the selected organizations' SMS and purchased copies of the consensus standards. The following outline was used to summarize each SMS:

- Agency Mission, Implementing Documents (Drivers), Purpose, Scope, Applicability
- Contractor Applicability
- Safety Management System
- Risk Management, Hazard Identification and Control
- Accountability
- SMS Responsibilities
- Measuring Performance of the Program
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- Safety Climate

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ACRONYMS AND ABBREVIATIONS

ACMC	Assistant Commandant of the Marine Corps
ALARA	As Low as Reasonably Achievable
ANSI	American National Standards Institute
AoA	Analysis of Alternatives
AP	Accountable Persons
AR	Army Regulation
ARAP	Army Readiness Assessment Program
ASA IE&E	Army Installations, Energy, and Environment
ASAP	Aerospace Safety Advisory Panel
ASMIS	Army Safety Management Information System
ASOHMS	Army Safety and Occupational Health Management System
ASSP	American Society of Safety Professionals
AVP	Office of Accident Investigation and Prevention
AVS	Aviation Safety
AVS-1	Associate Administrator for Aviation Safety
CAST	Commercial Aviation Safety Team
CFR	Code of Federal Regulations
СМС	Commandant of the Marine Corps
CNO	Chief of Naval Operations
CNSC	Canadian Nuclear Safety Commission
CRM	Continuous Risk Management
CSA	Command Safety Assessments
CSA	Canadian Standards Association
DA or Army	Department of the Army
DASAF	Director of Army Safety
DASHO	Designated Agency Safety and Health Official
DEAR	DOE Acquisition Regulation
DoD	Department of Defense
DoDI	DoD Instruction
DOE or Department	Department of Energy
DON	Department of the Navy
DTSEM	Directorate of Technical Support and Emergency Management
ES&H	Environment, Safety and Health
FAA	Federal Aviation Administration
FRA	Functions, Responsibilities, and Authorities
FY	Fiscal Year
G	Guide
GSR	General Safety Requirements
HDBK	Handbook
HQMC	Marine Corps Headquarters
IAEA	International Atomic Energy Agency
ICAO	International Civil Aviation Organization
ILO	International Labour Organization
INST	Instructions

ISM	Integrated Safety Management
ISMs	Integrated Safety Management System
ISO	International Organization for Standardization
JPL	Jet Propulsion Laboratory
КРІ	Key Performance Indicators
KRI	Key Risk Indicators
Leads	Discipline Leads
LOBs	Lines of Business
LOE	Lines of Effort
Μ	Manual
MCDP	Marine Corps Doctrinal Publications
МСО	Marine Corps Order
MCSMS	Marine Corps Safety Management System
MDAAs	Mission Directorate Associate Administrators
MNMR	Mishap and Near Miss Reporting
NASA	National Aeronautics and Space Administration
NAVSAFECOM	Naval Safety Command
NPD	NASA Policy Directive
NPR	NASA Procedural Requirement
NSC	NASA Safety Center
0	Order
OHS or OH&S	Occupational Health and Safety
OHSMS	Occupational Health and Safety Management Systems
OPNAVINST	Office of the Chief of Naval Operations Instruction
OPR	Office of Primary Responsibility
OSHA	Occupational Safety and Health Administration
OSMA	Office of Safety and Mission Assurance
Ρ	Policy
PAM	Pamphlet
PAR	Performance and Accountability Reports
PDCA	Plan-Do-Check-Act
PPE	Personal Protective Equipment
PSA	Probabilistic Safety Assessment
Pub.	Publication
RAG	Report, Analyze and Get Better
RCS	Risk Control System
REGDOC	Regulation Document
RIDM	Risk-Informed Decision Making
RTS	Recommendation Tracking System
SCIP	Safety Culture Improvement Panel
SECNAV	Secretary of the Navy
SF	Safety Fundamentals
SHMS	Safety and Health Management System
SMA	Safety and Mission Assurance
SMP	Safety Management Plan
SMS	Safety Management Systems
SOH	Safety and Occupational Health
SRM	Safety Risk Management

SSP USMC or Marines USN or Navy VPP State Safety Program U.S. Marine Corps U.S. Navy Voluntary Protection Program

1 FEDERAL AGENCIES

1.1 DEPARTMENT OF THE ARMY (DA OR ARMY)

Agency Mission, Implementing Documents (Drivers), Purpose, Scope, Applicability. The mission of the U.S. Army is "to deploy, flight and win our nation's wars by providing ready, prompt and sustained land dominance by Army forces across the full spectrum of conflict as part of the joint force" (US Army, 2023).

Army Regulation (AR) 385-10, The Army Safety Program, 2017 describes the guidelines, obligations, and processes for the Army safety program elements and safety management system (SMS) requirements. The regulation applies to all organizations, including active Army and civilian employees.

Contractor Applicability. AR 385-10 does not apply to contractors; however, contractors are required to follow the safety requirements and responsibilities outlined in their contract, none of which are specific to having an SMS.

Safety Management System. In 2017, the DA modified AR 385-10 to include a SMS policy, formally integrating 25 safety program elements and a system for safety management. The DA Pamphlet (PAM) 385-10, Army Safety Program, 2010, supports the implementation of AR 385-10, and provides detailed information on the core safety functions and safety organizational structure.

The DA SMS has five core functions that integrate the Deming Plan-Do-Check-Act (PDCA) model to create a SMS framework and a process that can be applied to meet the work-related needs of commands (AR 385-10). However, commands with unique or highly specialized operations can adopt strategies for a SMS using published standards and guidance to better meet their mission-specific needs (AR 385-10).

The five core functions of the DA SMS are:

- 1. Program Management: Includes all aspects of managing a compliant safety program along with provisions for leadership participation, allocating resources, and creating policies and guidance to support the program.
- 2. Training and Promotion: Provides for safety education and training for all levels.
- 3. Inspections and Assessments: Addresses mechanisms used to evaluate performance and compliance with safety programs, policies, and regulatory requirements.
- 4. Mishap Reporting and Investigation: Provides for reporting, investigating, and implementing corrective measures to prevent mishaps and near misses, i.e., unsafe behaviors and conditions.
- Hazard Analysis and Countermeasures: Involves the use of operational data to identify trends and system deficits and develop countermeasures to reduce risk and address identified issues. (AR 385-10 and DA PAM 385-10)

Risk Management, Hazard Identification and Control. The DA has a separate policy for risk management, Army Techniques Publication 5-19, Risk Management, 2014, that states the commander has overall responsibility for risk management integration and is the risk acceptance authority.

DA PAM 385–16, System Safety Management Guide, 2013 outlines a risk management process that is part of the Hazard Analysis and Countermeasure step within the DA SMS overall model. The steps are:

- 1. Identify hazard in a succinct statement containing the "source, mechanism, and outcome" as well as any conditions that can result in an accident.
- 2. Evaluate the hazard by investigating potential hazardous sources, mechanisms that could initiate or trigger an accident, and potential outcomes (e.g., death, severe injury, etc.) to establish probability levels and severity categories.
- 3. Develop controls and make risk decisions by providing a selection of alternatives to control risk and select final controls through appropriate decision authority.
- 4. Implement controls.
- 5. Supervise and evaluate to verify that control is working as intended.
- 6. Hazard tracking involves implementation of a hazard tracking system used to monitor the status of all recognized hazards in the life cycle of the system.
- 7. Hazard closeout documents risk acceptance or hazard elimination.

Accountability. The Secretary of the Army is ultimately accountable for administering the requirements of the Department of Defense (DoD) Safety and Occupational Health (SOH) Program. The Secretary appoints the Assistant Secretary of the Army Installations, Energy, and Environment (ASA IE&E) as the senior SOH official responsible for creating, managing, and overseeing the Army SOH Program and for establishing practices that facilitate the sound administration of the Army's SOH policy and program, including selecting safety and health officers. The Director of Army Safety (DASAF) serves as the Commander of the Army Combat and Readiness Safety Center (AR 385-10).

At the organization and installation levels, Commanders lead the safety offices and assign safety directors who are members of the Commanders' staff (a direct report) and assure implementation of the Commanders' safety programs (AR 385-10).

SMS Responsibilities. At the installation, organization, and command level, the director of the safety office implements the DA SMS as part of the local safety program based on the organization's goals and objectives. (AR 385-10)

Measuring Performance of the Program. The DASAF publishes an Annual Assessment of the Army Safety Program that contains the most recent information on mishap trends and progress toward safety goals. This publication also includes implementation progress of the new performance-based reporting system, Army Safety and Occupational Health Management System (ASOHMS). The annual report summarizes trends related to accidents, tactical safety, off-duty safety, workplace safety, and OSHA data (Annual Assessment of the Army Safety Program, Fiscal Year (FY) 2022). The report also focuses on fatalities and lessons learned, and analyzes equipment damage, injuries, and OSHA inspections.

Measuring performance of the System. In 2015, the DA initiated a comprehensive review and ultimate overhaul and modernization of the DA SMS shifting the perspective from reactive to proactive. (Annual Assessment of the Army Safety Program, FY 2020). The review resulted in the creation of the Army Safety Management Information System (ASMIS) 2.0, a software system to track safety performance. The ASMIS consists of five modules that align with the SMS five core functions: Program Management,

Assessments and Inspections, Mishap and Near Miss Reporting (MNMR), Training and Education, and Hazard Management, however only two of the modules were operational according to the FY 2022 report. The DA's Recommendation Tracking System (RTS) is being integrated into the MNMR module. The DA's goal is to complete the remaining modules in Fiscal Year 2024 (Annual Assessment of the Army Safety Program, FY 2021).

Safety Climate. The DA uses the Army Readiness Assessment Program (ARAP) to measure safety climate and culture through an anonymous survey open to all employees (Annual Assessment of the Army Safety Program, FY 2020). Examples of the survey questions include: "The most hazardous thing I do is..." and "The most important action(s) my unit can take to improve safety is/are..." (Annual Assessment of the Army Safety Program, FY 2023). Army leadership strongly supports ARAP participation. Completion rates have increased annually, and the FY 2022 completion rate exceeds 70 percent. The survey provides commanders with actionable and unfiltered responses from soldiers and employees that can be used to modify policy, procedures, and professional development (FY 2020).

Further, the DA's comprehensive review of the ASOHMS in 2015 resulted in the DA establishing change management requirements. The Army's goal is to promote a culture that integrates SOH into all operational tasks, enhance communication, and reduce stove-piping at all levels for seamless decision-making (FY 2020).

1.2 FEDERAL AVIATION ADMINISTRATION (FAA)

Agency Mission, Implementing Documents (Drivers), Purpose, Scope, Applicability. The mission of the FAA is "to provide the safest, most efficient aerospace system in the world" (FAA, 2023). The FAA has regulatory authority over aviation product/service providers and provides safety oversight of aviation product/service providers. The FAA is also an Air Navigation Services Provider.

The United States is a member of the International Civil Aviation Organization (ICAO), and the FAA complies with ICAO safety management standards. Due to being both a regulator and a provider, the FAA implements an ICAO compliant State Safety Program (SSP) that includes an integrated management system. FAA Order 8000.369C, *Safety Management System* (SMS) describes FAA's policy to integrate safety risk management into operations, business plans and decision making. The Order applies to six FAA Staff Offices and Lines of Business (LOBs) and can be applied to others by the FAA Administrator. The Staff Offices and LOBs must prioritize safety as they do other business processes (FAA, 2023).

The FAA SMS is specific to aviation safety and the aerospace system, not worker safety and health. The aerospace system is defined as "U.S. airspace, all manned and unmanned vehicles operating in airspace, all U.S. aviation operators, airports, airfields, air navigation services, pilots, regulations, policies, procedures, facilities, equipment and all aviation-related industry" (Order 8000.369C). The FAA has a separate worker safety and health policy, FAA Order 3900.19C, *Federal Aviation Administration Occupational Safety and Health Policy,* for federal employees. This policy aligns with Occupational Safety and Health Administration (OSHA) *Recommended Practices for Safety and Health Programs* (OSHA 3885, 2016).

The FAA codified Title 14 of the U.S. Code of Federal Regulations (CFR) 5 *Safety Management Systems*, which applies to air carriers and commercial operators, who must submit SMS documentation to the FAA for review and approval. In addition, the FAA is working to codify requirements for a SMS specific to design and manufacturing organizations (FAA *Performance and Accountability Report Fiscal Year 2022*). The FAA issued a Notice of Proposed Rulemaking for SMS in 14 CFR 21¹, 91², 135³, and 145⁴ (FAA *PAR Fiscal Year 2022*). The FAA is anticipating a final rule in 2024. In the meantime, design and manufacturing are encouraged to voluntarily adopt a SMS (FAA *PAR Fiscal Year 2021*).

Contractor Applicability. Order 8000.369C states that safety assurance activities within FAA, "apply whether the operations are accomplished internally or outsourced." Safety assurance is a function of FAA Staff Offices and LOB's who are responsible for oversight of product/service providers. In this context, FAA may outsource (contract) monitoring activities. The Order does not specify if contractors must implement a SMS.

Safety Management System. The FAA has included the ICAO SSP with their safety management system (FAA SMS), stating that "having an SSP and an integrated SMS facilitates interoperability among safety

¹ Certification Procedures for Products and Articles (14 CFR Part 21)

² General Operating and Flight Rules (14 CFR Part 91)

³ Operating Requirements: Commuter and On-Demand Operations and Rules Governing Persons on Board Such Aircraft (14 CFR Part 135)

⁴ Repair Stations (14 CFR Part 145)

management functions across FAA entities, and applies the same standards to our own duties as we do to those we regulate" (8000.369C).

FAA organizations (Staff Offices and LOBs) create their SMSs, which represent the collective FAA SMS. Organizations can leverage their existing Quality Management Systems to meet SMS requirements (8000.369C0).

The components of the FAA SMS outlined in Order 8000.369C include:

- 1. Safety Policy. Documents safety objectives, commitments, and roles and responsibilities of safety management.
- 2. Safety Risk Management (SRM). Identifies and appropriately controls hazards based on risk and verifies that controls are in place. Hazards are conditions that could foreseeably cause or contribute to an aircraft accident.
- 3. Safety Assurance. Validates that controls perform as intended.
- 4. Safety Promotion. Combines training and communication of safety information to support personnel competencies and safety culture.

The FAA applies these same components when performing oversight of the product and service providers they regulate (8000.369C).

Risk Management, Hazard Identification and Control. The FAA Order 8040.4B, *Safety Risk Management Policy,* 2017 supports FAA Order 8000.369C, formalizing SRM guidance for Staff Offices and LOBs. The policy applies common SRM language and communication standards to the FAA; and allows flexibility in how SRM is implemented specifically to the needs of the individual organization. The safety risk management process is one of the FAA's SMS principles and includes five steps:

- 1. System analysis. Establish an understanding of system design and performance factors, human interface, environment, processes, and activities to the level necessary to identify hazards.
- 2. Identify hazards. Identify and document hazards and the effects of each hazard in sufficient detail to determine the associated safety risk (within the system description).
- 3. Analyze safety risks. Determine and analyze the severity and likelihood of potential effects associated with identified hazards.
- 4. Assess safety risks. Compare the safety risk of each identified hazard's effect to establish safety performance targets, rank hazards based on risk, and determine the acceptability of the safety risk of each hazard.
- 5. Control safety risk. Design and implement safety risk control(s) for hazards to achieve an acceptable risk level. (8000.369C).

FAA creates a continuous feedback loop by evaluating proposed controls. Each FAA organization applies SRM for new and changes to existing systems (i.e., processes, equipment, and operations) (8040.4B). Reanalysis is performed when previously implemented controls are not working as expected. FAA organizations can use their own risk assessment techniques but must align with the SRM policy. (8040.4B).

The FAA Order 8040.4B includes information on safety assurance, one of the four components of the FAA SMS. Safety assurance plays a critical part in the FAA SRM and SMS by requiring the collection of data to confirm that existing controls are working as intended and to detect new hazards. FAA organizations also perform safety assurance activities as part of their oversight of the product/service providers they regulate. Information is collected in tandem during each step of the SRM process and may trigger the need for corrective action during the hazard identification step if an issue is identified. (8040.4B).

Each Staff Office and LOB must establish the levels of management that can accept safety risk based on the severity and likelihood of an unwanted outcome. The assigned management official with the Office of Primary Responsibility (OPR) accepts the risks and authorizes the operations (8040.4B).

Accountability for the SMS. FAA Order 8000.369C outlines the governance for FAA SMS through the establishment of an FAA SMS Executive Council, an FAA SMS Committee, and the Office of Accident Investigation and Prevention.

The Executive Council provides top-level guidance and includes the chair, Associate Administrator for Aviation Safety (AVS-1) who reports directly to the Office of the Administrator, and other senior level management. The FAA SMS Executive Council has ultimate responsibility for implementation and monitoring of the ICAO SSP, approval of FAA SMS Committee recommendations, and reconciling conflicts related to FAA SMS implementation at the Staff Office and LOB level (8000.369C).

The FAA SMS Committee includes safety professionals from each Staff Office and LOB. AVS-1 designates an individual to chair the Committee. The Committee is chartered and assists FAA organizations with implementing the FAA SMS, serves as the first line for resolving disagreements, manages the SSP, and assigns an OPR (8000.369C). The SMS Committee reports to the Executive Council and resources are provided to the Committee by AVS-1

The Office of Accident Investigation and Prevention (AVP) helps Staff Offices and LOBs remain aligned with FAA SMS policy and provides input to their processes to ensure that SMS requirements are met and woven into how the FAA does business (Order 8000.369C).

SMS Responsibilities (for implementation). The FAA Order 8000.369C requires FAA Staff Offices and LOBs to generate a SMS plan and implement an SMS for their organization.

Measuring Performance of the Program. The FAA SMS is integrated with their ICAO State Safety Program. Performance for both is measured according to the integrated SMS.

Measuring performance of the System. The FAA Performance and Accountability Reports (PAR) include six safety performance measures used by FAA organizations. Two metrics the FAA uses are general aviation fatal accident rate and commercial aviation fatality risk. According to the FY 2021 PAR, "Our commercial safety record indicates that safety management systems have successfully addressed the majority of system hazards that contribute to accidents and incidents" (FAA PAR FY 2021). The general aviation fatal accident rate is the number of fatal accidents per 100,000 flight hours. The FY 2022 target general aviation fatal accident rate was 0.95 and the result was 0.86. FAA established the Commercial Aviation Safety Team (CAST) to develop interventions to address commercial aviation fatality risks. The CAST is comprised of industry and government representatives. As a result of CAST efforts, and new FAA regulations, the fatality risk for commercial aviation decreased by 83 percent between 1998 and 2008.

The FAA intends to reduce commercial aviation fatality risk by an additional 50% by 2025 (FAA PAR FY 2022).

The FAA Performance and Accountability Report itemizes the benefits of implementing a SMS (2022). One benefit is organizational compliance with regulations. Another benefit is the ability of organizations to share knowledge and information to determine needed actions. (FAA PAR FY 2022). The CAST developed over 100 safety measures, 80 percent based on accident data and 20 percent from other data. The FAA recognized this 20 percent as a shift toward proactive risk mitigation (FAA PAR FY 2022). The report reinforces the FAA's goal to work with the aviation industry to continuously improve aviation safety using a proactive approach.

Part of the SMS process includes monitoring assigned controls and the SMS itself for effectiveness. (FAA PAR FY 2022). The Safety assurance component of the FAA SMS includes five processes to be monitored by FAA organizations: (1) data and information employee reporting systems, investigations, evaluations, and audits, (2) data pertaining to hazards, controls, and nonconformances, (3) system assessments that document new hazards or ineffective controls, (4) corrective actions and their effectiveness, and (5) periodic management reviews of SMS effectiveness for each organization (Order 8000.369C).

Safety Climate. The fourth component of the FAA SMS is Safety Promotion which supports a sound safety culture (FAA.gov). FAA has an initiative to expand its safety culture campaign to improve the national aerospace system's safety performance. During FY 2022, the Aviation Safety (AVS) LOB launched the Voluntary Safety Reporting Program, which allows FAA AVS employees confidentially report safety concerns (FAA PAR FY22). Management and union representatives review the concerns and assign corrective actions.

1.3 NATIONAL AERONAUTICS AND SPACE ADMINISTRATION (NASA)

Agency Mission, Implementing Documents (Drivers), Purpose, Scope, Applicability. NASA is "America's civil space program and the global leader in space exploration" (About NASA, 2023). NASA Policy Directive (NPD) 8700.1F, *NASA Policy for Safety and Mission Success*, 2022 (NPD 8700.1F, 2022), sets forth NASA's policies regarding risk and promotes the Agency's priority to "protect the public, NASA workforce, high-value property, and the terrestrial, orbital, and planetary environments from potential harm due to NASA operations and activities". In addition to workforce and public safety, the Policy prioritizes flight crew and mission success and a robust safety culture. NASA Procedural Requirement (NPR) 8715.1B, *NASA Safety and Health Programs*, 2021 (NPR 8715.1B, 2021), includes NASA's safety management system for their Safety and Health Management Program, i.e., SMS that is consistent with OSHA Publication 3885, *Recommended Practices for Safety and Health Programs*, 2016.

NASA Safety and Health Management Programs and the SMS are applicable to NASA Headquarters and NASA Centers, including Component Facilities and Technical and Service Support Centers (NPR 8715.1B).

Contractor Applicability. NASA uses the term "workforce" to describe NASA federal workers and NASA contractors (NPR 8715.1B).

The NASA Policy for Safety and Mission Success applies to the Jet Propulsion Laboratory (JPL), operated by a Federally funded contractor, and other contractors, only if it is referenced in their contract (NPD 8700.1F). Specific to Safety and Health Programs and SMS, "Center Directors and project managers shall ensure that NASA contracts are written to appropriately incorporate the requirements of this NPR based on the hazards associated with the work being performed" (NPR 8715.1B). Center directors and project managers ensure that contractors have tailored safety and health plans, based on their activities, and verify contractors are complying with safety requirements. At the Center level, a representative from the Safety and Mission Assurance (SMA) organization must review and approve contractor safety plans (NPD 8715.1B).

Safety Management System. NASA refers to their safety management system as a "safety and health management program" and describes the system as a "proactive, collaborative process to find and fix hazards associated with NASA activities and operations before someone is injured or becomes ill" (NPR 8715.1B). The NASA safety and health management program is modeled after OSHA Pub. 3885 and includes seven elements:

- 1. Management leadership,
- 2. Worker participation,
- 3. Hazard identification and assessment,
- 4. Hazard prevention and control,
- 5. Education and training,
- 6. Program evaluation and improvement, and
- 7. Communication and coordination

(NPR 8715.1B, 2021)

Risk Management, Hazard Identification and Control. NASA outlines their *Risk Management Procedural Requirements* in NPR 8000.4C, 2022. The requirements apply to all Agency activities, i.e., "to NASA Headquarters and NASA Centers, including Component Facilities and Technical and Service Support Centers. NPR 8000.4C applies to the JPL contractor; other contractors; and recipients of grants, cooperative agreements, or other agreements only to the extent specified or referenced in the applicable contracts, grants, or agreements." (NPR 8000.4C)

NASA defines risk as "the potential for shortfalls with respect to achieving explicitly established and stated objectives." (NPR 8000.4C) NASA's risk processes are broadly applied to "risk contributors" versus hazards. Risk is assessed based on the likelihood and consequence of a performance measure being degraded. (NPR 8000.4C)

NASA's risk management process includes a "coordinated flow of activities to identify, evaluate, and address risk with appropriate actions, which combines Risk-Informed Decision Making (RIDM)⁵ and Continuous Risk Management (CRM)⁶ in an integrated framework. This is done to foster proactive management of risk items, to inform better decision making through better use of risk information, and then to manage more effectively implementation of risk-related activities and actions by focusing the CRM process on the baseline performance requirements informed by the RIDM process" (NPR 8000.4C).

Risk is accepted, or not accepted, depending on established performance measures for a system or process and the acceptable limits of performance, referred to as the risk posture. Risk is accepted at the level of the organization where an activity or project is occurring. Risk decisions can be elevated to the next higher level of the organization when additional resources or a higher decision authority is needed. (NPR 8000.4C)

SMS Accountability and Authority. The NASA Administrator is ultimately responsible for the successful execution of NASA's safety and health management program (system). The Chief Health and Medical Officer⁷ is the Designated Agency Safety and Health Official (DASHO). The Chief (of) SMA⁸ and DASHO manage the program for the Administrator (NPR 8715.1B), and each oversee the administration of

⁵ RIDM involves a multi-disciplinary approach for making an informed decision at commencement of an activity or project and applies Analysis of Alternatives (AoA) to find alternatives, assess each alternative and select the alternative that is best based on cost and risk reduction.

⁶ The Continuous Risk Management (CRM) process for projects and activities and relies on a set specified performance requirements for each project and activity (NPR 8000.4C, 2022). Risk management occurs "continuously in an activity, proactively risk-informing the selection of decision alternatives and then managing the risks associated with implementation of the selected alternative" NPR 8000.4C, 2022). CRM requires communication and documentation of five continuous steps: identify risk contributors, analyze likelihood and consequence of risk contributors, plan how to handle risk, track performance of risk mitigation, and control risk based on data from the tracking step.

⁷ Served as the DASHO, establishes and oversees implementation of the health portion of the safety and health management policies required by 29 CFR § 1960.1. The Agency health management policy and program are defined in NPD 1800.2, NASA Occupational Health Program and NPR 1800.1, NASA Occupational Health Program Procedures

⁸ Establishes and oversees implementation of the safety portion of the safety and health management policy required by 29 CFR § 1960.1 and the safety programs and requirements delineated in NPR 8715.1B. The Agency safety management policy and program are defined in NPD 8700.1, NASA Policy for Safety and Mission Success, and this NPR.

Office of Safety and Mission Assurance (OSMA) requirements for their respective disciplines. The SMA is also responsible for managing the execution of the Institutional Safety Authority that is responsible for confirming that the Agency is conforming to all applicable safety requirements. The Institutional Safety Authority is part of the Agency's governing structure that consists of a complete network of "independent authorities" and "serve as the designated Agency-level "official voice" for institutional safety and the associated requirements" (NPR 8715.1B).

The development and maintenance of NASA safety policy directives and procedural requirements are the responsibility of OSMA, which is the Office of Primary Responsibility and the only authority allowed to grant relief from Agency safety requirements (NPR 8715.1B). The Office of Health and Medical Officer, headed by the DASHO, serves as the authority to offer relief from Agency Health requirements (NPR 8715.1B).

Center Directors are accountable for all facets related to health and safety occurring at their Center and are the Institutional Safety Authority.

SMS Responsibilities. Center Directors are responsible for implementing the requirements of the safety and health program at their Center including submission of an annual report to the DASHO and Chief, SMA regarding the status of their safety and health program (NPR 8715.3D, 2021). Center SMA Directors support the Center Directors to ensure the risk position reflects current policies and that local programs are compliant with Agency requirements, at their respective Center. The SMA also supports the Center Director with implementation of Institutional Safety Authority and provide third-party oversight and communicate information to the Director and Chief, SMA (NPR 8715.3D). Center Institutional Safety Discipline Leads (Leads) are designated by each Center Director to serve as subject matter experts and support the implementation of the Institutional Safety Authority through policy development, understanding and application (NPR 8715.1B). The Leads oversee implementation of the safety programs and policies associated with their expertise, including oversight of Center activities (NPR 8715.3D). For work specific to NASA Missions the Mission Directorate Associate Administrators (MDAAs) are responsible for ensuring their project managers work with the Center staff to establish a safety and health program specific to the specific NASA Mission work involved. (NPR 8715.3D).

Measuring Performance of the Program. NASA has established leading and lagging indicators to measure safety efforts. Leading indicators include "the number of open vs. closed inspection findings, awareness campaigns, training metrics, progress towards safety goals/objectives, the amount of hazard and safety analyses completed, and close calls" (NPR 8715.3D). Lagging indicators include incidents, injuries and illnesses, and environmental and property losses.

Measuring performance of the System. Each Center must verify that their safety and health management program (system) is implemented as intended and must annually assess their system for improvements, based on the Center's goals and performance measures, to ensure effectiveness of the system (NPR 8715.1B).

NASA OSMA has a procedural requirement for audits, reviews, and assessments which are used to verify compliance with OSMA requirements (NPR 8705.6D, 2019). OSMA uses audits, reviews, and assessments to verify that programs and projects have established processes and are implementing OSMA requirements, including requirements for a safety and health management program (system). Each year the OSMA notifies Centers, Component Facilities and JPL of the audit, review, and assessment

schedule for the next two years. Programs and projects are expected to support the audits and respond to findings by assigning corrective actions.

The NASA Safety Center (NSC), a division of OSMA, provides knowledge sharing and data analysis, including data from mishaps, audits, reviews, and assessments. The NSC produces safety videos, posters, handouts, etc. that assist NASA with being a learning organization (NASA Safety Center, 2023). NSC's products are available from their website to NASA employees only.

Safety Climate. Cultivating a robust safety culture is one of the three priorities listed in NPD 8700.1F. NASA's OSMA website states: "Safety Culture's mission at NASA is to create an environment where everyone works safely, feels comfortable communicating safety issues, learns from mistakes and successes, feels confident balancing challenges and risks while keeping safety in the forefront, and trusts that safety is a priority" (sma.nasa.gov, 2023). The safety culture website includes links to "Caught Doing Right" posters and bios on workers who received "Yes, If" coins for safety contributions.

NPR 8715.1B indicates that each Center's Safety and Health Management Program must "actively promote safety culture," and outlines specific means to do so by "reporting safety concerns and incidents, participating in safety and health awareness activities, engaging in safe behaviors, and sharing relevant lessons to improve mission success and safety". The *NASA Safety Culture Handbook*, 8709.24, 2015, outlines NASA's Safety Culture Program and "…contains guidance on the development, implementation, sustainment, growth, and practice of Safety Culture at the Center level". The "Applicable Documents" section of the Handbook includes a reference to DOE Guide (G) 450.4-1B *Integrated Safety Management System Guide* Volume 1 (DOE G 450.4-1B-2001) for use with Safety Management System Policies and indicates the document is "applicable to the guidance" in their Handbook. The content of the Handbook does not elaborate on the application of DOE G 450.4-1B and does not speak to the interface, or intended interaction, between the NASA Safety Management System and NASA's Safety Culture.

NASA has developed a Safety Culture Survey to obtain feedback from the workforce. The survey is administered every two years to all NASA Centers and organizations. Center SMA Directors provide survey results to their Center Directors and OSMA within 90 days of the survey completion. Survey results are used to improve Center SMSs (NPR 8705.6D).

An independent Aerospace Safety Advisory Panel (ASAP) is tasked with continuous oversight of NASA's safety programs. Each year the Panel publishes a report which provides recommendations and summarizes progress made on previous years' recommendations. The ASAP reports focus on risk to human space flight programs.

The 2022 ASAP report identified NASA's need to clearly identify who is responsible and accountable "for safety and risk management" and ensure that this information is readily available (ASAP Annual Report 2022). Of note, the 2022 ASAP report recommends that NASA focus on building and maintaining a skilled and experienced work force. ASAP expresses concern with "organizational silence,⁹" an aging

⁹ "...a collective phenomenon where employees feel compelled to silence, fail to speak up, or purposefully withhold their views out of fear that negative information will not be well-received by an organization's leaders" (ASAP Annual Report 2022).

workforce, transition to hybrid or remote work, and "quiet quitting.¹⁰" According to the report, these concerns with the work force are directly related to maintaining a culture of safety and transparency.

¹⁰ "...described as millions of people not going "above and beyond" in their performance, but instead, just meeting the minimum requirements of their job description, affecting productivity and efficiency (ASAP Annual Report 2022).

1.4 DEPARTMENT OF THE NAVY (DON)- UNITED STATES NAVY (USN OR NAVY)

The Department of the Navy (DON) is one of three military departments within the U.S. Department of Defense; the DA and Department of the Air Force, being the other two. The Secretary of the Navy (SECNAV) leads the DON, comprised of two uniformed services: the USN and the U.S. Marine Corps (USMC). The highest-ranking officers in the DON are the Chief of Naval Operations (CNO) and the Commandant of the Marine Corps.

Agency Mission, Implementing Documents (Drivers), Purpose, Scope, Applicability. The mission of the USN is to "defend freedom, preserve economic prosperity, and keep the seas open and free" (Navy, 2021). The Navy instituted the Navy SMS with newly issued guidance as part of the 2020 Navy Safety and Occupational Health Manual, OPNAV M-5100.23, that also outlines elements for the Agency's SOH Program. The Navy updated their guidance in the 2022 Navy Safety and Occupational Health Manual (OPNAV M-5100.23) which serves as the primary resource for this document. All Naval commands and operations, units and activities maintain SOH as a core value to "prevent mishaps, save lives, and preserve combat readiness" (OPNAV M-5100.23, 2020).

The Navy SMS applies to the entire Navy, comprised of sailors, civilians, contracted employees, and industry partners. The SMS principles apply to all Navy activities in air, land, sea, and space at all times and in all operating environments.

Contractor Applicability. The Navy SMS applies to contracted employees (OPNAV M-5100.23 CH-2, 2022).

Safety Management System. In 2020 the USN instituted the Navy SMS using a risk-based decisionmaking framework that applies defense-in-depth and promotes continuous improvement to ensure resilience and operational readiness (OPNAV Instructions (INST) 5100.23H, 2020). The Navy "SMS is the concept of operations for controlling risks" and establishes conditions for success rather than prescribed requirements (OPNAV M-5100.23 CH-2, 2022).

The goal of the Navy SMS is to avoid unnecessary harm to people or damage to equipment across the entire scope of Navy activities (OPNAV M-5100.23 CH-2, 2022). OPNAV M-5100.23 details the SMS organization and structure that supports the Navy's resilient systems which are "Safe-to-Operate and Operating Safely." The top-down and bottom-up approach includes Responsibilities and Accountability, Risk Control System (RCS), and Assurance to produce the four desired outcomes, i.e., the 4Ps:

- 1. Outcome 1: Safe Place. All factors for a safe workplace organizational structure, risk tolerance, resources (availability and allocation) to ensure compliance with requirements and policy, emergency preparedness.
- 2. Outcome 2: Safe People. All individuals behave safely. This includes empowerment to raise issues, competence (technical and non-technical skills) All levels of the work force have the required skills and needed instruction to perform their work and do so safely to include fitness for duty. The safety-critical need for all staff to behave safely.
- 3. Outcome 3: Safe Property/Materiel. All physical structures and areas used for work and the machines and devices are in a suitable condition, appropriate for the work and accessible, and working correctly. A workplace free from unnecessary hazards and amply staffed.

4. Outcome 4: Safe Processes/Procedures. Operating, emergency and safety procedures are appropriate and available. Individuals and team working within safety system boundaries established by standards and procedures and support through resources and effective leadership.

Accountability for the SMS. The Navy SMS accountability structure supports unity, risk ownership and SMS authority as follows:

- 1. As the highest serving member, the CNO/Echelon 1 owns and is accountable for risk at every level via the SMS. The CNO elevates risks to the next higher authority, i.e., the Secretary of the Navy, when the risk cannot be mitigated with Navy.
- 2. NAVSAFECOM (Naval Safety Command) establishes and facilitates the Navy SMS, advising the CNO on all matters related to SMS and representing Echelon 1 as the SMS authority for SMS policy, governance, guidance, accountability, and assurance.
- 3. Echelon commanders (2, 3 and 4) are the designated Accountable Persons¹¹ (AP) who are personally accountable to the CNO via the chain of command for successful implementation of the SMS or safety management plan (SMP).
 - a. Safety experts are assigned to each AP to support the implementation of the SMS/SMP. The designated safety individual must remain neutral and cannot be responsible for executing operational activities within the command or unit, reflecting the Navy's practice of defense-in-depth.
 - b. Commanding Officers and Officers in Charge audit their SMS and SMP to ensure controls appropriately mitigate risk.
 - c. Individuals and teams are accountable for following the SMS and SMP, to include reporting unmitigated risks up the chain of command.

SMS Responsibilities (for implementation). The responsibilities outlined within OPNAV M-5100.23 require Echelon 2 commanders (and subordinate commands) to create and implement a SMS or SMP using the information in the OPNAV M-5100.23 and applicable references.

Risk Management, Hazard Identification and Control. The USN manages risk using a systems approach focused on Prevention and Correction (defense-in-depth) to build a unified and resilient SMS (OPNAV M-5100.23 CH-2, 2022). The Navy does not prescribe a specific SMS structure like other departments or agencies. The Navy's approach provides principles, including those offered in International Organization for Standardization (ISO) 45001, *Occupational Health and Safety Management Systems*, as tools that leaders can use to develop their organization-specific SMS (2022).

The RCS chapter of OPNAV M-5100.23 CH-2, (2022) provides the following principles to control risks and protect people and materiel:

¹¹ Accountable Person. The individual who is personally accountable and has the authority and responsibility for the effective execution of the SMS or SMP. This individual owns the risks within their command. This responsibility cannot be delegated (OPNA V M-5100.23 CH-2, 2022).

- Leadership and Accountability. Leaders must have knowledge of work activities at all levels, supervise staff, and must ensure work is being performed as expected by individuals competent to make risk-based decisions. Individuals must work safely and take required action when conditions are not safe.
- 2. Resilience: A Systems Approach to Risk. Each system must have the ability to "bounce-back from" or "absorb disturbances." The Navy uses a Resilience Model which prioritizes preventing and reducing issues or safety risks by implementing elimination and mitigation controls to reduce risk to an acceptable level, or As Low as Reasonably Achievable (ALARA). Defense in depth is accomplished by ensuring that no one control can be a single-point failure. Additional controls are applied so that if an issue occurs the damage is minimized. A resilient system is predicated on resilient thinking that applies leading and lagging indicators "to judge the level of assurance and overall safety performance from prevention [of issues] through to correction [to avoid additional harm] to ensure a system is "Safe-to-Operate and Operating Safely." (2022)
- 3. Safety Case. Documentation of risk mitigation to ALARA for a specific system with a well-defined application and operating environment.
- 4. Proven work model. The Navy's proven work model includes the Watch-standing principles (Naval Nuclear Power Program major safety-program values) and ensuring Engineering/Equipment, Training, and Supervision are addressed equally during the planning and execution, as well as assessment of unplanned events.

Measuring Performance of the Program and System. The Navy uses a "layered defense system" that includes independent audits and self-assessments; collecting and analyzing leading and lagging indicators; and organizational learning to assure it is resilient and "Safe-to-Operate and Operating Safely." (OPNAV M-5100.23 CH-2, 2022) This collective approach to measuring performance of the system and the program assure the desired 4Ps of the SMS. (2022) Safety assurance includes regular and scheduled official assessments to demonstrate compliance with rules and specifications. (OPNAV M-5100.23 CH-2, 2022) First- and second-party audits are conducted within the Command as outlined in OPNAV M-5100.23, and third-party audits are independent:

- First party self-assessments inform the Commanding Officer that the Unit is "Safe-to-Operate and Operating Safely" by fulfilling policy requirements and conforming to the established risk management process. Uncontrolled risks must be logged, communicated, and monitored to remediation and unsafe activities warrant immediate work stoppage until ALARA.
- Second party audits are formal and performed by the APs on behalf of Echelon 2 to ensure the Command is "Safe-to-Operate, Operating Safely", and resilient. The assessment focuses on mission readiness and "confirm the SMS or SMP is effective at identifying, controlling and owning risks and issues."
- NAVSAFECOM performs independent systems level assessments (of Echelon 2 commends and below) to verify that the SMS performs as designed. The audits examine the effectiveness of the AP at generating safe operations, controlling risks and compliance with OPNAV M-5100.23, and referenced documents. This third-party oversight is on behalf of the CNO to ensure operational readiness and mission success.

At the operational level, assurance is built into the RCS through resilience where risks are identified, owned, and controlled at the appropriate level. (OPNAV M-5100.23 CH-2) The Navy uses resilience as "a formal method to organize key leading and lagging indicators to judge the level of assurance and overall safety performance."

- "Key Performance Indicators" (KPI) are lagging indicators (e.g., "number and rate of mishaps; enforcement action, lost work time, lost equipment availability, lost capability, financial losses") used by the Navy to determine the success of SMS based on how well the agency protected individuals and materials from harm.
- "Key Risk Indicators" (KRI) are "derived from audits, inspections, hazard reports, health and medical surveillance, competence availability, benchmarking, surveys", that can discover potential vulnerabilities and provide an opportunity to course correct. KRIs are leading indicators on the effectiveness of the RCS.

KRIs and KPIs are used to measure risk management and safety performance. KRIs and KPIs link "DON's strategic planning, Enterprise Risk Management Concept of Operations and performance to the management processes." (OPNAV M-5100.23 CH-2)

DON assures a safe working environment by institutionalizing organizational learning with a formal lesson learned program and the application of their Report, Analyze and Get Better (RAG) cycle. RAG is the continuous process of gathering data from accidents/unsafe activities, evaluating the effectiveness of risk controls, and using that intelligence to build resilience into the system. (OPNAV M-5100.23 CH-2, 2022) In addition, each Echelon 2 SMS and SMP must include a lesson learned program consistent with OPNAV INST 3500.37D, Navy Lessons Learned Program. This instruction is in place to "redefine pinnacle events" and give low level issues the same level of attention as high level issues which supports safe daily operations and more cost-effective learning. (OPNAV M-5100.23 CH-2, 2022)

The Naval Safety Center publishes an annual report which highlights mishap trends and lessons learned for both the Navy and Marine Corps. The most recent annual report is dated 2021 and summarizes information from 2021. However, the report does not specifically address SMS performance (Naval Safety Center Annual Report, 2021).

The NSC website includes a resources menu with links to statistics, posters, risk management information, etc. A second tab contains links to safety promotions including four online magazines with articles aimed at mishap prevention. The statistics page includes a link to FY 2022 mishap statistics which contains numerous bar graphs summarizing mishaps. However, the statistics are not interpreted, and corrective actions or resultant initiatives are not discussed. (NSC, 2023)

Safety Climate. Safety culture is an integral part of the Navy. The safety culture and the SMS are integrated and reflected in the way the Navy functions. The SMS supports the Navy's safety culture through defined responsibilities, requiring accountability for safe work practices, mitigating risk at the right level, proactively attending to small issues, defense-in-depth for all activities, communicating unresolved issues up the chain of command to the level necessary for action, and structed methods for continuous improvement. (OPNA V M-5100.23 CH-2, 2022)

The Navy's senior level command officers conduct safety culture workshops to "focus on operational excellence by gauging trust, integrity and effective communication" by involving everyone in the workshop (OPNA V M-5100.23 CH-2, 2022) This activity provides an inward look to determine if perceptions about culture and climate are accurate, and if not to identify and remediate potential issues.

1.5 UNITED STATES MARINE CORPS (USMC OR MARINES)

Agency Mission, Implementing Documents (Drivers), Purpose, Scope, Applicability. The "Marine Corps mission reflects every Marine's purpose - our Nation" (Marines, 2023). The "United States Marines are a family that fights together, finding individual purpose in a collective cause—the protection of our Nation and the advancement of its ideals" (Marines, 2023).

The Marines are part of the Navy, although they are an autonomous body with a separate command system from the Navy. In February of 2022, the Navy elevated the authority of NAVSAFECOM (Naval Safety Command, 2022). The "new" NAVSAFECOM oversees the Navy and Marine Corps SMS. In September 2022 the Naval Safety Command announced a "new" SMS that applies to "every Sailor, Marine and civilian employee and to all activities across the naval enterprise" (Naval Safety Command, 2022). As of February 2023, the Marine Corps had not modified their Marine Corps Safety Management System (MCSMS) to include the NAVSAFECOM authorities and responsibilities or other changes based on the "new" SMS rolled out by Naval Safety Command and described in the Navy Safety and Occupational Health Manual, OPNAV M-5100.23 CH-2.

The USMC operates under six enduring principles that reflect its core values of honor, courage, and commitment. One of the USMC's enduring principles is "Marines take care of their own," which includes effectively managing risk in every decision (Marine Corps Doctrinal Publications MCDP 1-0 *Marine Corps Operations*, 2011). To support this enduring principle, the USMC requires a SMS that conforms to Marine Corps Order (MCO) 5100.29C, *Marine Corps Safety Management System*, 2021, to manage risks and improve performance.

The MCSMS applies to Marines, Sailors, and civilian Marines and provides safe and healthful places to work, live, and recreate (MCO 5100.29C, Vol. 1).

Contractor Applicability. The MCSMS Order does not apply to contractors. (MCO 5100.29C, Vol. 1). The Command level requires contractors to follow safety regulations in their contract, and the contracting officer performs safety oversight (MCO 5100.29C, Vol. 1).

Safety Management System. The MCSMS focuses on operational excellence, "the professional, efficient, and expert execution" of missions, purpose, and duties (MCO 5100.29C, change transmittal memorandum). Operational excellence includes continuous improvement and entails knowing that there is a correct way to do things, acknowledging what the correct way is, and making the conscious decision to do things in the correct way, each time. The USMC believes that safety is what will occur naturally when "we are performing to high standards" (MCO 5100.29C).

The MCSMS replaced the Marine Corps Safety Program codified in MCO 5100.29B, 2011. The legacy Marine Corps Safety Program was not part of mission planning and execution but an additive requirement with a list of tasks outlining "what to do." The USMC identified that the Safety Program did not have "unity of purpose and unity of effort between MC Headquarters (HQMC) and commanders at all levels." The MCSMS is not a safety checklist but a systematic approach that integrates safety (i.e., "how to do it") into mission planning and execution. It applies a common framework to harmonize HQMC and commanders at all levels to establish a just culture; teach Marines and units; plan, execute, and debrief operations and activities on/off duty; evaluate the system's success; and constantly improve the process (MCO 5100.29C, Vol. 1). The MCSMS is structured for "managing SOH risks and opportunities" specific to the physical and mental health, both on-duty and off-duty Marines, focusing on preventive and protective measures (MCO 5100.29C, Vol. 1). The MCSMS is a single system. The Marine Corps supports the MCSMS through policies and courses; every unit, element, and individual within the Marine Corps has a specific job and responsibility. The USMC Commanders are responsible for developing Unit-specific SMSs that align with the four pillars (see below) and is customized based on the unit's mission, functions, and locale.

The USMC identifies 11 factors necessary for the successful implementation and maintenance of the MCSMS that include:

- 1. "Top management leadership, commitment, responsibilities, and accountability
- 2. Top management developing, leading, and promoting a culture in the organization that supports the intended outcomes of the system
- 3. Clear, effective communication
- 4. Consultation with and, if applicable, the participation of Marines, Sailors, civilian Marines, organized labor representatives and families
- 5. Allocation of the necessary resources to implement and maintain it
- 6. Policies compatible with the overall strategic objectives and direction of the organization
- 7. Effective processes for identifying hazards, controlling risks, and taking advantage of opportunities
- 8. Continual performance evaluation and monitoring of the SMS to improve performance
- 9. Integration of the SMS into the organization's processes
- 10. SOH objectives that align with SOH policy and consider the organization's hazards, SOH risks, and SOH opportunities
- 11. Compliance with all legal requirements" (MCO 5100.29C, Vol. 1).

The MCSMS has Four Pillars that integrate a PDCA business cycle to ensure continuous improvement is inherent with the system.

- Pillar 1: Policy and Leadership. Policy defines the requirements and communicates safety related roles and responsibilities. Leadership is responsible for safe operations and must establish accountability throughout their organization and communicate expectations. The policy aspect aligns with "plan" in PDCA and how each organization implements the policy corresponds to the "do" in the cycle.
- Pillar 2: Risk Management. All levels of Marine Corps leadership must develop procedures for risk management. The planning, preparation, briefing, execution, and debriefing of missions and tasks must include risk management.
- Pillar 3: Safety Assurance. Assess the unit's conformity to standards and application of MCSMS elements, and measure progress toward established goals and corrective actions initiatives. Pillar 3 reflects "check" and "act" in the PDCA cycle.
- Pillar 4: Safety Promotion and Training. Safety promotion requires each command to convey lessons learned, audit and assess findings, mishap and near miss data, document the logic

behind the adoption of controls, and preventive and corrective measures. Training is required formal and informal teachings on SOH and military-specific activities and topics to ensure a fully functional SMS. Personnel must receive regular training commensurate with their position and duty assignment within the organization, and their level of influence on the safety of the organization's operations. Pillar Four includes Safety Culture, identifying four types- just, reporting, learning, and flexible.

In developing their SMS, the USMC utilized several regulatory and national standard setting entities, OSHA CFR 1960, *Basic Program Elements for Federal Employee Occupational Safety and Health Programs and Related Matters*, DoD Instruction (DoDI) 6055.01, *Department of Defense Safety and Occupational Health Program*, Office of the Chief of Naval Operations Instruction (OPNAVINST) 3750.6S, *Naval Aviation Safety Management System*, and American National Standards Institute / American Society of Safety Professionals (ANSI/ASSP) Standard Z10, *Occupational Safety and Health Management*.

Risk Management, Hazard Identification and Control. The USMC's risk management process is one of their Four Pillars and has five steps:

- 1. Identify Hazards,
- 2. Assess Hazards,
- 3. Develop Controls and Make Risk Decisions,
- 4. Implement Controls,
- 5. Supervise and Evaluate (MCO 5100.29C, Vol. 1).

USMC applies risk management at the task level and considers each phase of a task from planning and preparation to execution and debriefing. For each task, hazards are prioritized based on probability and severity and controls are identified and implemented. After implementation, controls are monitored to ensure their efficacy. The USMC provides tailored training to affected staff communicating their risk management expectations applicable regardless of rank. Commanders are responsible for understanding and communicating conditions that could exist during a task that would prevent successful completion. The USMC asserts four risk management principles,

- 1. Accept no unnecessary risk,
- 2. Anticipate and manage risk by planning,
- 3. Make risk decisions at the right level,
- 4. Accept risks when the benefits outweigh the costs (MCO 5100.29C, Vol. 1).

Risk decisions can be made by any Marine; however, leaders have the overall responsibility to accept, eliminate, or reduce the risk. (MCO 5100.29 C Volume 2, *Risk Management*)

Accountability for the SMS. The Commandant of the Marine Corps (CMC), the highest-ranking member of the Marine Corps, is responsible for the USMC safety policy and direct [emphasis added] communication of safety policy and expectations to HQMC elements, Commanding Generals, and Marines. The Assistant Commandant of the Marine Corps (ACMC) is the DASHO responsible for safety policies and chairs the Marine Corps Executive Safety Board. The Director, CMC Safety Division supports the ACMC with administering the MCSMS. The Inspector General of the Marine Corps evaluates MCSMS implementation during compliance inspections and recommends corrective actions (MCO 5100.29C, Vol. 1).

The ACMC chairs the Executive Safety Council which meets twice annually with other senior USMC leaders. The council is responsible for considering and approving proposals and policies changes related to the MCSMS; cultivate resources and garner support for effective feedback tools; review and analyze loss trends and counter initiatives in-agency and compared to other organizations; and collaborate on tactical means for communicating policy changes to the enterprise and implementation instructions. (MCO 5100.29C, Vol. 1)

Unit Commanders are responsible for implementing the SMS at the Unit-level (subordinate elements) and have the most influence with whether a Unit accomplishes their mission. Unit Commanders affect culture, effective risk management, compliance, and performance. Unit Commanders customize a Unit-level SMS which includes a safety policy and mission statement. The safety policy communicates the Unit Commander's commitment to operational excellence and expectations for risk management. Each person in the Unit receives a copy of the safety policy and new personnel receive an in-brief from the Unit Commander within seven days of joining the Unit (MCO 5100.29C, Vol. 1). The safety office and local supervisors support the Unit Commander with implementation of the SMS and the Marines and DoD civilian staff participate in the MCSMS by complying with requirements, applying risk management skills, and reporting unsafe conditions and mishaps on and off duty.

Headquarters elements are responsible for facilitating the establishment of the MCSMS at the Headquarters and subordinate units. Additionally, they ensure the allocation of appropriate resources for its execution.

SMS Responsibilities (for implementation). There is only one MCSMS. Every unit, element, and individual within the Marine Corps has a role and subsequent responsibilities within the system. The Commander is responsible for the implementation of Unit's SMS (MCO 5100.29C Vol. 1).

Measuring Performance of the Program. The MCSMS replaced documents previously referred to as a program. The MCSMS is comprised of nine volumes. Key volumes to this discussion are Volume 1 the MCSMS overview, Volume 2 Risk Management, and Volume 6 Safety and Occupational Health which was in development at the time MCO 5100.29C CH-2 was published in February 2022. Measuring performance of the overall Program (Volumes 1-9) is described in Volume 1.

Measuring performance of the System. The USMC uses various tools, as part of their safety assurance pillar, to monitor the implementation and continuous improvement efforts of the MCSMS (MCO 5100.29C, Vol. 1). These include:

- Inspections or Command Safety Assessments (CSA) are performed on subordinate organizations' safety system, at least every 36 months, to assess MCSMS compliance and execution. A final report evaluates the SMS and rates its performance.
- Self-assessments are completed by each unit, every 24 months, to assess the performance of their MCSMS and recommend improvements. The results and action items are tracked through completion. The results are submitted to their Commander and included in the

- Annual Program Management Review. Monitoring is required by all commands, units, and activities in response to a mishap. The activity includes reporting, investigating and record keeping.
- Safety Climate Assessment Surveys include safety climate surveys and culture workshops used as tools to elicit direct feedback from the staff in the unit. "Unit Commanders shall invest time, energy, and presence in the health of their command safety management system and seek a command climate focused on operational readiness and doing the things the right way. The commander is required to complete the safety climate survey within 90 days following change of command and annually hereafter."

The Naval Safety Center publishes an annual report which highlights mishap trends and lessons learned for both the Navy and Marine Corps. The most recent annual report is dated 2021. The report does not specifically address SMS performance. However, the report does delineate three lines of effort (LOE), or priorities, for 2021: digital transformation, risk management rebranding, and safety professional development. Each of these LOEs could be tied back to the Four Pillars, although the report doesn't make this connection (Naval Safety Center Annual Report, 2021).

The Naval Safety Command website includes a resources menu with links to statistics, posters, risk management information, etc. A second tab contains links to safety promotions including four online magazines with articles aimed at mishap prevention. The statistics page includes a link to FY 2022 mishap statistics which contains numerous bar graphs summarizing mishaps. However, the statistics are not interpreted, and corrective actions or resultant initiatives are not discussed (NSC, 2023).

Safety Climate. Commander's Intent. "Change the culture of the Marine Corps by redefining safety to focus on the Operational Excellence of our units and Marines, and by refocusing all Marines on the continuous management of risk" (MCO 5100.29C, Vol. 1, 2021).

Pilar 4 of the MCSMS promotes four types of safety culture (MCO 5100.29C, Vol. 1, 2021):

- 1. Just Culture encourages employees to report hazardous and unhealthy work situations without repercussions. Officers support a culture focused on solutions rather than blame to build trust through all levels of the organizations.
- 2. Reporting Culture encourages voluntary reporting of unsafe conditions.
- 3. Learning Culture involves willingness to communicate lessons learned and adjust procedures and practices.
- 4. Flexible Culture employees can suggest organizational improvements.

2 GOVERNING BODIES

2.1 OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION (OSHA)

Background. OSHA effectively has a Safety and Health Management System (SHMS) for its employees and has Recommended Practices for Safety and Health Programs for employers (OSHA 3885). The SHMS establishes baseline requirements for safety and health of all OSHA employees and employee participation is acknowledged in the purpose as being the key element of a successful SHMS (OSHA Field Safety and Health Manual, 2020). OSHA 3885 provides recommended practices for addressing safety and health issues in the workplace (2016).

Standard Organization Purpose, Applicability, Success Factors, System Approach. The goal of the SHMS is to create and administer acceptable safety and health initiatives. OSHA is responsible for ensuring that employees of the Administration have a safe and healthful workplace that complies with the Occupational Safety and Health Act and with OSHA standards. To eliminate/control hazards before they cause fatalities, injuries, and illnesses, it is also crucial to implement an effective SHMS that is tailored to the varying work responsibilities and working conditions of employees (OSHA Field Safety and Health Manual, 2020). According to OSHA 3885, the main goal of safety and health programs is to prevent workplace injuries, illnesses, and deaths (2016). The recommended practices use a proactive approach to managing workplace safety and health with continuous improvement being the central concept.

Contractor Applicability. All safety and health programs shall ensure the highest level of protection for employees, temporary employees, contractors, and the visiting public consistent with existing rules, standards, and guidance (OSHA Field Safety and Health Manual, 2020). Contractors at OSHA have the responsibility to know the types of hazards present, procedures, or measures to avoid or control exposures. Contractors are required to inform sites of chemicals brought onto site (OSHA Field Safety and Health Manual, 2020). OSHA Field Safety and Health Manual, 2020). OSHA 3885, Recommended Practice notes four recommended practices for working with contractors: "Host employers, contractors, and staffing agencies should disclose the dangers existing at the jobsite as well as the hazards that contract employees' employment may generate. Host employers, contractors, and staffing agencies coordinate on work planning and scheduling to identify and resolve any conflicts that could affect safety and health."

Safety Management System (Requirements/Structure/Framework). The OSHA 3885 system provides a framework of recommended practices that include management leadership, worker participation, hazard identification and assessment, hazard prevention and control, education and training, program evaluation and improvement, communication and coordination for host employers, contractors, and staffing agencies. The SHMS follows the OSHA 3885 framework with the addition of twenty functional area programs. The safety and health management system described in Chapter 2 and Chapter 3 is dedicated to program evaluation and system evaluation. Following are the seven core, interrelated elements of OSHA's prescribed system and suggested actions employers can take to implement a system in their workplace:

- Management leadership
 - o Action item 1: Communicate your commitment to a safety and health program

- Action item 2: Define program goals
- Action item 3: Allocate resources
- Action item 4: Expect performance
- Worker participation
 - Action item 1: Encourage workers to participate in the program
 - Action item 2: Encourage workers to report safety and health concerns
 - Action item 3: Give workers access to safety and health information
 - Action item 4: Involve workers in all aspects of the program
 - Action item 5: Remove barriers to participation
- Hazard identification and assessment
 - Action item 1: Collect existing information about workplace hazards
 - Action item 2: Inspect the workplace for safety hazards
 - Action item 3: Identify health hazards
 - Action item 4: Conduct incident investigations
 - Action item 5: Identify hazards associated with emergency and nonroutine situations
 - Action item 6: Characterize the nature of identified hazards, identify interim control measures, and prioritize the hazards for control
- Hazard prevention and control
 - Action item 1: Identify control options
 - Action item 2: Select controls
 - o Action item 3: Develop and update a hazard control plan
 - Action item 4: Select controls to protect workers during nonroutine operations and emergencies
 - Action item 5: Implement selected controls in the workplace
 - Action item 6: Follow up to confirm that controls are effective
- Education and training
 - Action item 1: Provide program awareness training
 - Action item 2: Train employers, managers, and supervisors on their roles in the program
 - Action item 3: Train workers on their specific roles in the safety and health program
 - o Action item 4: Train workers on hazard identification and controls
- Program evaluation and improvement
 - Action item 1: Monitor performance and progress
 - o Action item 2: Verify that the program is implemented and is operating
 - Action item 3: Correct program shortcomings and identify opportunities to improve
- Communication and coordination for host employers, contractors, and staffing agencies
 - o Action item 1: Establish effective communication
 - Action item 2: Establish effective coordination

Risk Management, Hazard Identification and Control. OSHA employees conduct enforcement inspections and Voluntary Protection Program (VPP) onsite assessments which pose office and field hazards. Supervisors and employees identify and analyze hazards associated with their work and attend relevant training. The SHMS prescribes implementing hazard preventive and protective measures that: eliminate the hazard/risk; control it at the source through engineering controls or organizational measures; minimize it by designing safe work systems or using administrative control measures; or, if residual hazards/risks cannot be controlled by collective measures, use of appropriate personal protective equipment. Hazard assessments identify personnel dangers and should be performed for all tasks. A basic level of personal protective equipment (PPE) is needed on most job sites, regardless of industry. Employees may need additional PPE during some inspections and should follow the employer's rules during the inspection. The SHMS includes a provision that hazard prevention and control procedures must be reviewed and revised "as necessary" to ensure employees are protected (OSHA Field Safety and Health Manual, 2020).

Accountability for the SMS. The Assistant Secretary is responsible for the health and safety of OSHA employees. Regional administrators are responsible for the SHMS and programs within their offices (OSHA Field Safety and Health Manual, 2020).

SMS Responsibilities (for implementation). Management is responsible for establishing an effective program with roles and responsibilities. OSHA 3885 states that programs must identify a frontline person to make plans and coordinate activities, lead the program effort by establishing roles and responsibilities, and provide and track progress (OSHA 3885). In the OSHA SHMS, the Directorate of Technical Support and Emergency Management (DTSEM) is responsible for the implementation and management of the program (OSHA Field Safety and Health Manual, 2020). Regional Offices, Area Offices, and District Offices implement the system and programs at the local level with Area and District Offices reporting up to the Regional Offices.

Measuring Performance of the Program. According to OSHA 3885, both leading and lagging indicators are used to monitor program performance. Lagging indicators include injury and illness data, industrial hygiene results indicating harmful exposures, and workers' compensation data (OSHA, 3885). Examples of leading indicators include level and frequency of employee participation, timely completion of safety training, and timely response to reported hazard and near misses (OSHA, 3885). OSHA recommends using employee reports of incidents and hazards, along with workplace inspections and investigations, as key indicators that programs are, or are not, working as intended (OSHA, 3885).

Measuring performance of the System. Regional, Area, and District Offices are required to perform annual self-assessments of their SHMS. Area and District Offices provide feedback on their SHMS effectiveness to the Regional Office and make course corrections as needed. Regional Offices provide completed assessments to the DTSEM. A required template for the self-assessment is included in the OSHA Field Safety and Health Manual and the directions require management and non-management employees to participate in the self-assessment.

Safety Climate. The SHMS assigns responsibility to Regional Administrators for creating a supportive safety and health culture. The SHMS does not provide additional information about culture. OSHA 3885 does not make a link between implementing a safety and health program and culture.

Quality Assurance. Not applicable.

2.2 INTERNATIONAL ATOMIC ENERGY AGENCY (IAEA)

Background. The IAEA was established in 1957 as part of U.S. President Eisenhower's "Atoms for Peace" and serves as an international organization that promotes information exchange to facilitate peaceful nuclear activities (IAEA, 2023). As of January 2023, there are 176 Member States (countries) in the IAEA (IAEA, 2023).

Organization's Mission/Purpose, Implementing SMS Documents, Scope/Applicability. IAEA's statute authorizes the Agency to "establish or adopt...standards of safety for protection of health and minimization of danger to life and property" (Leadership and Management for Safety, 2016). The "IAEA safety standards are the global reference for protecting people and the environment from harmful effects of ionizing radiation" and are organized as follows:

- Safety Fundamentals (SF) are high-level documents providing vision and expectations for safety.
- *General Safety Requirements (GSR)* set forth conditions that must be met to fulfill the safety fundamentals.
- *Safety Guides* offer references and instruction to support the safety requirements (IAEA Safety Standards brochure, 2016).

The IAEA uses the term "management system" (rather than safety management system) that includes safety, health, environmental, security, quality, human-and-organizational-factor, societal and economic elements the rationale for this approach is detailed on this document. The primary documents that govern the IAEA management system include Fundamental Safety Principles, 2006, and Leadership and Management for Safety, 2016. The two documents that support implementation include Application of the Management System for Facilities and Activities, 2006; and The Management System for Nuclear Installations, 2009.¹²

The principal users of IAEA safety standards are the IAEA Member States, with some states automatically adopting the standards as their regulations and others using the documents as references dependent on the regulatory system of the adopting country. The standards are also used by benefactors and entities that create, build, or control nuclear installations (No. GSR Part 2, 2016).

Contractor Applicability. The IAEA does not address applicability of their safety standards to contractors.

Safety and the Management System. The objective of the safety¹³ standards published by the IAEA are to "protect people and the environment from harmful effects of ionizing radiation" (No. SF-1, 2006). The standards are based on unified set of ten safety principles, outlined in No. SF-1 as:

¹² The content for this write-up was primarily derived from the safety fundamentals and safety requirements documents to ensure consistency of content (highest-level documents and most current versions) with other entities included in Phase 1- Benchmarking.

¹³ In accordance with No. SF-1, 2006, IAEA defines 'safety' as "the protection of people and the environment against radiation risks, and the safety of facilities and activities that give rise to radiation risks" and 'safety' when safety in IAEA documents "includes the safety of nuclear installations, radiation safety, the safety of radioactive

- "Principle 1: Responsibility for safety rests with the entity responsible for the facility or activity that poses the risk.
- Principle 2: Role of government to create the structure, legal requirements, for safety that includes an independent governing organization.
- Principle 3: Leadership and management for safety the highest-ranking individuals taking the lead to address safety concerns and attaining and sustaining safety through a management system.
- Principle 4: Justification of facilities and activities to ensure that benefits derived from each are worth the associated risks.
- Principle 5: Optimization of protection by ensuring risks are as low as reasonably achievable and all feasible safety measures are in place.
- Principle 6: Limitation of risks to individuals by monitoring and limiting exposure (i.e., dose).
- Principle 7: Protection of present and future generations as well as the environment from present risk as well as future risks that may result from legacy work, includes planning for waste management.
- Principle 8: Prevention of accidents by taking measures to protect against an occurrence as well as control severity and minimize loss in the case of an occurrence.
- Principle 9: Emergency preparedness and response to ensue readiness in the case of an occurrence.
- Principle 10: Protective actions to reduce existing or unregulated radiation risks related to natural sources as well as those resulting from legacy activities" (2006).

Safety Principle 3: Leadership and management for safety includes IAEA's expectations for a management system that reaches beyond safety to include health, environmental, security, quality, human-and-organizational-factor, societal and economic elements and is referred to as "management system" (management system or system). The cornerstone of the system is active leadership in issues related to safety at the highest levels of the organization. Safety is attained and sustained through an "effective management system" (No. SF-1, 2006). The system must "integrate all elements of management" to ensure safety requirements are implemented with, and not compromised by, other requirements (e.g., human performance, quality, and security¹⁴) (2006). The management system must also consider interactions at all levels of the organization as well as human factors and the interface between man and machine; recognize sound practices (i.e., work done safely); and include fostering safety culture, routine monitoring of safety performance, and instituting lessons learned (2006).

In 2016, the IAEA established 14 requirements, for their Member States, "to establish, assess, sustain and continuously improve effective leadership and management for safety" (No. GSR Part 2, 2016).

waste management and safety in the transport of radioactive material; it does not include non-radiation-related aspects of safety."

¹⁴ The IAEA places special emphasis on "Safety measures and security measures must be designed and applied in an integrated manner" (No. GSR Part 2).

Outlined in No. GSR Part 2 (2016), "the management system shall integrate its elements, including safety, health, environmental, security, quality, human-and-organizational-factor, societal and economic elements, so that safety is not compromised" (Requirement 6: Integration of the management system) by:

- Creating, implementing, and constantly enhancing the system consistent with safety goals;
- Administering a system that supports and encourages work done safely and nurtures safety culture;
- Ensuring a means to resolve conflicts and pro-actively addressing potential security and safety, competing interests;
- Establishing clear roles and responsibilities as well as expectations for communication and interface both internally and externally;
- Documenting regulatory requirements in the management system;
- Providing a means to recognize changes that may impact safety; and
- Facilitating third party review of management system, periodically and in advance of significant changes.

The management system must be "documented, controlled, usable, readable, clearly identified and readily available at the point of use" (Requirement 8: Documentation of the management system). The written document must include:

- Policy statements of the organization on values and behavioral expectations;
- Fundamental safety objectives;
- Description of the organization and its structure;
- Description of the responsibilities and accountabilities;
- Levels of authority, including all interactions of those managing, performing, and assessing work and including all processes;
- Description of how the management system complies with regulatory requirements that apply to the organization; and
- Description of the interactions with external organizations and with interested parties No. GSR Part 2 (2016).

The management system documents must be created by individuals with knowledge and experience and include relevant as well as current sources for content. All revisions are subject to configuration control and review, and the system document must address retention times for records and content source. All individuals in the organization must be trained on the management system (Leadership and Management for Safety, 2016).

Risk Management, Hazard Identification and Control. The system should be created and implemented using a graded approach (Requirement 7: Application of the graded approach to the management system). IAEA standard *Use of a Graded Approach in the Application of the Management System Requirements for Facilities and Activities* (IAEA-TECDOC-1740), 2014 details the process for a graded

approach. The conditions used to base the grade should be based on the magnitude and intricacy of the project; the hazards and degree of associated risk (considering safety, health, environmental, security, quality and economic); and the possible negative effects should an accident or incident occur (No. GSR Part 2, 2016).

Accountability for the SMS. In such cases where senior management has delegated system responsibilities, senior management still is ultimately accountable for all activities related to the management system. Individuals are accountable for safety and for their input and behavior related to safety in support of safety culture (No. GSR Part 2, 2016).

SMS Responsibilities (for implementation). IAEA's position is that ultimate responsibility for safety lies with the individual or entity responsible for areas and actions that create risk (No. GSR Part 2, 2016). The responsibility for integration of safety into the management system is held by senior management who is responsible for writing the safety policy and for creating, applying, sustaining, and improving the management system to ensure safety (Requirement 3: Responsibility of senior management for the management system) (No. GSR Part 2, 2016). Senior management is also responsible for harmonizing organizational goals and objectives with safety policy, goals¹⁵ and objectives (Requirement 4: Goals, strategies, plans and objectives), and for interfacing with invested parties to ensure effective communication (Requirement 5: Interaction with interested parties) (No. GSR Part 2, 2016).

Safety Climate. No. SF-1 (2006) indicates that the management system must incorporate and promote safety culture and reflect safety expectations for everyone affected. Safety Culture includes a commitment to and accountability for safety made by the organization and individuals at all levels. Safety culture is also a process for fostering a "questioning and learning attitude and to discourage complacency with regard to safety" (2006).

No. GSR Part 2 "emphasizes that leadership for safety, management for safety, an integrated management system and a systemic approach (i.e., an approach relating to the system as a whole in which the interactions between technical, human and organizational factors are duly considered) are essential to the specification and application of adequate safety measures and fostering a strong safety culture."

Measuring Performance of the Program and System. Measuring performance of the management system is Requirement 13 in No. GSR Part 2 which states that the "effectiveness of the management system shall be measured, assessed and improved to enhance safety performance" (2016). The organization must regularly evaluate management system processes, determine causes for non-conformances, and implement corrective actions in a timely manner. Requirement 13 allows for independent assessments, self-assessments, management reviews, and lessons learned (No. GSR Part 2, 2016).

The management system requires that "safety has to be assessed for all facilities and activities, consistent with a graded approach" (No. SF-1, 2006). The IAEA *Safety Assessment for Facilities and Activities* (2016) outlines what is required for a safety assessment and includes application of defense in depth.

¹⁵ Senior management must ensure safety goals are measurable.

A formal process for analyzing and reporting findings from accidents and incidents is a necessary element of the management system. The feedback system provides opportunities to study, share and act upon operating experiences, through lesson learned (No. SF-1, 2006).

2.3 INTERNATIONAL LABOUR ORGANIZATION (ILO)

Background. The ILO was created in 1919 and is a member of the United Nations with 187 Member States (ILO, 2023).

Organization's Mission/Purpose, Implementing SMS Documents, Scope/Applicability, Success Factors, System Approach. The primary goal of the ILO is to promote "decent work" which is "decent and productive work in conditions of freedom, equity, security and human dignity" (ILO OSH 2001, 2009 or Guidelines). The ILO's charge includes safeguarding the workforce from occupational health conditions, illness, and mishaps. Recognizing that laws do not change at the same pace as technology and work environments, the ILO published *Guidelines on Occupational Safety and Health Management Systems*, in 2001, to facilitate an employer's ability to manage the hazards and risks in the ever-evolving work environment. The Guidelines are voluntary (2009).

ILO gathers information using a tripartite approach that offers a consensual view of occupational safety and health and promotes a sustained safety culture for organizations. The Guidelines address OSH management systems at the national and the organizational level. National OSH management standards complement national legislation and regulations. At the national level, the Guidelines provide the framework for a nationwide OHS management system policy, promotes compliance with national rules, and offers a tailored approach that considers organizational size and nature of work being performed. The organizational level guideline is intended to integrate OSH management system elements into an organization as a whole and encourage everyone in an organization to apply the OSH management principles (ILO-OSH 2001, 2009).

The Guidelines suggest the "competent institution or institutions" charged with preparing, administering, and assessing national policies establish principles and methods to:

- Encourage the execution and integration of OSH management systems into organizations' overarching management systems;
- Support and foster willful measures for the organized recognition, development, execution, and enhancement of OSH undertakings at both the national and organization level;
- Nurture involvement of organizations' workforce and their representatives;
- Administer regular improvements without unneeded bureaucracy, paperwork and funding;
- Encourage cooperative and helpful relationships for OSH management systems at the organization level for all involved parties and facilitate interactions into a harmonized structure for OSH management; Assess how well the national policy and OSH management system framework is working at scheduled intervals;
- Analyze the success of the OSH management system and practice through using appropriate measurement tools and make public the analysis results; and
- Ensure contractors and any temporary workers are required to follow the same safety and health laws of the contract holding organization (2009).

To promote unity between policy and implementation activities the competent institution is to:

• Develop roles and responsibilities for the entities involved in coordinating implementation;

- Perform regular reviews of the how OHS management system implementation at the organizational level to include published reports on findings;
- Designate and assign duties for those preparing and promoting tailored guidelines; and
- Ensure the policy is available to all those who may benefit.

Contractor Applicability. The Guidelines indicate that a national OSH management system policy should require contractors to uphold the same OSH regulations as those followed by the contract holding organization. At the organizational level, contract arrangements should ensure that contract workers follow the same health and safety regulations, or ones that provide equivalent protections, as the workers for the contract holding organization. Further, the organization should create a plan for contract agreements that includes standards for choosing and assessing; communicating hazards and controls; reporting incidents, safety and health hazard awareness and training, routine surveillance of work activities and a means to ensure OSH processes and agreements are met (ILO-OSH 2001, 2009).

The language in the Guidelines does not suggest that contractors implement an OHS management system.

Safety Management System (Requirements/Structure/Framework). The OSH management system ILO recommends should contain elements of policy, organizing, planning and implementation, evaluation, and action for improvement. The system outlines a cyclical process that emphasizes continual improvement and audits as the elements progress. The System promoted by ILO has the following 5 elements and 16 supporting elements:

- 1. Policy
 - a. Organization-specific occupational safety and health policy
 - b. Worker participation
- 2. Organizing
 - a. Responsibility and accountability
 - b. Competence and training
 - c. Occupational safety and health management system documentation
 - d. Communication
- 3. Planning and implementation
 - a. Initial review
 - b. System planning, development, and implementation
 - c. Occupational safety and health objectives
 - d. Hazard prevention
 - i. Prevention and control measures
 - ii. Management of change
 - iii. Emergency prevention, preparedness, and response
 - iv. Procurement
 - v. Contracting

- 4. Evaluation
 - a. Performance monitoring and measurement
 - b. Investigation of work-related injuries, ill health, diseases and incidents, and their impact on safety and health performance
 - c. Audit
 - d. Management review
- 5. Action for improvement
 - a. Preventive and corrective action
 - b. Continual improvement

Each element and its supporting components are described in detail within the Guidelines (ILO-OSH 2001, 2009).

Risk Management, Hazard Identification and Control. The *Planning and implementation* section of the Guidelines outlines methods for hazard and risk identification, assessment, prevention, and control. The *Initial review* step provides the opportunity to recognize, predict and evaluate the hazards and risks and establish if scheduled or current controls remove the hazards and contain the risks. The *Hazard prevention* outlines the measures to remove and mitigate the hazards and risk through the hierarchy of control (ILO-OSH 2001, 2009).

The ILO also published "A 5 STEP GUIDE for employers, workers and their representatives on conducting workplace risk assessments" (2014). The 5-step guide defines risk assessment and provides one way to conduct risk assessments that the ILO states is "the most straightforward for the majority of organizations" (2014). Following are the five steps:

- "Identify the hazard
- Identify who might be harmed and how
- Evaluate the risk identify and decide on the safety and health risk control measures
- Record who is responsible for implementing which risk control measures and the timeframe
- Record the findings, monitor, and review the risk assessment and update when necessary" (2014).

Accountability for the SMS. According to ILO-OSH 2001 "Employers and competent national institutions are accountable for and have a duty to organize measures designed to ensure occupational safety and health" (2009).

SMS Responsibilities (for implementation). The Guidelines indicate that the employer has the ultimate responsibility for protecting safety and health of the workforce; complying with OSH laws and regulations; and demonstrating leadership with all OSH undertakings (2009).

The employer and upper-level management should assign responsibility, accountability, and authority for the establishment, application, and conduct of operations of the system as well as the fulfillment of the applicable OSH objectives. And a framework and procedure should be put in place to:

- Ensure OSH is a responsibility of line management;
- Describe and relay to workers the individuals with the authority, responsibility, and accountability for recognizing, assessing, and mitigating hazards and risks;
- Observe work to make certain necessary protections are in place;
- Foster unity between the workforce in support of administering the OHS management systems elements in a meaningful way;
- Abide by applicable laws and policies;
- Create and execute well-defined policies and objectives that can be measured;
- Create an effective means to locate and remove hazards and risks and nurture healthy practices at the workplace;
- Institute health support activities;
- Facilitate a means for worker and representatives to be actively involved in OHS management system to support effective policy implementation;
- Make necessary resources available to OHS staff to support job responsibilities; and
- Support workers involvement is safety committees (ILO-OSH 2001, 2009).

ILO recommends that a senior management level individual, or individuals, should be given "responsibility, accountability, and authority" for:

- Establishing, implementation, regular evaluation, and assessment of the OSH management system;
- Regular meetings to report on OSH management system performance to management; and
- Promoting and urging participation from all workers in the organization. (ILO-OSH 2001, 2009).

Measuring Performance of the Program. The ILO Guidelines provide a framework for an OSH management system, not a safety and health program. That said, ILO proclaims implementation of OHS management system Guidelines provide the necessary tools to improve OSH performance. Line management has primary responsibility for OHS performance. The elements of the OHS management system include establishing well-defined performance criteria and indictors (qualitative and quantitative) specific to the work being performed as well as a processes to track, measure, and document performance on a routine basis. The tracking and measurement should be pro-active (i.e., inspecting work systems, monitoring work areas and environments) and reactive (i.e., reviewing accident and injury reports, property damage); documented; a reflection of the overall OHS performance; and ultimately used to establish the effectiveness OHS policy implementation and if hazards and risks are being identified and properly controlled (ILO-OSH 2001, 2009).

Measuring performance of the System. ILO recommends two types of methods for performance tracking and measurement, active and reactive (as outlined in the section above), with the latter providing greater insight into the workings of the OHS management system. Specifically, investigations into occupational mishaps, events, and illness typically point to a breakdown in the OSH management system performance or failure. Audits are an integral part of the OHS management system framework

and are geared to ascertain if the OSH management system and the necessary components are instituted, sufficient and working at intended. As outlined in the ILO-OSH 2001 the audit procedure should document the expertise of the auditor¹⁶ as well as audit breadth, frequency, method, and reporting and cover:

- OSH policy;
- Worker participation;
- Responsibility and accountability;
- Competence and training;
- OSH management system documentation;
- Communication;
- System planning, development and implementation;
- Prevention and control measures;
- Management of change;
- Emergency prevention, preparedness and response;
- Procurement;
- Contracting;
- Performance monitoring and measurement;
- Investigation of work-related injuries, ill health, diseases and incidents, and their impact on safety and health performance;
- Audit;
- Management review;
- Preventive and corrective action;
- Continual improvement; and
- Any other audit criteria or elements that may be appropriate" (2009).

The findings from the audit should provide definitive results on the OHS management system's effectiveness in meeting OHS goals and objectives and achieving worker participation; addressing conclusions from previous assessments; facilitating compliance with laws and regulations; and accomplishing continuous improvement and best work practices (ILO-OSH 2001, 2009). The results from the audit are to be delivered to those in a position to take corrective action. Workers involved in all phases of the audit is permissible, if relevant (2009).

Management reviews are another means to look at how well the OHS management system is working and should focus on: assessing the approach to ensure alignment with performance goals; reviewing capacity to meeting needs of the organization, workforce and customers; need for change; ways to correct problems and inadequacies; thoughtful measures feedback to support ongoing improvements;

¹⁶ The auditor can be internal or external to the organization, with knowledge and experience in the work practice subject to the audit but not directly involved with the job (ILO-OSH 2001, 2009).

forward thinking activities to support OSH objectives and corrective actions as well as ensuring previous corrective actions are meeting organizational needs. The timing and content of the review should be determined by the employer or high-level management and should consider the results from pro-active and reactive evaluations. Management audits are to be documented and delivered to individuals responsible for taking corrective action as well as those in monitoring and assessment positions (ILO-OSH 2001, 2009).

Safety Climate. The ILO-OSH, 2001 Foreword and Introduction state that the Guidelines support a sustainable "safety culture" within organizations, however, the OHS management system outline does not link organizational culture to the OSH management system (ILO-OSH 2001, 2009).

Quality Assurance. The ILO guidelines do not associate OSH management systems with quality assurance.

2.4 CANADIAN NUCLEAR SAFETY COMMISSION (CNSC)

Background. In 1997, the Canadian government passed the Canadian Nuclear Safety and Control Act (NSCA) to limit the risks associated "with the development, production, and use of nuclear energy and the production, possession and use of nuclear substances" to Canada's national security, the environment, and public's health and safety (NSCA, 1997). The Act created CNSC (or Commission), an independent body, to regulate the nuclear industry (1997).

Since its establishment in 2000, the CNSC, has served as the court responsible for developing regulations for all Canadian nuclear activities (NSCA, 2023). Regulations created by the CNSC are focused on upholding all applicable laws and avoiding unnecessary risk to the environment and health and safety of all affected persons as well as national security (NSCA 1997). Further the Commission is responsible for sharing with the public relevant laws and scientifically sound information related to the impacts of such activities on health and the environment (1997).

The CNSC is the only Canadian agency that regulates nuclear facilities in Canada (CNSC 2023). The NSCA provided CNSC with the authority to write regulations and these documents are used to outline the requirements. Regulatory documents, comprise most of the CNSC documents, and provide either requirements or guidance for gaining facility licensure or certification (CNSC 2023).

Licensing for every facility regulated by the CNSC is based on commitments made by each licensee in their license application and supporting documents (CNSC 2023). CNSC staff evaluates information submitted by facilities in their license applications and supporting documentation to ensure it meets the CNSC's regulatory intent. Then the CNSC grants a license to operate consistent with these commitments (CNSC 2023). Applicants must describe their approach to implementing 14 "safety and control areas:"

- 1. Management system (Regulation Document (REGDOC)-2.1.1 and 2.1.2),
- 2. Human performance management (REGDOC-2.1.1 thru REGDOC-2.2.5),
- 3. Operating performance (REGDOC-2.3.1 thru 2.3.3),
- 4. Safety analysis (REGDOC-2.4.1 thru 2.4.5),
- 5. Physical design (REGDOC-2.5.1 thru 2.5.7),
- 6. Fitness for service (REGDOC-2.6.1 thru 2.6.3),
- 7. Radiation protection (REGDOC-2.7.1 thru 2.7.3),
- 8. Conventional health and safety (REGDOC-2.8.1),
- 9. Environmental protection (REGDOC 2.9.1 thru 2.9.2),
- 10. Emergency management and fire protection (REGDOC-2.10.1 thru 2.10.2),
- 11. Waste management (REGDOC-2.11 thru 2.11.2),
- 12. Security (REGDOC-2.12.1 thru 2.12.3),
- 13. Safeguards and non-proliferation (REGDOC-2.13.1 thru 2.13.2), and
- Packaging and transport (REGDOC-2.14.1 Vol. I, II, III). (CNSC, 2023).

The CNSC expects each license holder to implement safety and security measures to comply with established regulations. Furthermore, the CNSC's regulatory approach stresses their commitment to regulate the Canadian nuclear industry consistent with specific "principles" including continuous improvement, defense in depth, using a graded approach, protection of the environment, protection of the safety and health of "persons," protecting national security, meeting international obligations, implementing nuclear non-proliferation goals, and safeguarding nuclear materials from diversion. These principles comprise the major elements of the CNSCs regulatory approach (REGDOC-3.5.3, 2023).

Standards, Purpose, Applicability. CNSC has established two regulatory documents that serve as the structure to create plans and procedures to support meeting safety objectives, regular monitoring of performance and a strong safety culture, i.e., *Management System* (REGDOC-2.1.1, 2019) and *Safety Culture* (REGDOC-2.1.2, 2018).

The purpose of REGDOC-2.1.1 is to provide information on appropriate management systems based on type of license; changes to management systems and regulatory documents; and oversight (2019). REGDOC-2.1.1 is implemented as a condition of contracts for Class IA power and non-power nuclear reactors; Class IB nuclear facilities; uranium mines and mills; and radioactive waste management facilities. The document identifies other types of licensees that may use it as a reference to develop a management system. The Management System (REGDOC-2.1.1) points to Canada's national consensus standard which contains additional regulatory requirements but must be purchased: Canadian Standards Association (CSA), *Management system requirements for nuclear facilities* (CSA N286-12, 2012).

REGDOC-2.1.2 provides regulatory requirements and instruction for nurturing and evaluating safety culture, referred to as fostering safety culture, and applies to Class I licensees and uranium mines and mills (2018). Nuclear power plants must perform safety culture assessments that are "comprehensive, systematic and rigorous" and occur at least every five years (REGDOC-2.1.2, 2018). Appendix A of REGDOC-2.1.2 provides a reference framework for safety culture which is applicable to all licensees.

CNSC references three other documents to support Management System development that include-CSA N286-12, 2012 (mentioned above); CAN/CSA-ISO 9001:16, *Quality Management Systems* – *Requirements* and ISO 14001, *Environmental Management Systems* (2019).

Contractor Applicability. CSA N286-12 includes the processes and practices that licensees are expected to develop to ensure the licensee is performing oversight of contractors (REGDOC-2.1.1, *Management System*, 2019).

Safety and the Management System. The CNSC Management System is defined as "the framework of processes, procedures and practices used to ensure that an organization can fulfill all tasks required to achieve its objectives safely and consistently" (REGDOC-2.1.1). The CNSC Management System requirements refer to CSA N286-12. Management systems are required for Class IA power and non-power nuclear reactors, Class IB nuclear facilities, uranium mines and mills, and radioactive waste management facilities, and are optional for all other nuclear facilities. The principles outlined in CSA N286-12 must be followed for the life of the facility and apply to all activities and locations within the facility.

Each licensee's Management System must define the organization, performance assessment and improvement, operating experience, change management, safety culture, configuration management, records management, contractor management, and business continuity (REGDOC-3.5.3, 2023). CNSC adopted twelve principles for establishing a Management System from CSA N286-12 (REGDOC-2.1.1):

- 1. "Safety is the paramount consideration guiding decisions and actions,
- 2. The business is defined, planned, and controlled,
- 3. The organization is defined an understood,
- 4. Resources are managed,
- 5. Communication is effective,
- 6. Information is managed,
- 7. Work is managed,
- 8. Problems are identified and resolved,
- 9. Changes are controlled,
- 10. Assessments are performed,
- 11. Experience is sought, shared, and used, and
- 12. The management system is continually improved."

CNSC expects each licensee's Management System to meet all twelve principles. Each licensee must adhere to the generic and facility-type requirements for Management Systems that are specified in CSA N286-12. The CSA management system is not strictly a safety management system. It also encompasses quality, environment, economics, and security (REGDOC-2.1.1).

Expectations for Management Systems are further described in governing documents created to assist licensees prepare a license application, such as REGDOC 1.1.3, *License Application Guide: License to Operate a Nuclear Power Plant* (2022). This guide recommends that the licensee describe (1) all relevant safety policies, (2) how these policies are communicated to relevant workers, (3) every facet of how the organization's management system addresses safety and quality, (4) what management controls will be used to ensure that established programs meet safety-related objectives, (5) how the access to senior management is provided for safety related topics, and (6) how a healthy safety culture is achieved (CNSC 2022). The information included in the license application becomes part of the licensing basis ensuring each attribute of the Management System described in the license application will be implemented once the license is granted (CNSC 2023).

Risk Management and Assessment of Occupational Health and Safety Opportunities, Hazard

Identification, and Control. CNSC license applicants must identify hazards and demonstrate how they will implement controls to mitigate risks associated with their operations. Applicants are required to prepare a "deterministic safety analysis, a probabilistic safety assessment (PSA) and a hazards analysis" (Regulatory Fundamentals, 2023). These analyses must demonstrate that all safety objectives and goals can be met, and defense-in-depth principles are evident. After the CNSC grants a license, the control measures described in the license application become part of the licensing basis for the facility (Regulatory Fundamentals, 2023).

Responsibility and Accountability for the SMS

The role of top management is described in the CNSC Management System regulatory document (2019), which incorporates CSA N286-12 (2022). A licensee's top management is responsible for controlling all aspects of the business which includes the implementation and continuous improvement of the management system. According to this standard, organizational leaders (top management) commit to the management system by:

- "Taking accountability for the effectiveness of the Management System,
- Ensuring the integration of the Management System requirements into the organization's processes,
- Communicating the importance of effective management and of conforming to the Management System requirements,
- Ensuring that the Management System achieves its intended results,
- Engaging, directing, and supporting persons to contribute to the effectiveness of the Management System,
- Supporting other relevant management roles to demonstrate their leadership as it applies to their areas of responsibility,
- Establishing, advocating, and adhering to an organizational approach to safety that stipulates that issues relating to protection and safety receive the attention warranted by their significance,
- Acknowledging that safety encompasses interactions between people, technology, and the organization,
- Establishing behavioral expectations and fostering a healthy safety culture, and
- Establishing the acceptance of personal accountability in relation to safety on the part of all individuals in the organization and ensuring that decisions made at all levels take account of the priorities and accountabilities for safety" (CNSC, 2019).

Top management defines organizational expectations, monitors system performance, and take steps toward continuous improvement (CNSC, 2019).

Measuring Performance of the System. Top management is required to establish, as part of its Management System, mechanisms to set expectations and objectives and to monitor performance (CNSC 2019). For example, power reactor license applicants must describe the specific Management System (s) they use to monitor and assess processes and programs, and which ensure management's goals and objectives are met. These systems include evaluation and monitoring of all procedures, processes, and programs to meet safety, health, environmental protection, security, and quality objectives over the course of a facility's lifetime (CNSC 2022).

To assure compliance during operation, CNSC conducts compliance reviews using a range of tools and approaches including review of technical reports, operating data, and onsite assessments. These compliance reviews evaluate the degree to which each license holder meets their regulatory obligations

(CNSC 2023). When a license holder fails to meet requirements, CNSC can take a range of enforcement actions to force the license holder to comply with applicable regulations (CNSC 2023).

Safety Climate. CNSC has a dedicated regulatory document for safety culture requirements and guidance (REGDOC 2.1.2, *Safety Culture*, 2018). Safety culture requirements mandate that the licensing basis define how management will meet safety performance objectives (CNSC 2018) and the licensee's management responsibilities including monitoring safety and health performance (CNSC 2019). The CNSC approach has five principles (CNSC 2018):

- 1. "Every organization has a safety culture,
- 2. Safety culture is influenced by external and internal factors including all workers,
- 3. Safety culture is complex and changes over time,
- 4. Safety culture needs to be assessed and monitored to achieve the common goal of understanding the organization's safety culture and limiting risk, and
- 5. Safety culture assessment and improvement activities are informed by a defined framework of key characteristics known to reflect a healthy culture."

Each Licensee is required to describe how these principles will be met. Licensees are "responsible for fostering a healthy safety culture through promoting and reinforcing a collective commitment to safety that is responsive to the risk and complexity of the licensed activities" (REGDOC 2.1.2). Applicants for nuclear power reactor licenses must include a description of how their management system communicates "...its vision, mission, core values, guiding principles, safety policy and commitment to foster a healthy safety culture" to workers and other interested parties (CNSC 2017).

CNSC safety culture principles address continuous improvement in multiple ways. Management must promote and reinforce their commitment to safety and continual improvement. (CNSC 2018). During operation, each license holder is expected to design and conduct safety culture surveys and assessments to ensure they are effectively monitoring their safety culture and implementing improvements (CNSC 2018).

Quality Assurance. The CNSC management system integrates requirements for quality, security, safety and health, environment, and economics. The license application for nuclear facilities must describe the quality assurance program.

3 CONSENSUS STANDARDS

3.1 INTERNATIONAL ORGANIZATION FOR STANDARDIZATION (ISO) - 45001

Organization Background, Technical Standard Overview and Applicability. ISO is an "independent, nongovernmental international organization" that brings together experts from around the world to develop consensus standards on relevant topics "that support innovation and provide solutions to global challenges" (ISO, 2023). There are 167 members in ISO, with one member per country. The American National Standards Institute is the ISO member for the United States (ISO, 2023).

Organizations are "responsible for the occupational health and safety of workers and others who can be affected by its activities" and this responsibility extends to "promoting and protecting their physical and mental health" (ISO, 2018). ISO created International Standard, 45001:2018, Occupational Health and Safety Management Systems— Requirements with Guidance for Use (ISO 45001 or Standard) which can be adopted by organizations to "provide safe and health workplaces, prevent work-related injury and ill health, and continually improve its [Occupational Health and Safety] OH&S performance" (ISO 45001, 2018).

ISO 45001 is a voluntary consensus standard, thereby it is not a requirements document.

Purpose, Success Factors, and Management System Approach. ISO 45001 provides implementing organizations the framework and strategies (e.g., hazard identification, risk reduction, management involvement criteria) to manage safety and health-related risk and optimize OH&S performance by recognizing opportunities for improvement. The Standard offers a proactive approach that focuses on prevention and eliminating hazards.

The success of the OH&S management system (System) "depends on leadership, commitment and participation from all levels and functions of the organization" (ISO45001:2018). The Standard describes 11 key factors ("success factors") needed for administering and maintaining an effective OH&S management system:

- 1. Leadership commitment (including leadership's acceptance of the responsibility and accountability for the System).
- 2. Management leading a culture in the organization that supports the System;
- 3. Communication;
- 4. Worker participation in the development and continuous improvement of the System;
- 5. Integration of the System into the institution's overarching goal and objectives;
- 6. Securing necessary resources to support and grow the System;
- 7. Effectively designed and implemented safety-related processes (e.g., processes necessary for hazard identification and removal, minimizing risks to workers, and continuous improvement);
- 8. Regular assessments and tracking of OH&S performance in support of ongoing improvement;
- 9. Integration of the OH&S Management System into other business systems;
- 10. Harmonizing OH&S goals, objectives, policies with the organization's hazards, risks, and opportunities for improvement; and

11. Following applicable safety and health laws.

The ISO 45001:2018 approach to safety is built around a PDCA cycle which is an iterative process developed to facilitate continuous improvement. The context of the organization is baseline information that is needed by the organization to apply the ISO model (e.g., internal and external factors, planned activities, and the needs and expectations of the workers). The organization implements their System by applying PDCA.

- Planning (<u>plan</u>- work safely e.g., determine and assess the risks and opportunities);
- Support and Operation (<u>do-</u>work consistent with established processes);
- Performance evaluation (<u>check-OH&SMS</u> effectiveness by watching activities and recording results, benchmarking against intended outcomes of the System and identifying opportunities for improvement);
- Improvement (act- to correct deficiencies and improve performance); and
- Leadership and worker participation are the linchpins for the OH&S management system, which relies on the people to be constantly connected and interacting with PDCA.

ISO 45001 describes a management system that is flexible and adaptable to each organization's unique needs. Organizations that implement the System can expect to continuously improve OH&S performance, fulfill legal requirements, and accomplish organizational objectives.

Contractor Applicability. ISO 45001explicitly states in the "Contractors" section of the Standard that the institution is to ensure that the OH&S management system requirements are met by the contractor and its employees, and the contract must include the OH&S criteria used for choosing the contractor.

Safety Management System (Requirements). The requirements for an OH&S Management System outlined in ISO 45001 are:

- Leadership and worker participation- Top management is responsible for showing "leadership and commitment" to the System. They must create, administer, and sustain the "OH&S policy" and assign clear "organizational roles, responsibilities and authorities." The organization is responsible for "consultation and participation of workers" in the System and must develop a means to ensure workers at all levels are involved in the creation, planning, administering, assessment, and enhancement of the System.
- Planning- Actions to address risks and opportunities- The organization is responsible for creating a System based on the "context" of the organization, "interested parties" and "scope of its OH&S management system" as outlined in the ISO model.

In the first part of the planning process, the organization identifies hazards and assesses risks and opportunities by:

- Creating, administering, and preserving a means for "hazard identification¹⁷" that is forward-looking and continuous.
- Developing and implementing procedures that document evaluation of risks and controls specific to OH&S, as well as risks related to the creation, execution, workings, and maintenance of the OH&S management system (assessment of OH&S risks and other risks to the OH&S management system).
- Instituting a means to measure and improve OH&S performance as well as ways to enhance the OH&S management system.

During the second step in the planning process, the organization determines legal and other requirements by making certain legal requirements are noticed and followed. The third step in the process is planning action whereby the organization develops and executes a means to tackle risks and opportunities, procedures for emergency events, and integration of plans with other business practices and management systems. In the final planning step, the organization establishes OH&S objectives and how to achieve them, with their aim being continuous improvement.

Support is critical to the OH&S management system. The organization is responsible for ensuring resources e.g., "human, natural, infrastructure, technology and financial," are available to do the work; workers have the proper expertise and abilities to perform their assigned tasks; potentially impacted individuals are aware of the risks involved with the work being performed; a sound communication plan (for both external and internal interactions) for collecting, maintaining and distributing information (addressing potential audience sensitivities and reading level needs) is in place; and documentation is updated and controlled.

Operation includes three components. For operational planning and control, the organization creates an operational control plan and uses the hierarchy of controls to eliminate hazards (thereby reducing risk) and establishes a management of change process to reduce the likelihood of new hazards and risks. The organization implements a procurement process for selecting products and materials that support hazard reduction; ensuring contractors have the training, expertise, systems, and resources to do the work; and monitoring and controlling outsourced work. Each organization must also implement an emergency preparedness and response plan.

Performance evaluation is a necessary component of the OH&S Management System. Monitoring, measurement, analysis, and performance evaluation includes developing a procedure for assessing¹⁸ OH&S performance and the OH&S management system, to include compliance with legal requirements. An internal audit process must be developed to make certain the policy is consistent with institutional requirements as well as referenced ISO standards, and the OH&S management system is implemented and maintained. The internal audit process must include a means to communicate audit results and

¹⁷ "Hazards can be physical, chemical, biological, psychosocial, mechanical, electrical, or based on movement and energy; the organization's hazard identification process(es) should consider: "routine and non-routine activities and situations; human factors; new or changed hazards; potential emergency situations; people17; and changes in knowledge of, and information about, hazards: (ISO 45001:2018)

¹⁸ I.e., who will conduct, what will be included, when and frequency, criteria- all and what measured against, how results will be communicated and feedback process?

feedback to improve System and EH&S performance. Audit reports must be documented and maintained. In addition, assessments may use OH&S performance as a means to measure the success of the OH&S Management System. Management review requires top management to review the organization's OH&S management system (at planned intervals) to ensure its continuing suitability, adequacy, and effectiveness. The management review includes reviewing: previous reports to ensure corrective measures have been taken; internal and external needs (and any changes to either) for potential impact on the OH&S management system; OHS policy and objectives, OH&S performance trends, resource allocations; communication plans; and opportunities for improvement. Organizations are to document their management reviews in reports that address each issue, and the report is communicated to affected parties.

Improvement involves actively identifying opportunities for improvement and implementing actions to enhance the System. Organizations must have a process to address incidents, nonconformities, and corrective actions. The process must include timely evaluation (e.g., investigate, establish possible cause(s), review prior incidents); review of relevant assessments and audits; determining corrective action(s); assessing the risk of action; implementing corrective action(s); reviewing effectiveness; and changing the System, as necessary. Continuous improvement is a requirement in the System to ensure the organization is continually seeking ways to enhance work practices and the System. The continuous improvement process must include fostering a culture that embraces the System, asking workers to participate in bettering the System, communicating System enhancements to affected individuals and groups, and retaining documents that demonstrate improvement (2018).

Risk Management. The Standard includes a "requirement" for the evaluation of OH&S risks and risks to the OH&S management system. The organization must have processes to:

- Evaluate OH&S risks based on recognized hazards and effectiveness of existing controls, and
- Ascertain and analyze other types of risk associated with the OH&S management system.

The Standard does not identify a specific risk management model but does emphasize that the risk management process must be based on the breadth and type of activities and hazards, and be forward-looking, planned and documented.

Annex A of the Standard provides guidance on how to use the Standard and Section A.8.1.2 describes how the hierarchy of controls are applied: "Each control is considered less effective than the one before it. It is usual to combine several controls in order to succeed in reducing the OH&S risks to a level that is as low as reasonably practicable" (ISO 45001, 2018).

The Standard refers to several other sources for information on risk management including ISO 31000, Risk Management – Guidelines.

Responsibility and accountability for the SMS. Top management within the organization is ultimately accountable for ensuring the OH&S management system functions and is "fully communicated within the organization" (ISO45001:2018). Top management delegates responsibilities and authorities for the System and workers with delegated authority and responsibilities verify the System conforms to the Standard and provide System performance reports to top management (2018).

Measuring Performance of the System (Determining conformity with ISO 45001). As outlined in ISO45001:2018, organizations can demonstrate conformity with the Standard through a self-determination and self-declaration, third party review and confirmation, customer review and confirmation, and by certifying or registering their System with an outside organization.

The Standard contains a section on "Performance evaluation" which states that the "organization shall evaluate the OH&S performance and determine the effectiveness of the OH&S management system" (ISO 45001, 2018).

Measuring Performance of the Program. The Standard includes a section on "Performance evaluation" and allows the organization to choose what to measure, the methods to use, and the frequency. The process for performance measurement must be established (e.g., documented) and results of performance evaluations must be communicated throughout the organization.

Safety Climate. ISO 45001:2018 does not refer explicitly to safety climate or safety culture. Critical elements of a sound safety culture are reflected in the standard, particularly the section that addresses leadership and worker participation. Leadership's commitment to safety must include "promoting a culture in the organization that supports the intended outcomes of the OH&S management system" (ISO 45001:2018, §5.) and establishing an environment supporting worker involvement and safeguarding workers from "reprisal" when participating in critical safety management system activities (e.g., reporting incidents, etc.).

The Standard includes numerous provisions for worker involvement in every essential safety and health system component (e.g., hazard identification, performance monitoring, control of process change, work planning, management system evaluation, and feedback and continuous improvement).

Quality Assurance. ISO 45001 does not include requirements specific to other subjects, "such as those for quality, social responsibility, environmental, security or financial management, though its elements can be aligned or integrated with those of other management systems" [§0.5]. Nevertheless, ISO 45001 includes as part of its bibliography ISO 9000:2015, Quality management systems—Fundamentals and Vocabulary and ISO 9001, Quality— management systems—Requirements which can be used by organizations in addition ISO 45001.

3.2 AMERICAN NATIONAL STANDARDS INSTITUTE / AMERICAN SOCIETY OF SAFETY PROFESSIONALS (ANSI/ASSP)

Background on Organizations and Committee, Technical Standard Overview and Applicability. ANSI), established in 1918, manages the creation of national consensus standards for industry and ensures the quality of those standards through a rigorous approval process (ANSI, 2023). ASSP, an international group for occupational safety and health professionals, serves as the secretariat for ANSI committees in the development of safety standards (ASSP, 2023).

ASSP and ANSI recognized that national and international organizations implementing formal safety management systems were demonstrating positive safety performance. The ANSI Z10 Committee, established in 1999, brought together a wide- range of blue and white- collar workers to review existing safety management systems, across disciplines, and identify the elements most germane to successful safety management systems (Z10.0-2019-Foreword). The result was ANSI/ASSP Standard Z10.0, *Occupational Health, and Safety Management Systems* (Z10.0-2019 or Standard) a voluntary consensus standard focused on OH) management systems (OHSMS) (OHSMS or System). First published in 2005, revised in 2012 and again in 2019, the Standard uses, as its framework, recognized management system principles compatible with quality and environmental management systems, and ISO 45001 *Quality Management Systems*, ISO 14001 *Environmental Management Systems*, and ISO 45001 *Occupational Health and Safety Management Systems* – requirements with guidance for use and incorporates methods applied by the ILO Guidelines on OHSMS (2019).

Z10.0-2019 is a voluntary consensus standard, thereby it is not a requirements document, unless adopted as such by an organization. The document includes Annexes (non-requirements) to support implementation.

Purpose, Management System Approach, and Success Factors. The purpose of Z10.0- 2019 is to provide all types and sizes of organizations with an effective means for providing a safe and healthful working environment, reducing risk for illness and injury, and continually improving occupational health and safety performance, which in turn promotes success in other areas such as quality and productivity. The Standard offers work practices that are proactive and support a "socially responsible" and sustainable way of doing business that strives for "worker well-being" (Z10.0-2019). The Z10.0 management system regards safety, not just the absence of injury and illness, but as a dynamic interaction between man, machine and the environment and monitors controls to ensure optimal performance (2019).

The management system approach outlined in the Standard allows for flexibility in how an entity meets the requirements and is meant to be customized to the needs to of the organization. Z10.0 is structured to be compatible with other management systems, by aligning with Deming's PDCA model (2019-Foreword). The standard describes seven primary OSHMS components which necessary for an effective OHSMS:

- 1. Context of the Organization,
- 2. Management Leadership and Worker Participation,
- 3. Planning,
- 4. Support,
- 5. Implementation and Operation,

- 6. Evaluation and Corrective Action,
- 7. Management Review
- (ANSI 2019).

Within each of the seven system components the standard identifies specific elements that are needed to fully meet the standard.

Contractor Applicability. The "Implementation and Operation" component of the system, outlined in Z10.0-2019, indicates that the procurement process must have a means to ensure contractors are able to meet the requirements of its OHS management system. In addition, "the organization shall establish a process to ensure that the requirements of <u>its</u> OHS management system are met by contractors," indicating that the contractor is to follow the OHS management system of the organization (Z10.0-2019).

Safety Management System (Requirements/Structure/Framework). Z10.0-2019 includes a set of requirements to improve OHS performance, deliver a safe place to work, and decrease work related mishaps, diseases, and deaths. Each organization decides how to meet those requirements based on its unique safety and health needs. The OHSMS framework is built upon the seven primary components, the details of which are expanded upon in this section.

The Z10 committee created a pictogram showing the interplay of OHSMS components. To start, the "Context of the Organization" is next to a sphere (that contains the remaining forementioned OHSMS components) serving as the boundary for the model and reflecting the role of creating the scope of the OSHMS (2019). This element illustrates the need to know the organization, why it exists, what it would like to achieve, the services and goods offered, the desires and beliefs of its workers and stakeholders, as well as any obstacles to achieving any of these (2019).

The sphere includes in separate overlapping ovals "Worker Participation" and "Management Leadership" as the core these elements are vital to the development, execution, continuous improvement, and overall success of the system (Z10.0-2019). Top management owns the System, are responsible and accountable and must lead and support all phases of the OHSMS from development to continuous improvement, to include developing policy and responsible and accountable for the system. Workers must be given timely access to information and have the needed resources to perform work, participation must be unobstructed and meaningful, with involvement in establishing level of risk, changes to work plans as well as all aspects of the OHSMS elements described in the next section (2019).

The sphere contains arrays with the remaining OHSMS components. To start, "Planning" is specific to the creation and continuous improvement of the OHSHS (Z10.0-2019). This step requires a review the current practices against the requirements outlined in Z10.0; assessing and prioritizing the hazards, insufficiencies, opportunities, and legal requirements; creating goals and objectives for improvement as well as formal strategies and allocating the necessary resources.

The "Support" component outlines what is needed to foster a successful OHSMS, which begins with evaluating the needs, based on the specific organization, and then earmarking those resources. The hired workforce must have the appropriate skills for the job hired, and ongoing teaching and training must be accessible; appropriate to the talent and knowledge level of the workforce and be evaluated. A communication plan is required, to ensure the workforce is mindful and knowledgeable regarding the

transfer of information, internally and externally. This element includes consideration of demographics, timeliness, consistency, relevance, urgency of the content as well as supporting open lines of communication, reporting mishaps and illness, changes in work plans, newly identified hazards, as well as recommendations and feedback. All documents related to the OHSMS must be managed, protected, accessible to the workforce and all worker information protected following applicable laws (2019).

"Implementation and Operation" identifies the "operational elements that are required for implementation of an effective OHSMS" (Z10.0-2019). A plan must be developed outlining how the OHSMS will be executed, managed, and sustained to meet its objectives at the operational level (Z10.0-2019). This includes an ongoing process to recognize OHSMS problems that arise during operational activities. The standard requires organizations to develop and implement processes to address key OSHMS elements that include hazard identification and analysis; recognizing system deficiencies; seeking opportunities for improvement; identifying applicable and current legal requirements; assessing risk and implementing controls (consistent with a specified hierarchy of controls); reviewing design and redesign to better control hazards and taking the opportunity to reduce risk during management of change (and from a lifecycle perspective); implementing contract requirements; managing risk to and created by contractors; establishing occupational health services; and generating emergency response plans (2019).

The "Evaluation and Corrective Action" component is discussed in the Measuring Performance section of this document (Z10.0-2019).

"Management Review" the final OHSMS component listed in Z10.0-2019 is discussed in the Measuring Performance section of this document.

Risk Management, Hazard Identification and Control. Z10.0-2019 requires the development and execution of a risk assessment process as part of the "Implementation and Operation" component based on the hazards identified during operational activities. The risk identification process must receive input from the workers and other affected individuals. The risk management process employed must consider current organizational deficiencies; impact to work practices when conditions change; identify all high-risk activities; and document the levels of risk, how acceptable levels of risk are generated and who has decision-making authority (2019). ANSI also publishes Risk Management Guidelines (ANSI/ASSP/ISO 31000).

Accountability for the OSHMS. The organization's top management is ultimately accountable for administering, maintaining, resourcing, integrating (with other business practices), and tracking performance of the OHSMS (Z10.0-2019).

Responsibility for the OSHMS. Top management is responsible for the overall OHSMS (Z10.0-2019). Implementation is carried out by those individuals based on assigned roles, responsibilities, and authorities. Workers are responsible for carrying out the OHSMS duties assigned, and all workers are required to abide by the institution's OHSMS. Throughout the Standard, the "organization" is listed as the entity required to determine the specifications within each component of the OHSMS (2019).

Measuring Performance. The "Evaluation and Corrective Action" component of the OHSMS endorsed by ANSI and ASSP includes requirements for assessing performance of the System, instituting ways to correct deficiencies, and feeding this information back into the system (Z10.0, 2019). A process must be

developed for System monitoring and tracking and measuring OHS performance, based on leading and lagging indicators identified by the organization. Z10.0-2019 requires s system for investigating incidents as well as performing regular audits. System deficiencies must be assigned corrective action(s) with priority given to high-risk hazards. The Standard requires the implementing organization to develop and implement specific processes for feedback and organizational learning at the system and operational levels. All these processes must include worker participation, facilitate continuous learning, and seize upon opportunities to improve the System.

The "Management Review" component in the ANSI Z10.0 OHSMS requires the establishment of a process for the organization's management to the evaluate OSHMS performance on an annual basis against established expectations for adequacy and effectiveness (Z10.0-2019). Inputs to the management review process must include information from all operational elements of the System as well as progress toward risk reduction, organizational learning, successful tracking and resolution of deficiencies, worker involvement, and organizational goals. Following the review, top management must evaluate the information collected and use it to determine what changes in the organization (e.g., policy or resource changes) are needed to enhance OSHMS success (2019).

Safety Climate. The Z10.0 standard makes numerous references to organizational culture and the relationship of organizational culture to OHS performance. The standard also notes that a just culture is needed so that workers feel comfortable reporting how they perform work. However, Z10.0 does not have a dedicated section that addresses culture nor is culture a separate element of the OHSMS.

Quality Assurance. ANSI Z10.0 is designed to be integrated with quality, environmental and other management systems within an organization (e.g., ISO 9001:2015, *Quality Management Systems* — *Requirements*). The Standard emphasizes that the OSHMS must be integrated into the organization's existing business systems (potentially including the organization's quality system).

4 DEPARTMENT OF ENERGY (DOE OR DEPARTMENT)

Agency Mission, Implementing Documents (Drivers), Purpose, Scope, Applicability. DOE's mission is "to ensure America's security and prosperity by addressing its energy, environmental and nuclear challenges through transformative science and technology solutions" (DOE, 2023).

To ensure work is performed safely and efficiently in support of the mission, the Department outlines its expectation for safety in DOE Policy (P), 450.4A, *Integrated Safety Management Policy* (2018). The requirements and responsibilities for implementation of the Department's SMS, Integrated Safety Management (ISM), are outlined in DOE Order (O) 450.2, *Integrated Safety Management* (2017). Resources to assist with implementation and verification include DOE G 450.4-1C, *Integrated Safety Management System Guide* and DOE Handbook (HDBK) 3027-99 *Integrated Safety Management Systems (ISMS) Verification Team Leader's Handbook*. In 2006, the Department first introduced safety culture elements into what is now DOE O 450.2 and later formalized its expectations for safety culture in 2011 through DOE P 450.4A.

Contractor Applicability. The Department's institutional Directives for ISM do not apply to DOE contractors. DOE contractor requirements for a safety management system are outlined in DOE Acquisition Regulation (DEAR) Title 48 of the U.S. Code of Federal Regulations (CFR) 970.5223-1, *Integration of Environment, Safety, and Health into Work Planning and Execution,* 2000 (DEAR Clause).

<u>Contractor Safety Management System.</u> A DOE contractor is required to perform work safely and in a way that sufficiently protects the worker, the public and the environment. The contractor must "exercise a degree of care commensurate with the work and the associated hazards," "ensure that management of environment, safety and health (ES&H) functions and activities becomes an integral but visible part of the Contractor's work planning and execution processes," and ensure work is performed based on seven requirements outlined in paragraph (b) of the DEAR Clause. The wording of the seven requirements is consistent with the DOE ISM Guiding Principles but not labeled as guiding principles. The DOE contractor must have a written SMS describing how the work will be managed and performed using the following core functions:

- 1. Define the scope of work
- 2. Identify and analyze hazards associated with the work
- 3. Develop and implement hazard controls
- 4. Perform work within control
- 5. Provide feedback on the adequacy of controls and continue to improve safety management

(DEAR Clause, 2000).

DOE provides further definitions of the five core functions in DOE P 450.4A, Integrated Safety Management Policy (2018).

The contractor's SMS must be integrated with other business process.

<u>Contractor Risk Management, Hazard Identification and Control</u>. The DEAR Clause does not use the term risk, nor does it outline a risk management process for the contractor.

Hazard identification and control is required as part of the "performance of work," hazards are to be identified and controlled prior to starting work, and controls are to be tailored to the work and the hazard. Ideally the process should be designed to prevent and eliminate hazards. (DEAR Clause) Further the contractor is required to document how hazards will be identified and analyzed as well as how hazard controls will be developed and implemented. (DEAR Clause)

<u>Contractor Accountability for the SMS.</u> The contractor is "accountable for the safe performance of work." Further, the DEAR Clause requires that the contractor include in the written SMS the "level of authority for agreement" before an operation is "to be initiated and conducted," and the type of documentation and authority must be "tailored to the complexity and hazards associated." (DEAR Clause) For subcontractors, the prime contractor is ultimately accountable for work being performed in accordance with applicable environmental, safety and health (EH&S) regulations.

<u>Contractor SMS Responsibilities (for implementation).</u> Line management is responsible for the protection of employees, the public, and the environment, in accordance with the DEAR Clause.

The contractor is responsible for developing, managing, and conducting work in accordance with a written SMS that reflects how the contractor will adhere to the five core functions. The SMS is required to be submitted to DOE for review and approval.

The contractor is responsible for complying with EH&S requirements outlined in their contract with DOE as well as evaluating and resolving any non-compliance in a timely manner. (DEAR Clause) Contractors must flow down safety and health requirements to subcontractors and include a clause like the DEAR Clause in subcontracts, including provisions to stop work. The need for review and approval of a written subcontractor SMS is at the discretion of the contractor and should be determined by the hazards and difficulty of the work being performed. (DEAR Clause)

<u>Measuring Performance of the Contractor's Program.</u> The initial contractor SMS, as well as annual updates, must show how safety performance objectives, performance measures, and commitments will be created, tracked, and executed while upholding the integrity of the SMS. (DEAR Clause) Further, the contractor is required to assess and reconcile any noncompliance with applicable ES&H requirements, in a timely manner.

<u>Measuring performance of the Contractor's System</u>. The DOE contracting officer establishes how and when the contractor submits the SMS for review, revision, and approval. As previously described, the contractor establishes performance objectives, performance measures, and commitments. The contractor must also allocate resources to meet their safety objectives and performance commitments. The contractor's SMS is evaluated on an annual basis. (DEAR Clause) The Heads of DOE Field Elements are responsible for deciding if and when to perform a verification¹ of a contractor's SMS. "The primary purpose of the ISMS verification is to review the adequacy of the contractor's ISMS and its implementation in order to provide a recommendation to the Approval Authority. A secondary purpose is to evaluate the role of DOE in the implementation and oversight of the contractor's ISMS." (DOE-HDBK-3027-99, 1999) Contractor Safety Climate. Safety Culture is not mentioned in the DEAR Clause.

Safety Management System. The goal of DOE P 450.4A (2018), is no mishaps, occupational injuries or diseases, legal violations, or recordable release into the environment. To support the performance of work in a way that safeguards the workers, public and environment, DOE implements ISM to "systematically integrate safety into management and work practices at all levels in the planning and

execution of work." (DOE P 450.4A, 2018) Each DOE organization is required to create, execute, and maintain an ISMS consistent with the ISM framework that includes guiding principles and core functions.

The following are the ISM guiding principles and core functions as written in DOE's ISM P 450.4A (2018):

- 1. LINE MANAGEMENT RESPONSIBILITY FOR SAFETY. Line management is directly responsible for the protection of the workers, the public, and the environment.
- CLEAR ROLES AND RESPONSIBILITIES. Clear and unambiguous lines of authority and responsibility for ensuring safety are established and maintained at all organizational levels within the Department and its contractors.
- 3. COMPETENCE COMMENSURATE WITH RESPONSIBILITIES. Personnel possess the experience, knowledge, skills, and abilities that are necessary to discharge their responsibilities.
- 4. BALANCED PRIORITIES. Resources are effectively allocated to address safety, programmatic, and operational considerations. Protecting the workers, the public, and the environment is a priority whenever activities are planned and performed.
- 5. IDENTIFICATION OF SAFETY STANDARDS AND REQUIREMENTS. Before work is performed, the associated hazards are evaluated and an agreed-upon set of safety standards and requirements is established which, if properly implemented, will provide adequate assurance that the workers, the public, and the environment are protected from adverse consequences.
- 6. HAZARD CONTROLS TAILORED TO WORK BEING PERFORMED. Administrative and engineering controls to prevent and mitigate hazards are tailored to the work being performed and associated hazards.
- 7. OPERATIONS AUTHORIZATION. The conditions and requirements to be satisfied for operations to be initiated and conducted are clearly established and agreed upon.

The ISMS core functions are:

- 1. DEFINE THE SCOPE OF WORK. Missions are translated into work, expectations are set, tasks are identified and prioritized, and resources are allocated.
- 2. ANALYZE THE HAZARDS. Hazards associated with the work are identified, analyzed, and categorized.
- 3. DEVELOP AND IMPLEMENT HAZARD CONTROLS. Applicable standards and requirements are identified and agreed-upon, controls to prevent/mitigate hazards are identified, the safety envelope is established, and controls are implemented.
- 4. PERFORM WORK WITHIN CONTROLS. Readiness is confirmed and work is performed safely.
- 5. PROVIDE FEEDBACK AND CONTINUOUS IMPROVEMENT. Feedback information on the adequacy of controls is gathered; opportunities for improving the definition and planning of work are identified and implemented.

Risk Management, Hazard Identification and Control. DOE's ISM does not describe safety management in terms of risk management. DOE does not have a have a separate policy or order outlining a risk management process or the agency's approach to managing risk. Hazard identification and control are two of the core functions of DOE's ISM. Core functions occur at the activity level and for all phases of work. DOE has also set requirements for hazard identification and control in their *Worker Safety and Health Program* regulation, 10 CFR 851.

Each DOE site has a unique mission. Therefore, to support a productive and economically sound system organizations are meant to tailor their SMS to the hazards and risks of their activities. DOE's ISM policy also states that decisions with safety implications must be made by technically qualified managers with consideration to hazards and risk (DOE P 450.4A).

Accountability for the SMS. DOE line management is ultimately responsible and accountable for protecting workers, the public and the environment. (DOE P 450.4A, 2018). Line management is defined in DOE O 450.2 *Integrated Safety Management* as "the unbroken chain of responsibility that extends from the Secretary of Energy to the Deputy Secretary, to the Secretarial Officers who set program policy and plans and develop assigned programs, and to the program and Field Element managers who are responsible for execution of programs."

SMS Responsibilities (for implementation). The responsibilities for the implementation of ISM and ISMS are identified in DOE P 450.4A, (Policy section); two sections of DOE O 450.2 (Requirements and Responsibilities sections); and the DEAR Clause 970.5223-2 (Section e.) as follows:

- Department (DOE P 450.4A- Policy section);
- **DOE** (and the DEAR Clause, section e);
- DOE line management organizations (DOE O 450.2, Requirements);
- DOE line managers (DOE O 450.2, Requirements);
- Secretary/Deputy Secretary (DOE O 450.2 Responsibilities);
- Secretarial Offices (DOE O 450.2, Responsibilities);
- Heads of Field Elements (DOE O 450.2, Responsibilities); the
- ISM Champion Safety Council (DOE O 450.2, Requirements and Responsibilities);
- Office of Environment, Health, Safety and Security (EHSS) (DOE O 450.2, Responsibilities);
- Safety Culture Improvement Panel (DOE O 450.2, Requirements and Responsibilities); and
- **Contracting officer** (DEAR Clause, section e) each have requirement and responsibilities to support ISM/ISMS as well as the contractor SMS.

The Department is responsible for ensuring that DOE line management is ultimately responsible and accountable for the protection of workers, the public and the environment for the activities performed at their facility. The Department fulfills this obligation by forming roles, responsibilities, authorities, and accountabilities; evaluating safety performance; and ensuring that DOE and its contractors uphold the level of safety outlined in policies and regulations. (DOE P 450.4A -Policy section)

The Secretary of Energy and Deputy Secretary of Energy establish and communicate safety expectations through DOE policies and rules; designate ISM Champions Council leadership and approve changes to the Council's charter. (DOE P 450.4A, Responsibilities)

DOE line management organizations, as defined in DOE O 450.2, must establish a means to ensure their DOE offices and their contractors create an ISMS, including the "implementing mechanisms, processes and methods to be used in an ISM System Description Document."

Each Secretarial Office is responsible for creating and sustaining their own ISM System Description and safety functions, responsibilities, and authorities (FRA) to include detailing the authorities, responsibilities, and expectations for assigned safety duties. (DOE O 450.4A, Responsibilities) At the site level, DOE line management organizations are responsible for reviewing and approving the ISM System Descriptions, monitoring the ISMS, and determining the need for and frequency of updates for the ISM declarations for both the Field Element and contractors. For the Field Elements only, creation and execution of safety goals and objectives is reviewed by the Program Office. (2017-Responsibilities section)

Heads of the DOE Field Elements establish and update the ISM System Descriptions and FRA for their location; monitor the ISMS for contractors and provide feedback; create yearly safety goals for their site and approve contractor's safety performance objectives, measures, and commitments; support decisions regarding ISM declarations and decide if as well as when to perform ISM verifications of contractor ISM systems; and implement the "Field Element management systems" to ensure DOE safety requirements and expectations are achieved. (DOE O 450.4A- responsibilities section)

DOE line managers exist at each program and site office and are responsible for implementing ISM at their location and are responsible for determining "the adequacy for approval and frequency of updates" for both the specific DOE office as well as any contractors operating at that location. (DOE O 450.2, 2017 -requirements section) DOE line management must produce, distribute, and update a FRA³ document that identifies the organization's safety management functions. The Department's "safety management responsibilities for ensuring adequate protection and safe operations must be met by DOE line management and cannot be delegated to contractors," in accordance with DOE O 450.2, 2017- Requirements section.

EHSS holds the position of "senior manager" of the Office of Primary Interest responsible for safety directives to support line management; creates and updates guidance documents to support line management and contractor implementation of ISMS, and details the authorities and responsibilities assigned to EHSS through the FRA (DOE O 450.2, 2017-Responsibilities section)

The ISM Champions Council, whose members are designated by DOE program and site office line managers, are responsible for supporting line management in creating, executing, implementing, and maintaining a well-functioning ISM system. The Council is also charged with informing the Deputy Secretary of the agency's overall ISM implementation status. (DOE O 450.2, Requirements and Responsibilities sections).

DOE contracting officers are responsible for reviewing and approving contractors' SMS documentation and contractors' safety performance objectives, performance measures, and commitments. (DEAR Clause, Section e).

Measuring Performance of the Program. The DOE ISM Policy states that the Department must ensure DOE line management is fulfilling its responsibility for "ensuring adequate protection of the workers, the public, and the environment" by measuring safety management performance, particularly for high

consequence nuclear facilities. The policy lists incident reports as one measure of SMS performance. (DOE P 450.4A)

Secretarial Officers "monitor the status" of the Field Element's ISM systems, safety goals, and objectives; and determine the need for ISM declarations and updates based on hazards, risks and performance measures of Field Elements and contractors. (DOE O 450.2)

The Heads of DOE Field Elements track the creation of yearly safety goals for the Field Element and safety performance objectives, measures, and commitments for the contractor and applies the Field Element management systems to confirm DOE safety requirements and expectations are realized.

DOE O 450.2 requires DOE line management to take steps to ensure contractors who manage DOE facilities are doing so with safety as a priority. Line management must ensure safety requirements are included in contracts and monitor compliance, evaluate contractor performance, identify trends, gather operational data, and feed relevant information back to the contactor to enhance safety. DOE O 450.2 also requires DOE line management organizations to establish the necessity for and frequency of ISM declarations and ISM verifications of contractor's ISM systems.

Measuring performance of the System. Heads of DOE Field Elements determine whether and when to conduct ISM verifications of contractor ISM systems. (DOE O 450.2) In 2006, DOE established an ISM Champions Council to support DOE line management in developing, executing, and maintaining their ISM systems. (DOE O 450.2)

Safety Climate. DOE expects "...all organizations to embrace a strong safety culture where safe performance of work and involvement of workers in all aspects of work performance are core values of managers and workers. The Department encourages a questioning attitude by all employees and a work environment that fosters such attitude." (DOE P 450.4A) DOE O 450.2 established a Safety Culture Improvement Panel (SCIP) to continuously improve DOE safety culture. In August 2021, the Secretary promoted DOE's safety culture expectations in a video which was socialized with the entire DOE complex. This video is posted on DOE's safety culture website along with additional information about culture and the SCIP.

The expectations and requirements for safety culture do not extend to the DEAR Clause.

In 2017, the Department updated the DOE O 450.2 to include requirements for the SCIP to "provide sustained leadership, consistent implementation, and an enterprise-wide cross-organizational focus to continuous safety culture improvement."." The SCIP's responsibilities include:

- Reinforcing the execution of safety culture and safety conscious work environment throughout DOE;
- Creating and communicating methods to enhance and nurture a positive safety culture;
- Offering senior line management advisement when evaluating safety culture concerns and strengths;
- Providing opportunities for assessing and sharing the Department's safety culture position, growth, and challenges;
- Constantly enhancing DOE safety culture with the assistance of representatives from across the complex;

- Remaining current with organizational safety culture advancements; and
- Identifying opportunities to integrate safety culture and a safety conscious work environment into workforce training.

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