Safety Management System Manual
December 2022

Air Traffic Organization

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FOREWORD

The fundamental mission of the Air Traffic Organization (ATO) is to ensure the safe provision of air traffic services in the National Airspace System (NAS). Thanks to its employees, the ATO operates the safest, most efficient air traffic system in the world.

As the ATO helps build the Next Generation Air Transportation System, the resulting cross-organizational changes to the NAS require an intensive, proactive, and systematic focus on assuring safety. The ATO uses the Safety Management System (SMS) to achieve this. The SMS constitutes the operating principles that support the ATO in objectively examining the safety of its operations.

This document is the result of an ATO-wide effort and reflects current international best practices and intra-agency lessons learned. It marks an important next step toward a mature and integrated SMS in the FAA. Therefore, it is important that all ATO personnel work diligently to uphold and follow the procedures and guidance in this SMS Manual to manage safety risk and help promote a positive safety culture in the ATO and the FAA.

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1.1 About the Safety Management System Manual

The Air Traffic Organization (ATO) Safety Management System (SMS) is a formalized and proactive approach to system safety. It directly supports the mission of the Federal Aviation Administration (FAA): "to provide the safest, most efficient aerospace system in the world." The ATO **SMS** is an integrated collection of policies, processes, procedures, and programs used to manage safety risk in the provision of air traffic management and communication, navigation, and surveillance services.

The ATO SMS Manual informs ATO employees and contractors about the goal of the ATO SMS, describes the interrelationship among the four components of the SMS, and instructs readers on the process of identifying safety hazards and mitigating risk in the National Airspace System (NAS). More detailed guidance on the practical application of the SMS, and specifically Safety Risk Management (SRM), is contained in the annex of this document. This SMS Manual and its complements, such as the Safety Risk Management Guidance for System Acquisitions (SRMGSA), ATO Safety Guidance documents, and other FAA safety documents, are used to carry out the safety mission of the FAA and requirements of the SMS.

1.1.1 Changes to the SMS Manual

Safety and Technical Training (AJI) reviews this SMS Manual annually. Individuals who would like to propose a change to the document may submit comments via the ATO SMS Policy Management Portal.

1.2 Establishment and Continuous Support of the ATO SMS

Safety, the principal consideration of all ATO activities, is defined as the state in which the risk of harm to persons or damage to property is acceptable. Managing and assuring the safety of operations using the SMS has long been a focus of air navigation service providers worldwide, with the International Civil Aviation Organization (ICAO) having provided the guiding principles and the mandate for member organizations to use an SMS. The ATO's SMS efforts support the FAA safety mission, which emphasizes continuous improvement of safety and the integration of safety management activities across FAA organizations, programs, and Lines of Business (LOBs). Efforts to develop and implement complex, integrated Next Generation Air Transportation System systems to improve the safety and efficiency of air travel in the United States make clear the relevance of the SMS.

1.3 SMS Policy Derivations

The ATO SMS is supported by numerous levels of policy and requirements, as depicted in Figure 1.1. Relevant programs that predate the SMS are detailed in other FAA publications and processes. This SMS Manual only references those documents when necessary. Section 1.8 lists many of the related documents.

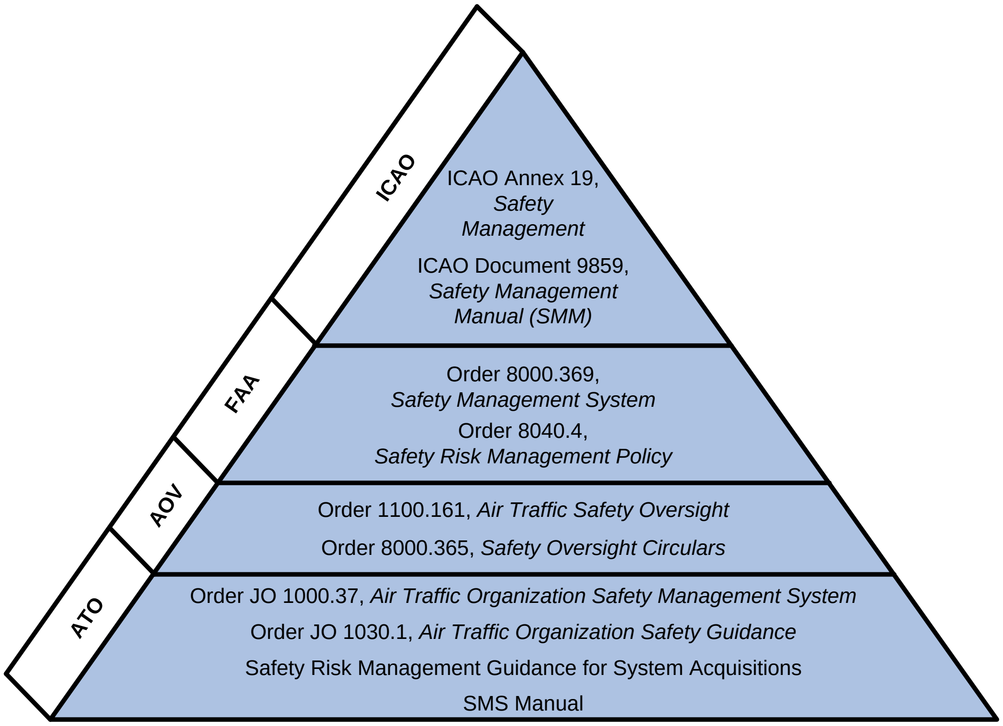

ICAO
FAA
AOV
ATO
ICAO Annex 19, *Safety Management*
ICAO Document 9859, *Safety Management Manual (SMM)*
Order 8000.369, *Safety Management System*
Order 8040.4, *Safety Risk Management Policy*
Order 1100.161, *Air Traffic Safety Oversight*
Order 8000.365, *Safety Oversight Circulars*
Order JO 1000.37, *Air Traffic Organization Safety Management System*
Order JO 1030.1, *Air Traffic Organization Safety Guidance*
Safety Risk Management Guidance for System Acquisitions
SMS Manual

Figure 1.1: SMS Policy and Requirements Hierarchy

1.3.1 ICAO SMS Policy

The FAA derives its high-level SMS policy from ICAO policy. ICAO Annex 19, *Safety Management*, provides standards and recommended practices for safety management for member states and air traffic service providers. Additionally, ICAO Document 9859, *Safety Management Manual (SMM)*, provides guidance for the development and implementation of the SMS for air traffic service providers. ICAO Document 9859 also provides guidance for safety programs in accordance with the international standards and recommended practices contained in Annex 19.

1.3.2 FAA SMS Policy

FAA Order 8000.369, *Safety Management System*, describes the essential aspects of an SMS and provides implementation guidance to FAA organizations. This document is designed to create a minimum SMS standard that each FAA LOB can follow to implement an SMS.

FAA Order 8040.4, *Safety Risk Management Policy*, establishes requirements for how to conduct SRM in the FAA. It formalizes SRM guidance for FAA LOBs and Staff Offices and describes specific steps when performing and documenting SRM that crosses FAA LOBs. The ATO must consider and, when necessary, use the provisions in this order when coordinating SRM with other FAA organizations. AJI functions as the ATO liaison to interface with outside organizations. Within the ATO, AJI adjudicates discrepancies among Service Units.

1.3.3 Air Traffic Safety Oversight Service Order

The Air Traffic Safety Oversight Service (AOV) provides independent safety oversight of the ATO. FAA Order 1100.161, *Air Traffic Safety Oversight*, provides high-level SMS requirements of the ATO and AOV. When AOV involvement is required, AJI functions as the liaison between AOV and other ATO Service Units and organizations. Additional guidance from AOV is submitted via Safety Oversight Circulars (SOCs) that provide information that may be used by the ATO to develop and implement internal procedures. AOV publishes all SOCs on the intranet.

1.3.4 ATO SMS Policy and Requirements

FAA Order JO 1000.37, *Air Traffic Organization Safety Management System*, documents high-level SMS requirements, roles, and responsibilities. FAA Order JO 1030.1, *Air Traffic Organization Safety Guidance*, establishes a method and process for providing the ATO with supplemental guidance material pertinent to the SMS. The SRMGSA provides SMS requirements and guidance pertinent to programs proceeding through the FAA Acquisition Management System (AMS) process. The ATO has also established Quality Assurance and Quality Control orders that govern safety data collection and the establishment of safety-related corrective actions. Those orders are as follows:

- FAA Order JO 7210.632, *Air Traffic Organization Occurrence Reporting*
- FAA Order JO 7210.633, *Air Traffic Organization (ATO) Quality Assurance (QA)*
- FAA Order JO 7210.634, *Air Traffic Organization (ATO) Quality Control*
- FAA Order JO 7200.20, *Voluntary Safety Reporting Programs*

All ATO organizations and individuals under the purview of FAA Order JO 1000.37 must adhere to the provisions of the aforementioned documents and this SMS Manual. If discrepancies exist between this SMS Manual and FAA orders and guidance, including those that originate outside the ATO, notify the Safety Management Group, AJI-31, Manager via the ATO SMS mailbox.[1]

1.4 The Four Components of SMS

There are four components of the SMS that combine to create a systematic approach to managing and ensuring safety. These components are:

- **Safety Policy:** The documented organizational policy that defines management's commitment, responsibility, and accountability for safety. Safety Policy identifies and assigns responsibilities to key safety personnel.
- **SRM:** A process within the SMS composed of describing the system; identifying the hazards; and analyzing, assessing, and treating risk. SRM includes processes to define strategies for monitoring the safety risk of the NAS.
- **Safety Assurance:** A set of processes within the SMS that verify that an organization meets or exceeds its safety performance objectives and that function systematically to determine the effectiveness of safety risk controls through the collection, analysis, and assessment of information.
- **Safety Promotion:** The communication and distribution of information to improve the safety culture and the development and implementation of programs and/or processes that support the integration and continuous improvement of the SMS within the ATO. Safety Promotion allows the ATO to share and provide evidence of successes and lessons learned.

Figure 1.2 represents the relationship of the four SMS components in an integrated model. The integration and interaction of the four components is essential to managing the SMS effectively and fostering a positive safety culture.

[1] The role of the AJI-31 Group Manager is defined in FAA Order JO 1000.37.

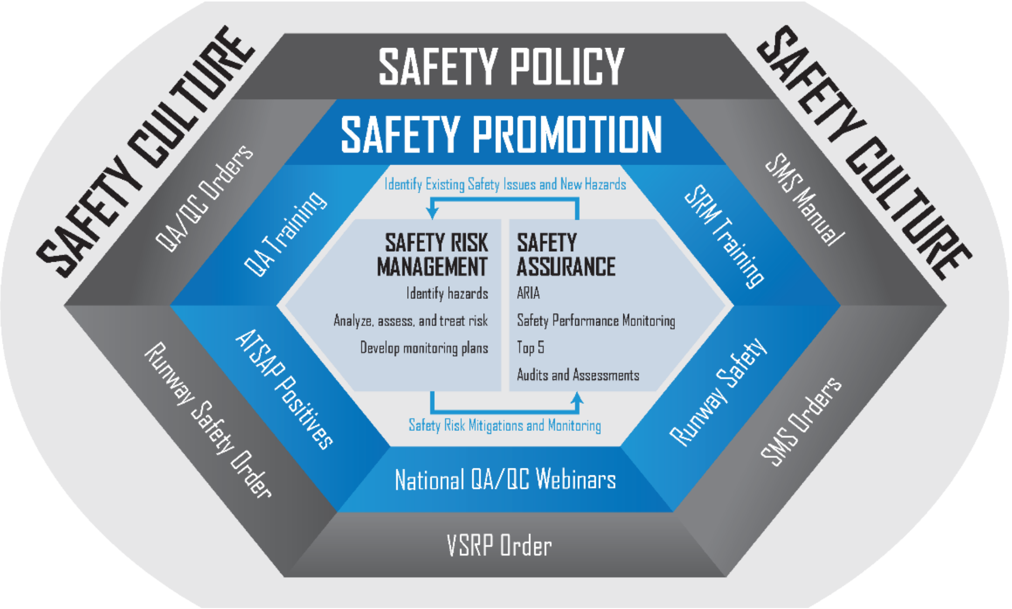


Figure 1.2: The Integrated Components of the SMS

1.4.1 Safety Culture and Promotion in the ATO

Safety culture is defined as the way safety is perceived and valued in an organization. It represents the priority given to safety at all levels in the organization and reflects the real commitment to safety. The ATO uses its SMS to promote a positive safety culture through policies that align safety goals with organizational standards, training, voluntary reporting, and best practices.

A strong safety culture helps ensure that personnel are trained and competent to perform their duties and that continual updates on training are provided. Promoting strong safety values means that all ATO employees share lessons learned from investigations and experiences, both internally and from other organizations.

Safety Promotion programs and activities are vital to achieving positive safety outcomes throughout the ATO. The tenets of Safety Promotion are used to foster a positive safety culture in which ATO employees understand why safety is important and how they affect it, providing a sense of purpose to safety efforts. Each employee must consider the potential effect that their decisions may have on safety, and each employee is responsible for understanding the significance of their job as it relates to safety. SMS training identifies the importance of the SMS and how each employee and contractor fits into the mission of using the SMS to improve safety in the ATO. For more information on SMS training, refer to the ATO SMS Toolbox.

Open communication is critical to a positive safety culture. The ATO communicates safety objectives to all operational personnel to improve the way safety is perceived, valued, and prioritized. In an organization with a strong safety culture, individuals and groups take responsibility for safety by communicating safety concerns and striving to learn, adapt, and modify individual and organizational behavior based on lessons learned.

1.4.1.1 Safety Programs and Initiatives

The ATO maintains a positive safety culture using programs and initiatives such as:

- **Recurrent Training:** An initiative that uses collaboratively developed instruction designed to maintain and update previously learned skills while promoting a positive safety culture.
- **Top 5 Program:** A program that identifies high-priority data-driven safety issues that are trending in the NAS. The Top 5 is determined based on data obtained from the Aviation Risk Identification and Assessment (ARIA) automated system, Voluntary Safety Reporting Programs, stakeholder input, and other databases used to log and report unsafe occurrences.
- **Fatigue Risk Management:** A group that provides operational fatigue risk expertise, guidance, and support to the ATO in developing fatigue reduction strategies and policy recommendations to mitigate and manage operational fatigue risks in the NAS.
- **Partnership for Safety:** A joint effort between the ATO and the National Air Traffic Controllers Association that encourages employees to become actively engaged in identifying local hazards and developing safety solutions before incidents occur.
- **Voluntary Safety Reporting Programs**
    - **Air Traffic Safety Action Program (ATSAP):** A confidential system for controllers and other employees to voluntarily identify and report safety and operational concerns. For more information, refer to the ATSAP website.
    - **Confidential Information Share Program (CISP):** A program for the sharing and analysis of information collected through the ATSAP and airlines' Aviation Safety Action Programs to provide a more complete representation of the NAS. For more information, visit the CISP website.
    - **Technical Operations Safety Action Program (T-SAP):** A system for reporting safety-related events or issues pertaining to operations, equipment, personnel, or anything believed to affect safety in the NAS for technicians and other Technical Operations employees. For more information, refer to the T-SAP website.
- **Change Advisory Group:** A group that promotes open communication with ATO SMS stakeholders and affected organizations by providing an effective and efficient policy revision process and expediting the review and concurrence process for the ATO SMS Manual.
- **Runway Safety:** A team that works with all stakeholders to develop innovative programs and techniques to reduce the severity and likelihood of surface incidents.
- **Lessons Learned:** An initiative that improves ATO processes, addresses deficiencies proactively, and empowers employees to play a direct role in the safety of the NAS by providing valuable safety information.

1.5 SMS Benefits

ATO processes and tools that support the SMS help:

- Provide a common framework to proactively and reactively identify and address safety hazards and risks associated with NAS equipment, operations, and procedures;
- Encourage intra-agency stakeholders to participate in solving the safety challenges of an increasingly complex NAS;
- Reduce isolated decision-making by using integrated safety management principles;
- Improve accountability for safety through defined managerial roles and responsibilities and SRM processes;
- Integrate Safety Assurance processes that enable the ATO to effectively measure safety performance;
- Provide documentation of the ATO's data-based efforts to improve NAS safety using a repeatable process;
- Promote a continuous cycle of assessing, correcting/mitigating, and monitoring the safety of air navigation services;
- Foster a positive safety culture that can help improve system safety; and
- Measure the performance and support the improvement of the SMS.

1.6 SMS Continuous Improvement

The SMS is the framework that the ATO uses to measure and help ensure the safety of its operations. In an evolving NAS, it is necessary to continuously seek improvement in ATO processes and policies that support ATO safety efforts and, by extension, support the SMS. The ATO and external organizations conduct audits and assessments to measure and determine compliance with the policies and procedures used to manage safety in the NAS. By assessing SMS maturity, the ATO is able to identify gaps in SMS performance, opportunities for improvement, and areas in which to focus new policy development.

1.6.1 Measuring NAS-Wide ATO Safety Performance

Historically, the ATO has based the identification of risk on whether an operation was compliant or separation was maintained; however, this approach has not always identified all aspects of risk in the most effective manner. Similarly, compliant operations have, on occasion and under certain applications, introduced varying levels of risk into the NAS.

Moving forward, the ATO will rely more on risk-based safety data to identify and analyze safety issues and evaluate the effectiveness of safety risk mitigation. The ATO has adopted a risk-based approach to collecting and analyzing data, rather than gathering and evaluating data based solely upon existing compliance standards. Understanding the level of risk associated with an operation is a holistic safety method that can proactively look beyond compliance. Risk-based safety addresses shortcomings without the boundaries of traditional compliance-based analysis.

Due to the ATO's transition from compliance-based safety assurance to Risk-Based Safety Management, FAA Order JO 7210.633 replaced Risk Analysis Events and the Risk Analysis Process with ARIA. Through ARIA, an airborne module identifies and measures potential risk between aircraft encounters by utilizing radar and other surveillance data. Each encounter is given a score through a Barrier Analysis Review. By basing mitigation efforts on aggregated data that identifies and validates risk in the system, the ATO is able to focus on a systemic view of the operation to identify risk before it leads to an event.

1.7 Policy Compliance with SMS

As the ATO's SMS matures, the tenets of the SMS components are integrated into new and existing ATO policy. For a directive to be considered compliant with the SMS, it must incorporate safety measures and SMS requirements to help manage safety.

1.8 FAA Documents Related to SMS Requirements

The following documents (orders, directives, handbooks, and manuals) address NAS safety management and are core documents that support the ATO SMS. This list is not all-inclusive and only represents a small portion of ATO documents that pertain to safety management. Some documents listed may have been updated since the publication of this SMS Manual.

1.8.1 Safety Reporting

a. FAA Order 7050.1, *Runway Safety Program*

b. FAA Order JO 7200.20, *Voluntary Safety Reporting Programs*

c. FAA Order JO 7210.632, *Air Traffic Organization Occurrence Reporting*

d. FAA Order JO 7210.633, *Air Traffic Organization (ATO) Quality Assurance (QA)*

e. FAA Order JO 7210.634, *Air Traffic Organization (ATO) Quality Control*

f. FAA Order JO 8020.16, *Air Traffic Organization Aircraft Accident and Aircraft Incident Notification, Investigation, and Reporting*

1.8.2 Facilities and Equipment Management

a. FAA Order JO 1320.58, *Instructions for Writing Notices, Maintenance Technical Handbooks, and System Support Directives*

b. FAA Order 1800.66, *Configuration Management Policy*

c. FAA Order JO 1900.47, *Air Traffic Control Operational Contingency Plans*

d. FAA Order 6000.15, *General Maintenance Handbook for NAS Facilities*

e. FAA Order 6000.30, *National Airspace System Maintenance Policy*

f. FAA Order JO 6000.50, *National Airspace System (NAS) Integrated Risk Management*

1.8.3 Hardware and Software System Development

a. FAA AMS

b. FAA Systems Engineering Manual

1.8.4 Safety Management and Risk Assessment

a. SRMGSA

b. AOV SOC 07-02, *AOV Concurrence/Approval at Various Phases of Safety Risk Management Documentation and Mitigations for Initial High-Risk Hazards*

c. AOV SOC 07-05A, *Guidance on Safety Risk Modeling and Simulation of Hazards and Mitigations*

d. AOV SOC 13-13A, *Corrective Action Plan Development and Acceptance in Response to Safety Compliance Issues*

e. FAA Order JO 1000.37, *Air Traffic Organization Safety Management System*

f. FAA Order JO 2900.2, *Air Traffic Organization Audits and Assessments*

g. FAA Order 1100.161, *Air Traffic Safety Oversight*

h. FAA Order 8000.369, *Safety Management System*

i. FAA Order 8040.4, *Safety Risk Management Policy*

j. FAA Order 8040.6, *Unmanned Aircraft Systems Safety Risk Management Policy*

2.1 Introduction to Managing System Safety

As Air Traffic Organization (ATO) operational procedures and National Airspace System (NAS) equipment (i.e., hardware and software) evolve, their interaction and interdependency across organizations within the ATO and throughout the Federal Aviation Administration (FAA) must be addressed. In a system as large and diverse as the NAS, the identification of a safety hazard and mitigation of its risk often falls within the purview of multiple organizations.

The effects of safety hazards and associated risk management methods across multiple organizations, domains, and implementation timelines must be properly understood to achieve the highest practical level of safety. Safety risk deemed acceptable for an individual element of the NAS may lead to unintentional safety risk in another element if Safety Risk Management (SRM) is not conducted with a "system of systems" philosophy. As emerging NAS equipment, operations, and procedures are tested and implemented, the SRM process must account for their potential safety impact on existing/legacy tools and procedures and vice versa. Sharing safety data and using an integrated safety management approach helps identify and resolve issues requiring the consideration of multiple disciplines.

The goal of an integrated approach to safety management is to eliminate gaps in safety analyses by assessing NAS equipment, operations, and procedures across three planes: vertical, horizontal, and temporal. The vertical plane is hierarchical, providing assessments from a specific project up to the NAS-level system of systems of which the project is a part. The horizontal plane spans organizations, programs, and systems. Finally, the temporal plane attempts to eliminate safety gaps across program and system implementation timelines. Figure 2.1 depicts several factors in each of the three planes that should be considered to ensure an integrated approach to safety management. Refer to the Safety Risk Management Guidance for System Acquisitions for more information.

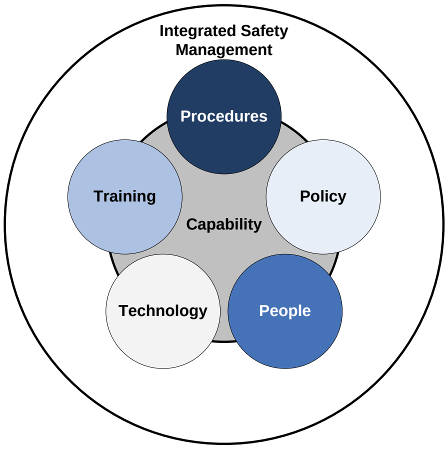


Figure 2.1: Integrated Safety Factors

2.2 Safety Assessment Using the Tenets of SRM and Safety Assurance

In acknowledging the complexity of the NAS and its various system interdependencies, the ATO uses the systematic processes and tenets of SRM and Safety Assurance to identify and address safety hazards and risks across the NAS.

The remainder of this section discusses the foundational concepts and practices used to identify and address safety issues and consider potential ramifications in an integrated way. It will describe at a high level the underlying causes of safety hazards and the means by which the ATO manages and tracks safety risk.

The SRM process provides the framework to track a NAS change after it has been implemented using Safety Assurance functions to determine whether controls and/or safety requirements are performing as intended/designed. Refer to Figure 2.2 for a depiction of the relationship between SRM and Safety Assurance.

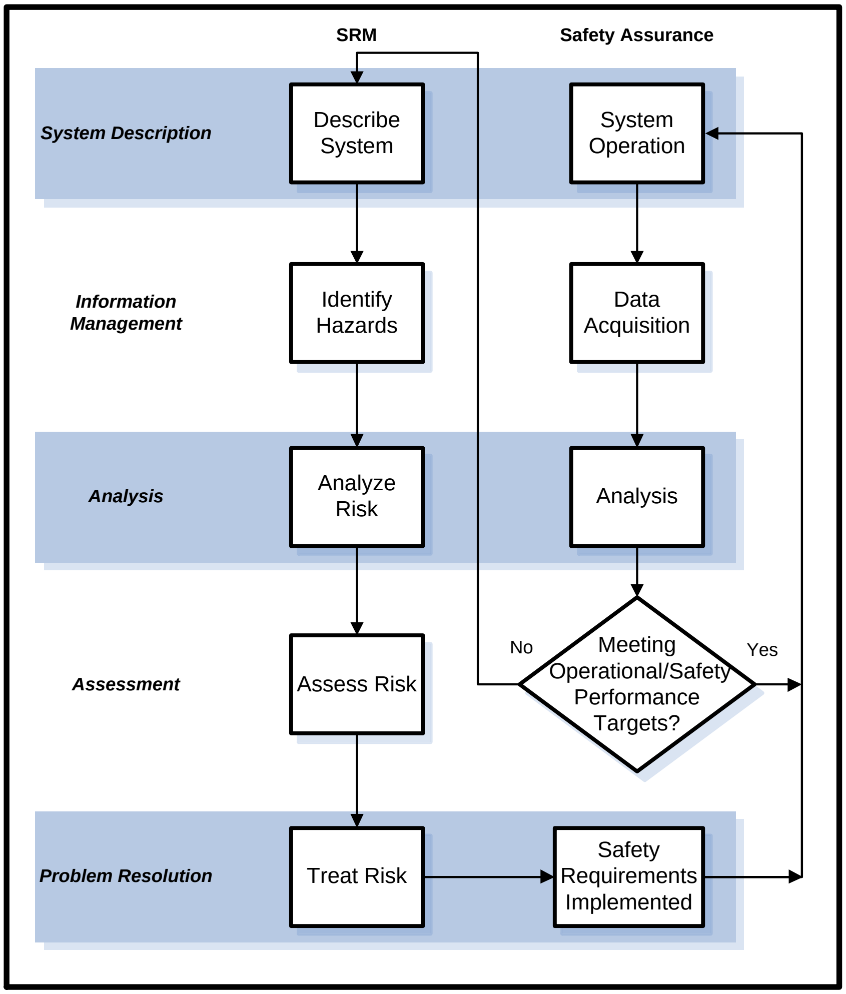


Figure 2.2: SRM / Safety Assurance Process Flow

2.3 SRM: Proactive and Reactive Hazard and Risk Management

SRM is a formalized approach to integrated system safety. It both informs decision-makers about the potential hazards, safety risks, and ways to reduce risk associated with a particular proposal and identifies ways to mitigate existing safety issues in the NAS. The methodology is applied to all NAS equipment, operations, and procedures to identify safety hazards and address risk.

It is necessary to make the approach to managing safety risk into a formalized, objective process. This helps ensure the effective management of a safety hazard's risk. SRM provides a means to:

- Identify potential hazards and analyze and assess safety risk in ATO operations and NAS equipment;
- Define safety requirements to reduce risk to an acceptable level;
- Identify safety performance targets, the measurable goals used to verify the predicted residual risk of a hazard; and
- Create a plan that an organization can use to determine if expected risk levels are met and maintained.

2.4 Safety Assurance: Identifying and Closing Safety Gaps

SRM alone does not ensure the safety of the services the ATO provides; equally important are the efforts performed under the umbrella of Safety Assurance. Safety Assurance builds on SRM efforts by collecting and assessing data to monitor compliance, assess the performance of safety measures, and identify safety trends. It provides the means to determine whether NAS equipment, operations, and procedures—and changes to them—meet or exceed acceptable safety levels. The Safety Assurance component of the Safety Management System (SMS) encompasses all of the ATO processes and programs that survey the NAS. These processes and programs can lead to the discovery of previously unidentified existing safety issues and risk controls that are outdated or no longer effective.

Continuous improvement of the safety of the NAS can occur only when an organization is vigilant in monitoring the performance of its operations and corrective actions. Refer to Section 6 for more information about the ATO programs that fit within the Safety Assurance component of the SMS.

2.4.1 The Top 5 Program

The Top 5 Program leverages the vast amount of safety data collected through mandatory and voluntary reporting programs and stakeholder feedback to identify trending safety issues and develop Corrective Action Plans (CAPs) to address and monitor the safety performance of those issues. The program uses SRM principles to guide its process. The Top 5 Steering Committee, composed of directors from ATO Service Units and representatives from the Air Traffic Supervisors' Committee and National Air Traffic Controllers Association, oversees the decision-making needs of the Top 5.

When identifying an item for the Top 5, observed safety trends are broken down into discrete issues by assessing details such as causal factors and system states. Subject matter experts from stakeholder organizations then participate on CAP Teams to perform an in-depth data review and identify mitigations that may reduce the prevalence and/or criticality of the observed safety trend. The team also sets safety performance targets that must be met prior to closing the issue from the Top 5. Safety and Technical Training (AJI) works to ensure corrective actions are implemented and monitors each issue against its performance targets to determine when closure of each issue from the Top 5 can occur.

The review performed by each CAP Team is documented and kept in the Top 5 issue portfolio, which is updated and signed annually by the Director of Policy and Performance, AJI-3, on behalf of the Top 5 Steering Committee. CAPs and monitoring strategies may be updated on a yearly basis, and these updates are captured in addenda to the issue portfolio. If any mitigations identified through the CAP are potential changes to the NAS, those changes must go through the SRM process. The Top 5 issue portfolio may be used as input to the safety analysis but does not serve as a substitute for an SRM document, if one is needed.

2.4.2 Audits and Assessments

To continuously improve the safety of its NAS equipment, provisioned services, operations, and procedures, the ATO conducts audits and assessments to determine whether the NAS is performing as expected. ATO employees also use audit and assessment techniques to test, validate, and verify safety data obtained and produced by the various entities and organizations in the NAS. Furthermore, ATO audits and assessments identify causes and correlations that can improve the understanding of safety performance.

Audits and assessments are defined as follows:

- An assessment is the process of measuring or judging the value or level of something. The objective of an assessment is to determine the organization’s ability to achieve its goals and accomplish its mission.
- An audit is a review that verifies conformance to established criteria, processes, and work practices. The objective of an audit is to determine an organization’s compliance with FAA directives and procedures.

Audits and assessments verify positive and negative safety trends. If a safety issue or hazard is identified through an audit or assessment, SRM is used to document the hazard and identify mitigations. In this sense, Safety Assurance and SRM complement each other by providing a continuous loop of hazard identification and risk management methods.

Audits and assessments may be scheduled or unscheduled formal reviews; examinations; or verifications of activities, controls, ATO operations, and ATO systems. The scope of safety audit and assessment activities can vary. An audit or assessment can either focus on a single procedure / piece of NAS equipment or broadly examine multiple elements of a system.

The ATO uses both audits and assessments at the facility, district, Service Area, and national levels. Using the above-described methodologies, the ATO assesses safety performance through:

- Proactive evaluation of facilities, equipment, documentation, and procedures (e.g., internal assessments);
- Proactive evaluation of Service Delivery Point performance, thus verifying the fulfillment of Service Delivery Point safety responsibilities (e.g., periodic competency checks in the form of Quality Control, operational skills assessments, and system safety reviews); and
- Periodic evaluations to verify a system’s performance in control and management of safety risks (e.g., internal and external audits and assessments).

For additional information about the ATO’s audit and assessment program, refer to FAA Order JO 2900.2, *Air Traffic Organization Audits and Assessments*.

2.4.3 ATO Quality Assurance and Quality Control

Requirements and guidance for Quality Assurance and Quality Control are contained in three ATO orders: FAA Order JO 7210.632, *Air Traffic Organization Occurrence Reporting*; FAA Order JO 7210.633, *Air Traffic Organization (ATO) Quality Assurance (QA)*; and FAA Order JO 7210.634, *Air Traffic Organization (ATO) Quality Control*.

These orders provide specific direction for the reporting, investigating, and recording of air traffic incidents. Responsibilities for assessing trends and noncompliance are also provided, along with guidance for identifying and correcting performance deficiencies.

2.5 Identifying and Addressing System Vulnerabilities

Before performing SRM, it is important to acknowledge the potential origins of safety hazards in the NAS. Daily operations in an ever-changing air traffic environment can present varying hazards and levels of safety risk. Given the complex interplay of human, material, and environmental factors in ATO operations, the complete elimination of all hazards and safety risk is unachievable. Even in organizations with excellent training programs and a strong safety culture, mechanical and electronic equipment will fail, software will function in an unintended manner, and human operators will make errors.

2.5.1 System Gaps and Hazard Defenses

Developing a safe procedure, hardware, or software system requires that the procedure/system contain multiple defenses, ensuring that no single event or sequence of events results in an incident or accident. Failures in the defensive layers of an operational system can create gaps in defenses, some known and others unknown. Gaps “open” and “close” as the operational situation, environment, or equipment serviceability state changes. A gap may sometimes be the result of a momentary oversight on the part of a controller or operator, typically described as an **active failure**. Other gaps may represent long-standing **latent failures** in the system. Latent conditions exist in the system before negative effects can occur. The consequences of a latent condition may lie dormant for extended periods of time. Figure 2.3 illustrates how an incident or accident can penetrate all of a system’s defensive layers.

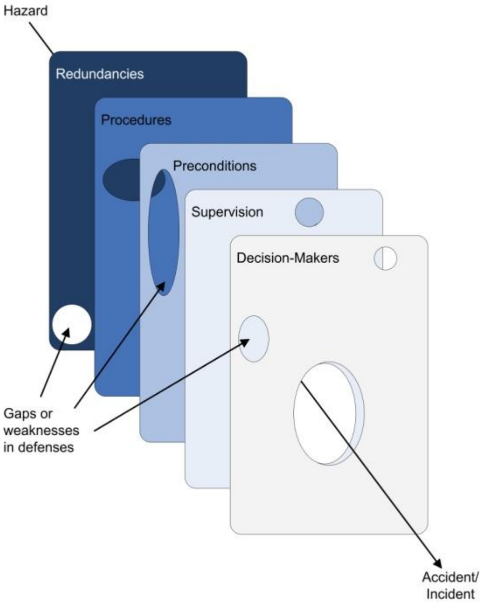


Figure 2.3: Defenses in Depth

These gaps may occur due to:

- Undiscovered and long-standing shortcomings in the defenses,
- The temporary unavailability of some elements of the system due to maintenance action,
- Equipment failure,
- Human interaction, and
- Policy/Decision-making.

2.5.2 Hazard Defenses

Designers of NAS hardware and software must strive to design systems that will not impose hazardous conditions during abnormal performance. Using a key systems engineering concept, such systems are referred to as being fault tolerant. A **fault-tolerant** system includes mechanisms that will preemptively recognize a fault or error so that corrective action can be taken before a sequence of events can lead to an accident. A subset of a fault-tolerant system is a system that is designed to be fail safe. A **fail-safe** system is designed such that if it fails, it fails in a way that will cause no harm to other devices or will not present a danger to personnel.

Error tolerance, another systems engineering concept, is a system attribute in which, to the maximum extent possible, systems are designed and implemented in such a way that errors do not result in an incident or accident. An error-tolerant design is the human equivalent of a fault-tolerant design.

Design attributes of an error-tolerant system include:

- Errors are made apparent,
- Errors are trapped to prevent them from affecting the system,
- Errors are detected and warnings/alerts are provided, and
- Systems are able to recover from errors.

For an accident or incident to occur in a well-designed system, gaps must develop in all of the defensive layers of the system at a critical time when defenses should have been capable of detecting the earlier error or failure. Functions, equipment, procedures, and airspace components of the NAS interact through numerous complex relationships. Given the temporal nature of these relationships, the ATO must continuously monitor safety risk to maintain an acceptable level of safety performance and prevent gaps.

2.6 The Human Element’s Effect on Safety

Human error is estimated to be a causal factor in the majority of aviation accidents and is directly linked with system safety error and risk. For this reason, hardware and software system designers must eliminate as many errors as possible, minimize the effects of errors that cannot be eliminated, and reduce the negative effect of any remaining potential human errors.

Human performance variability is a limitation that necessitates a careful and complete study of the potential effect of human error. Human capabilities and attributes differ in areas such as:

- Manner and ability of the senses (e.g., seeing, hearing, and touching),
- Cognitive functioning,
- Reaction time,
- Physical size and shape, and
- Physical strength.

Fatigue, illness, and other factors (e.g., stressors in the environment, noise, and task interruption) also affect human performance. Optimally, the system is designed to resist, or to at least tolerate, human error.

When examining adverse events attributed to human error, it is often determined that elements of the human-to-system interface (e.g., display design, controls, training, workload, or manuals and documentation) are flawed. The study of human reliability and the application of human performance knowledge must influence system design for safety systems and be an integral part of risk management. Recognizing the critical role that humans and human error play in complex systems and applications has led to the development of the human-centered design approach. This approach is central to the concept of managing human error that affects safety risk.

2.7 Closing Gaps Using SRM and Safety Assurance Principles and Processes

Safety risk can be reduced proactively and reactively. Monitoring operational data, carefully analyzing the system, and reporting safety issues make it possible to proactively detect and prevent sequences of events where system deficiencies (i.e., faults and errors, either separately or in combination) could lead to an incident or accident before it actually occurs. The same approach also can be used to reactively analyze the chain of events that led to an accident or incident. With adequate information, safety professionals can take corrective action to strengthen the system’s defenses when devising new air traffic procedures, operations, and NAS equipment or when making changes to them. The following is an illustrative, but not comprehensive, list of typical defenses used in combination to close gaps in defenses:

Equipment defense strategies:

- Redundancy:
  - Full redundancy, which provides the same level of functionality when operating on the alternate system
  - Partial redundancy, which results in some reduction in functionality (e.g., local copy of essential data from a centralized network database)
- Independent checking of design and assumptions
- System design that ensures that critical functionality is maintained in a degraded mode if individual elements fail
- Policy and procedures regarding maintenance to prevent a loss of some functionality in the active system or a loss of redundancy
- Automated aids or diagnostic processes designed to detect system failures or processing errors and to report those failures appropriately
- Scheduled maintenance
- Implementation of robust system development assurance programs in system acquisitions

Operating procedures:

- Adherence to standard phraseology and procedures
- Read-back of critical items in clearances and instructions

- Checklists and habitual actions (e.g., requiring a controller to follow through the projected flight path of an aircraft, looking for conflicts, and receiving immediate coordination from the handing-off sector)
- Inclusion of a validity indicator in designators for Standard Instrument Departures and Standard Terminal Arrival Routes
- Training and reporting methods

Organizational factors:

- Management commitment to safety
- A strong, positive safety culture
- Safety policy implementation with adequate funding provided for safety management activities
- Oversight to ensure that correct procedures are followed
- A zero-tolerance policy toward willful violations or shortcuts
- Control over the activities of contractors

2.8 Safety Order of Precedence

The methods for reducing safety risk generally fall under one of the four categories that make up the Safety Order of Precedence. The Safety Order of Precedence categorizes safety risk mitigations in the following order of preference:

Table 2.1: Safety Order of Precedence and Examples

Priority	Definition	Example
1.	**Design for minimum risk** - Design the system (e.g., operation, procedure, human-to-system interface, or NAS equipment) to eliminate risks. If the identified risk cannot be eliminated, reduce it to an acceptable level by selecting alternatives.	During airport planning, avoid intersecting runways if possible.
2.	**Incorporate safety devices** - If identified risks cannot be eliminated through alternative selection, reduce the risk by using fixed, automatic, or other safety features or devices, and make provisions for periodic function checks.	Install an Engineered Materials Arresting System, which uses crushable material placed at the end of a runway to stop an aircraft that overruns the runway.
3.	**Provide warning** - When alternatives and safety devices do not effectively eliminate or reduce risks, use warning devices or procedures to detect the condition and produce an adequate warning. The warning is designed to minimize the likelihood of inappropriate human reaction and response and must be provided in time to avert the hazard's effects.	Install a lighting system to alert pilots/controllers of potential unauthorized crossings. Provide new runway or taxiway markings.
4.	**Develop procedures and training** - When it is impractical to eliminate risks through alternative selection, safety features, and warning devices, use procedures and training. However, management must concur when procedures and training alone are applied to reduce risks of catastrophic or hazardous severity.	Develop new taxi and departure/arrival procedures for intersecting runway operations. Train pilots and controllers on new procedures for intersecting runways.

Note: Reliance solely on training is normally not a sufficient means to mitigate safety risk.

3.1 Scope of the Safety Risk Management Process

The Air Traffic Organization (ATO) Safety Risk Management (SRM) process is used to determine the safety risk of National Airspace System (NAS) changes or existing safety issues associated with the provision of air traffic management services. These services include the acquisition, operation, and maintenance of hardware and software; management of airspace and airport facilities; and development of operations and procedures. Security (e.g., physical, information, and cyber), environmental, or occupational safety and health issues that potentially affect the provision of air traffic management services should be considered during the SRM process. Conversely, if these issues do not have an effect on the safe provision of air traffic management services, these issues should not be considered.

It is important to note that the SRM process is not designed to and should not be used to account for programmatic considerations that are related to the environment, finance, budget, or labor/human resources. Additionally, safety hazards associated with the environment, occupational safety, or security that can or do affect the provision of air traffic management services must be reported to the appropriate authority.

This section provides a linear SRM process to follow, guidelines to identify safety hazards and mitigate their risks, and requirements for the development of consistent and thorough safety analyses. Using the steps in this section to perform SRM will not always result in an exhaustive study of air traffic procedures, operations, or NAS equipment (i.e., hardware and software). The appropriate level of detail used when conducting SRM depends on the complexity, size, and potential effect of the NAS change or existing safety issue. Figure 3.1 provides a high-level depiction of the key steps, decision points, and outputs of the SRM process.

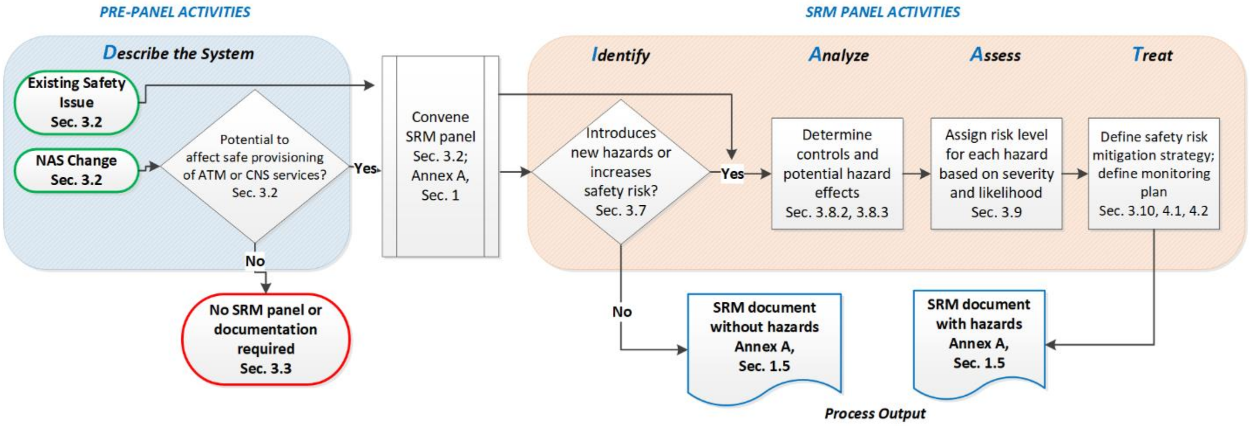

PRE-PANEL ACTIVITIES
SRM PANEL ACTIVITIES
Describe the System
Existing Safety Issue Sec. 3.2
NAS Change Sec. 3.2
Potential to affect safe provisioning of ATM or CNS services? Sec. 3.2
Yes
No
No SRM panel or documentation required Sec. 3.3
Convene SRM panel Sec. 3.2; Annex A, Sec. 1
Identify
Analyze
Assess
Treat
Introduces new hazards or increases safety risk? Sec. 3.7
Yes
No
Determine controls and potential hazard effects Sec. 3.8.2, 3.8.3
Assign risk level for each hazard based on severity and likelihood Sec. 3.9
Define safety risk mitigation strategy; define monitoring plan Sec. 3.10, 4.1, 4.2
SRM document without hazards Annex A, Sec. 1.5
SRM document with hazards Annex A, Sec. 1.5
Process Output

Figure 3.1: SRM Process

3.2 When to Perform SRM

SRM is most frequently performed in response to a NAS change. NAS changes may be proposed and initiated as part of implementation plans for new/modified air traffic procedures, operations, or NAS equipment, or in response to existing safety issues currently in the NAS. For the ATO, a **NAS change** is a modification to any element of the NAS that pertains to, or could affect, the provision of air traffic management and/or communication, navigation, and surveillance services. Air traffic controllers and technicians, their training, and their certification are elements of the NAS and directly relate to the provision of air traffic services.

In some cases, SRM is performed in response to a request to take action on an existing safety issue. **Existing safety issues** are existing contributing factors or findings that led to, or could lead to, an unsafe outcome. Requests for action to address such issues may be proposed and initiated as part of a Safety Assurance function. This is usually a result of Quality Assurance, audits, or assessments. If a request to take action on an existing safety issue is received, SRM must be performed.

Though not all NAS changes will require SRM, the decision and justification to forgo performing SRM is a safety decision. If there is uncertainty as to the appropriate path to take, contact a Safety and Technical Training (AJI) Safety Case Lead (SCL) for assistance. The following list presents NAS changes[1] that will require SRM. It is important to note that this does not constitute a complete list or explanation of all NAS changes that require SRM.

- Operational/procedural changes or waivers that are not defined in an existing order (e.g., flight trials, tests, demonstrations, and prototypes that are live in the NAS)
- Any waiver or change to an order, if the order implements a procedure that, when followed, could affect the provision of air traffic services
- Introduction of new types of navigation procedures into the NAS
- Changes to separation minima (refer to the ATO Safety Guidance (ATO-SG) ATO-SG-15-05, *Safety and Technical Training Guidance on Separation Minima*)
- Addition, modification, closure, or removal of an airport, runway, or taxiway; airport building construction; and lighting changes

  Note: Many of the changes that fall into this category are proposed and sponsored by the Office of Airports (ARP); ARP Safety Management System (SMS) requirements are documented in Federal Aviation Administration (FAA) Order 5200.11, *FAA Airports (ARP) Safety Management System*. The ATO must remain vigilant to ensure the SRM process is conducted on construction projects to maintain continued compliance with air traffic procedures and operations.
- New NAS systems used in Air Traffic Control (ATC) or pilot navigation (or new uses for such existing systems), regardless of their applicability to the FAA Acquisition Management System (AMS)
- System Support Directives that introduce new requirements and/or change requirements for risk-assessed operational systems/equipment in the NAS, such as:
  - Communication, navigation, and surveillance systems
  - Weather products/services
  - Displays
  - Alerting and advisory systems
  - Service provider equipment (e.g., the Automatic Dependent Surveillance–Broadcast (ADS-B) system and FAA Telecommunications Infrastructure)
  - Local adaptations (e.g., resulting from a Program Trouble Report)
  - Decision support tools

[1] Do not use the SRM process to address editorial or administrative changes.

- System Support Directives that are built with different levels of rigor (e.g., development assurance levels) than what was required during initial acquisition-level SRM
- Changes to system certification and maintenance standards, requirements, and practices (e.g., technical handbooks)
- Before NAS equipment, procedures, systems, or services are removed, discontinued, deactivated, or decommissioned from the NAS
- Site adaptations, if the acceptable technical limits for such adaptations are not defined in the system-level SRM work approved prior to the In-Service Decision, or if such limits are to be exceeded
- ATC facility changes, including:
    - Tower siting or relocation
    - Facility relocation
    - Cab replacement or redesign
    - Permanent consolidation or de-consolidation of facilities
    - Facility split
    - Temporary tower
- All charting specification changes prior to submission to the Interagency Air Committee for final signature (e.g., symbology, color changes in routes, and route identifiers)
- Airspace changes, including routes, airways, and sectors, and the addition or deletion of a position or sector
- Changes to policies, procedures, or NAS equipment for which training exists
- Removal of or modifications/waivers to existing national and/or local training requirements that could affect the NAS or NAS operations, except for the purposes of individual performance management
- Establishment of or modifications to Technical Training, AJI-2, orders, architecture, and curricula
- If conditions of the assumptions change in any way during the SRM process, initial risk must be reassessed
- When an emergency modification is necessary[2]

3.3 When SRM May Not Be Required

Some NAS changes do not require SRM. The change proponent must use the criteria in this section and Section 3.2 to make this determination.

SRM does not need to be performed for NAS changes that are compliant with policies/processes that have undergone SRM and have been documented with approval by the appropriate management official. If these policies or procedures are changed, or if any NAS change deviates from these policies or procedures, SRM must be performed to manage the safety risk. Note that editorial and administrative changes (i.e., any changes that do not affect the substantive elements of a procedure or system) do not require SRM.

[2] See Section 3.7.3.3 for more information on emergency modifications.

FAA and/or ATO documents (e.g., policies, directives, manuals, Standard Operating Procedures (SOPs), Letters of Agreement, and Letters of Procedure) for developing and implementing many routine and repeatable NAS changes could be considered compliant with the ATO SMS, meaning that SRM was performed, documented, and approved. For example, routine procedures such as flight inspections are conducted in accordance with FAA Order 8200.1, *United States Standard Flight Inspection Manual*. If there are no changes to those procedures, then SRM is not required. However, if there is a change to the frequency of flight inspections, SRM is required.

Modifications made to systems to meet initial operational specifications (e.g., Problem Trouble Reports) may not require additional SRM if the system specifications have previously undergone SRM. The modification and testing processes must also be compliant with the SMS.

3.3.1 Examples of NAS Changes Unlikely to Require SRM

The following list presents NAS changes that will likely not require SRM. It is not a complete list or explanation of all NAS changes that do not require SRM.

- Facility layout/redline/end-state drawings (e.g., Air Route Surveillance Radar (ARSR), Airport Traffic Control Tower (ATCT), Terminal Radar Approach Control Facility, or Air Route Traffic Control Center (ARTCC)), as identified in the Configuration Control Board Charter, Appendix A
- System Support Directives that do not change requirements and have followed AMS development assurance processes
- Changes to directives for those directives with no safety functionality
- Installation or moving of equipment if defined installation siting processes are not violated
- Maintenance actions, as specified in maintenance technical handbooks

Contact the Safety Engineering Team, AJI-314, Manager via the ATO SMS mailbox for assistance determining if SRM is required.

3.4 NAS Change Proposals

The configuration management requirements from the NAS Change Proposal (NCP) process may not specifically relate to safety effects. When a NAS change covered by an NCP requires SRM, the appropriate documentation must be included in the material provided to the Configuration Control Board. In terms of SRM, an NCP can be categorized as one of the following:

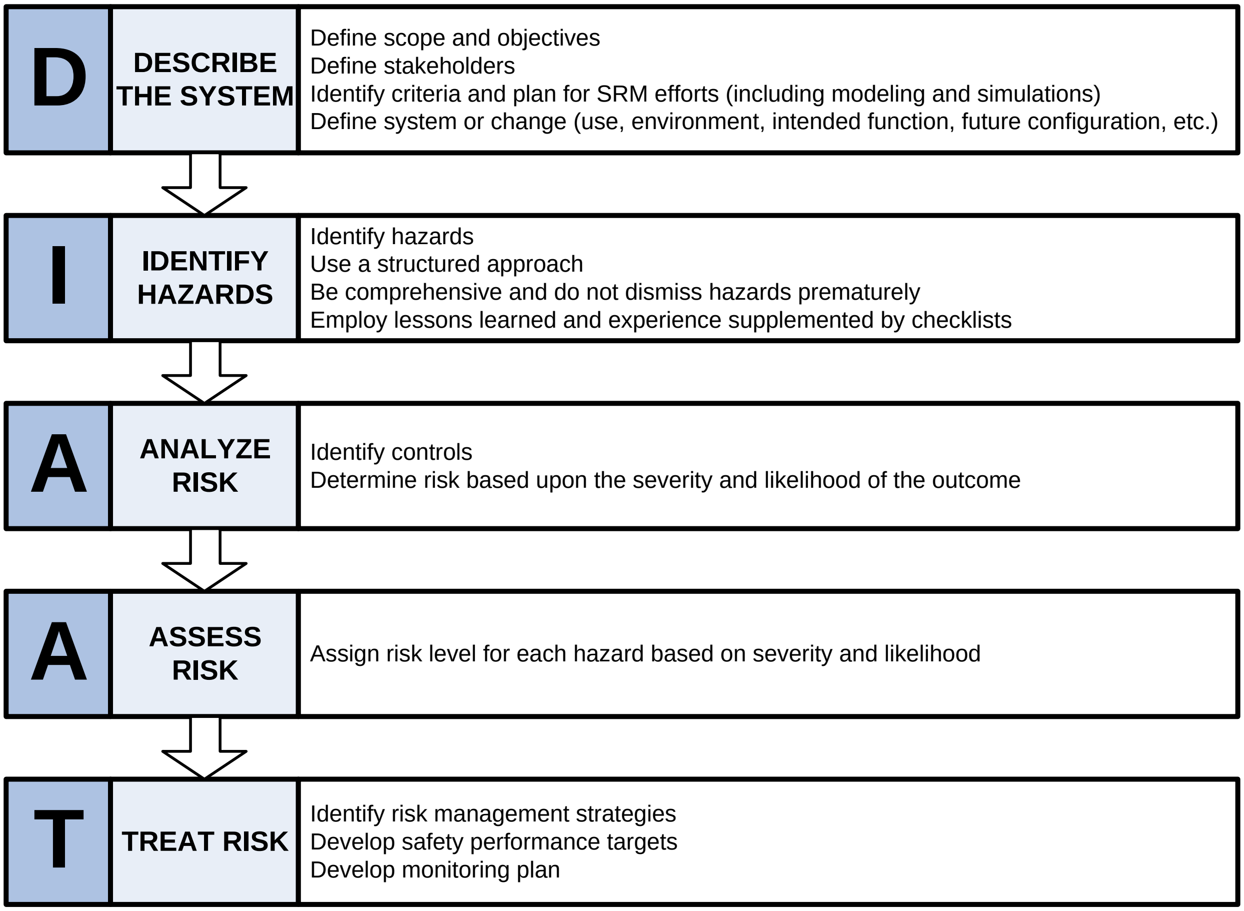
- Does not require SRM
- Requires SRM (refer to Annex A)

For more information on NCPs, refer to FAA Order 1800.66*, Configuration Management Policy*.

For information on SRM for technology refreshment portfolios, see the Safety Risk Management Guidance for System Acquisitions (SRMGSA).

3.5 SRM Process Phases

SRM is composed of a five-phase process called the DIAAT, presented in Figure 3.2. The DIAAT phases are described in detail in Section 3.6 through Section 3.10.



D
DESCRIBE THE SYSTEM
Define scope and objectives
Define stakeholders
Identify criteria and plan for SRM efforts (including modeling and simulations)
Define system or change (use, environment, intended function, future configuration, etc.)

I
IDENTIFY HAZARDS
Identify hazards
Use a structured approach
Be comprehensive and do not dismiss hazards prematurely
Employ lessons learned and experience supplemented by checklists

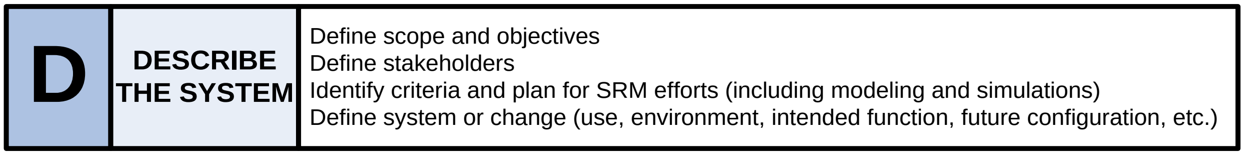
A
ANALYZE RISK
Identify controls
Determine risk based upon the severity and likelihood of the outcome

A
ASSESS RISK
Assign risk level for each hazard based on severity and likelihood

T
TREAT RISK
Identify risk management strategies
Develop safety performance targets
Develop monitoring plan

Figure 3.2: DIAAT Process

3.6 DIAAT Phase 1: Describe System



D
DESCRIBE THE SYSTEM
Define scope and objectives
Define stakeholders
Identify criteria and plan for SRM efforts (including modeling and simulations)
Define system or change (use, environment, intended function, future configuration, etc.)

3.6.1 Overview

As discussed in Section 3.2, NAS changes may be proposed and initiated as part of implementation plans for new or modified air traffic procedures, operations, or NAS equipment, or in response to existing safety issues in the NAS. As part of any pre-SRM panel activities and any follow-on SRM panel activities, it is important to develop a detailed description of the NAS change and/or current system and its affected elements.

Note: SRM for mitigations to existing hazards that were identified through safety audits or post-event safety risk analyses should use the event or situation that led to the realization of the hazard’s effect(s) as the basis for the documented system description. Use this section as guidance, but refer to Section 3.7.3 for further information.

3.6.2 Bounding SRM in an Integrated NAS

Bounding refers to the process of limiting the analysis and assessment of a change or system to only the elements that affect or interact with each other to accomplish the central function of that change or system. In many cases, there may be a limited or incomplete understanding of the air traffic environment in which the NAS equipment, operation, or procedure will be employed, or the interconnected systems with which the changing system must be integrated for effective operation. Furthermore, the scope for other associated NAS equipment, operations, or procedures may be unknown. Thus, it becomes difficult to ensure that there are no gaps across the boundaries of the change or system. As a result, the scope may be inadvertently set at an inappropriate level.

In light of these potential difficulties, the scope must be set such that gaps are eliminated. As systems become increasingly more complex, interactive, and interrelated, the analysis and assessment of potential safety risk must be integrated temporally, by domain, and across locations. Figure 3.3 provides a visual representation of this integration. Where time is concerned, it is important to consider whether potential safety risk mitigations implemented in the short term will be adequate years into the future when other systems are introduced in the NAS, or whether other follow-on mitigations will negate the effect of those implemented in the past.

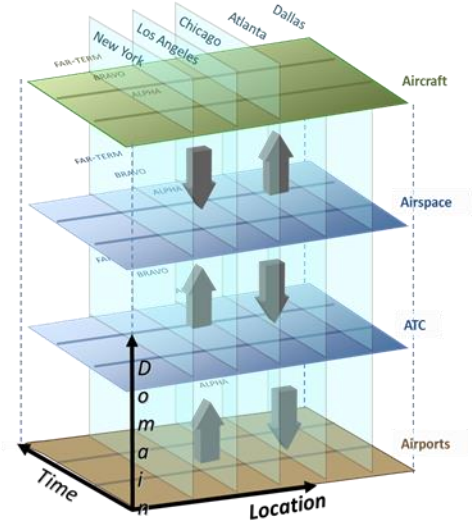


Figure 3.3: The Complex Integration Aspects of a Capability

Figure 3.4 depicts the potential scope and level of SRM required based on the potential impact and scope of the NAS change. The lowest-tiered SRM focuses on identifying hazards associated with individual projects/programs and individual changes to the NAS that are often associated with new system acquisitions. The middle tier is the capability level. Examples of capabilities include Performance Based Navigation, Surface Operations, or Data Communications. Here, system safety risk analyses and assessments become more complex, considering multiple combinations of dependent functions. The top tier represents high-level SRM activities associated with service levels and/or domains to reflect a strategic view of safety across the NAS. Safety management at this level is more static in nature (i.e., essentially non-recurring system safety engineering). It employs high-level functional hazard analyses to identify NAS-level hazards and safety requirements that flow down vertically to the other-tiered levels.

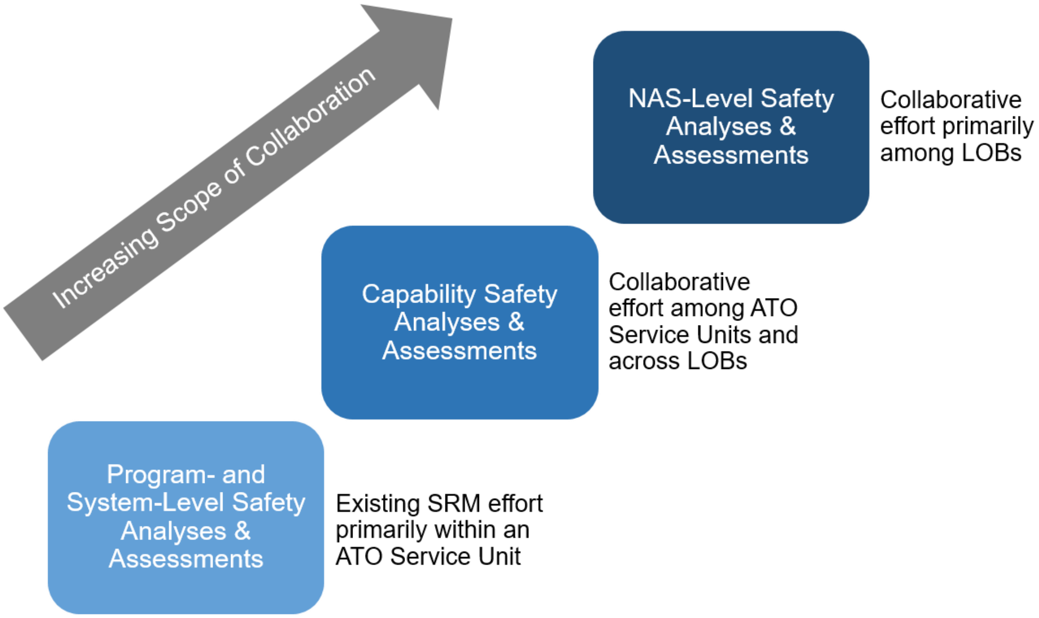

Increasing Scope of Collaboration
NAS-Level Safety Analyses & Assessments
Collaborative effort primarily among LOBs
Capability Safety Analyses & Assessments
Collaborative effort among ATO Service Units and across LOBs
Program- and System-Level Safety Analyses & Assessments
Existing SRM effort primarily within an ATO Service Unit

Figure 3.4: Three Tiers of Integrated Safety Management

3.6.3 Depth and Breadth of the NAS Change or Existing Safety Issue

In general, SRM for more complex and far-reaching NAS changes or existing safety issues will require a greater scope and more detail. When evaluating a NAS change or existing safety issue, consider any potential effects on organizations outside the ATO (e.g., Aviation Safety and ARP). Consider the following factors:

- **The depth of the NAS change or existing safety issue.** The complexity and nature (i.e., operational or system acquisition) of the NAS change will dictate the type and number of analyses or assessments required.
- **The breadth of the NAS change or existing safety issue.** The scope of SRM will require additional details when the NAS change affects more than one organization or Line of Business (LOB).

3.6.4 Involving Other FAA LOBs

When ATO SRM impacts FAA LOBs and/or organizations outside the ATO, the provisions and guidance in FAA Order 8040.4, *Safety Risk Management Policy*, apply. Refer to Section 3.7.7 for information on coordinating and addressing safety issues. Refer to Section 5.4.1 and Section 5.4.2 for discussion on cross-LOB risk acceptance.

3.6.5 Setting the Scope of Individual SRM Analyses and Assessments

Guidelines to help determine the scope of individual SRM analyses and assessments include:

- Having a sufficient understanding of system boundaries, including interfaces with peer systems, larger systems of which the system is a component, and users and maintainers;

- Determining the system elements that interact or sub-system components that may be affected; and
- Limiting the system to those elements that affect or interact with each other to accomplish the mission or function.

When setting the scope of individual SRM analyses and assessments:

- Define the relationships/interactions of the NAS change.
- Identify temporal aspects of these relationships/interactions.
- Collect safety documentation that has determined the building blocks of the NAS change.
- Set the scope wide enough to determine the aggregated risk and address any gaps.

3.6.6 Describing the System / NAS Change

System descriptions need to exhibit two essential characteristics: correctness and completeness. Correctness means that the description accurately reflects the system without ambiguity or error. Completeness means that nothing has been omitted and that everything stated is essential and appropriate.

The system description provides information that serves as the basis for identifying all hazards and associated safety risks. The system/operation must be described and modeled in sufficient detail to proceed to the hazard identification stage of the DIAAT process. For example, modeling might entail creating a functional flow diagram to help depict the system and its interface with the users, other systems, or sub-systems.

As discussed, the system is always a component of some larger system. For example, even if the change encompasses all services provided within an entire ARTCC, that ARTCC can be considered a subset of a larger body of airspace, which in turn is a subset of the NAS.

Complex NAS changes may require a detailed system description that includes numerous charts, drawings, design descriptions, and/or narratives. Simple NAS changes may only require one or two paragraphs describing the system and NAS change. The description must be clear and complete before continuing the SRM process. Questions to consider include:

- What is the purpose of the NAS change?
- What issue is necessitating the NAS change?
- How will the change be used / function in the NAS?
- What are the boundaries and external interfaces of the NAS change or system?
- In what environment will the system or NAS change operate?
- How is the system or NAS change interconnected/interdependent with other systems?
- How will the NAS change affect system users/maintainers?
- If the NAS change is a waiver/renewal, how could other waivers in effect interact with it?

The following are examples of information to consider when describing the system:

- Average annual approaches to each runway
- Fleet mix

- Number and type of airport operations
- Number of aircraft controlled (ground, pattern, and transitions)
- Number of hours the airport operates and number of aircraft controlled under Visual Flight Rules (VFR) versus Instrument Flight Rules (IFR)
- Availability and reliability of both hardware and software

Section 7 identifies sources of data to use in SRM.

Once the system elements are listed, a careful review of the NAS change description should be conducted. A bounded system limits the analysis and assessment to the components necessary to adequately determine the safety risk associated with the NAS change, system, and/or operation. When there is doubt about whether to include a specific element in the analysis, it is preferable to include that item, even though it might prove irrelevant during the hazard identification phase.

3.6.6.1 5M Model Method

The 5M Model can be used to capture the information needed to describe the system and aid in hazard identification. The 5M Model uses a Venn diagram to depict the interrelationships among its five elements, as seen in Figure 3.5. To adequately bound and describe a system, it is important to understand the relationships between the elements of the 5M Model.

The 5M Model illustrates five integrated elements that are present in any system:

- **Mission:** The clearly defined and detailed purpose of the proposed NAS change or system/operation
- **(hu)Man/Person:** The human operators, maintainers, and affected stakeholders
- **Machine:** The equipment used in the system, including hardware, firmware, software, human-to-system interfaces, system-to-system interfaces, and avionics
- **Management:** The procedures and policies that govern the system’s behavior
- **Media:** The environment in which the system is operated and maintained

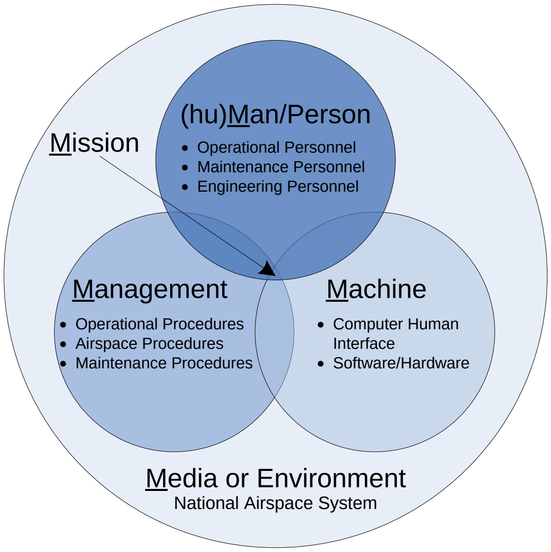


Figure 3.5: 5M Model

The 5M Model and similar techniques are used to deconstruct the proposed NAS change in order to distinguish elements that are part of or affected by the proposed NAS change. These elements later help to identify sources, causes, hazards, and current and proposed risk mitigation strategies.

3.7 DIAAT Phase 2: Identify Hazards

I	**IDENTIFY HAZARDS**	Identify hazards Use a structured approach Be comprehensive and do not dismiss hazards prematurely Employ lessons learned and experience supplemented by checklists

3.7.1 Overview

During the hazard identification phase, identify and document hazards, their possible causes, and corresponding effects. This phase is required to determine the appropriate means to address any safety risks associated with a NAS change or existing safety issue. A **hazard** is defined as any real or potential condition that can cause injury, illness, or death to people; damage to or loss of a system, equipment, or property; or damage to the environment. A hazard is a prerequisite to an accident or incident.

The following resources and methods can be used to identify hazards:

- The safety analysis that accompanies the proposed implementation of a new or modified operation, process, or piece of NAS equipment;
- Air Traffic Safety Action Program and Technical Operations Safety Action Program reports;
- Air Traffic Safety Oversight Service (AOV) compliance audits;

- Aviation Risk Identification and Assessment (ARIA);[3]
- National Transportation Safety Board safety recommendations;
- ATO Audits and Assessments;
- Audits performed as part of facility-level Quality Control efforts or AJI Quality Assurance efforts; and
- Reports of unsafe conditions in daily operations.

Refer to Section 6 for information about the various audit and reporting programs and tools.

3.7.2 Potential Sources of Hazards

The hazard identification stage considers all possible causes of hazards. The use of previous hazard analyses when identifying hazards is important, as it provides consistency in SRM and can reduce the time needed to identify hazards. For example, approved SRM documents on similar NAS changes or earlier integrated assessments, including applicable cross-organizational safety assessments and Independent Operational Assessments (IOAs), may be useful. Refer to Section 6 for information on IOAs.

Depending on the nature and size of the system under consideration, the causes may include:

- NAS equipment failure/malfunction,
- Operating environment (including physical conditions, airspace, and air route design),
- Human operator failure/error,
- Human-machine interface problems,
- Operational procedures limitations/design,
- Maintenance procedures limitations/design, and/or
- External services.

3.7.3 Existing Hazards

An existing hazard is any hazard that is currently in the NAS. Existing hazards often fall into the following categories.

3.7.3.1 Hazards Identified but Not in the Scope of an Ongoing NAS Change

These hazards must typically be addressed through a separate, follow-on safety analysis performed by the organization deemed responsible. An AJI SCL can assist in determining which organization should be notified about the existing hazard(s) identified.[4]

3.7.3.2 Hazards Identified by Audits

When an audit identifies a potential safety issue, the issue must be addressed. Refer to FAA Order JO 2900.2, *Air Traffic Organization Audits and Assessments*.

3.7.3.3 Emergency Modifications

There may be unusual, unforeseen, or extraordinary issues or conditions that require the implementation of hardware or software solutions in a timeframe that does not allow proceeding

[3] FAA Order JO 7210.633, *Air Traffic Organization Quality Assurance (QA)*, removed Risk Analysis Events (RAEs) and Risk Analysis Process (RAP), the process for notification and interviews associated with RAE. Any references to RAEs or RAP in this SMS Manual are for research and historical purposes only.

[4] AJI SCLs are experts in SMS policy and guidance that pertain to the ATO. Refer to the SRMGSA for a description of their roles and responsibilities.

through the formal SRM process. Emergency modifications are temporary fixes installed to maintain continuity of air navigation, air traffic control, communications, or support services during unusual or emergency conditions. Such NAS changes may result from unforeseen natural occurrences, a lack of replacement parts, software patches, or real-time situations that require immediate action. Refer to FAA Order 6032.1, *National Airspace System (NAS) Modification Program*, for more information on emergency modifications.

A memorandum must be sent to the Director of Policy and Performance, AJI-3, within two days of the implementation of the modification.[5]

The memorandum must:

- State what system was modified,
- Provide a summary of the emergency modification,
- Identify why the modification was made, and
- Indicate when the safety risk assessment will be conducted.

The official who authorized the emergency modification must ensure that SRM is performed in accordance with the ATO SMS Manual within 30 days of the implementation of the modification. After SRM is completed, a follow-up memorandum must be sent to the AJI-3 Director stating that it has been completed and uploaded to the Safety Management Tracking System (SMTS). The AJI-3 Director must inform AOV and the ATO Chief Operating Officer (COO).

3.7.3.4 Existing High-Risk Hazards

When the AJI-3 Director validates an existing hazard as high risk, they must notify the ATO COO and AOV of the high risk and the interim actions needed to mitigate the risk. The ATO COO must approve the interim action and accept the associated risk or require the operation to be stopped. The responsible Service Unit must coordinate with the AJI-3 Director to address the risk and any potential corrective actions.

Thirty calendar days after the notification is sent to the ATO COO and AOV, the responsible Service Unit must coordinate with the AJI-3 Director to develop a permanent plan that will eliminate the hazard or reduce the risk to an acceptable level and provide that plan to AJI. The plan must include:

- A description of the hazard and system state,
- The severity and likelihood of the high risk,
- Data or empirical evidence that justifies the determination that a high-risk hazard exists,
- Safety requirements or a decision to cease the operation,
- A schedule to complete an SRM document in accordance with this SMS Manual, and
- An approval signature by the Vice President of each responsible/affected Service Unit.

Cessation is viable if the prescribed means are inadequate to reduce the risk to an acceptable level. In some cases, though, cessation of the operation may not be the safest means to mitigate the risk. There could be unintended consequences that result in more potential harm or increase system safety risk.

[5] The AJI-3 Director provides leadership and expertise to ensure that operational safety risk in the air traffic services that the ATO provides is identified and managed. They also ensure that safety risk is considered and proactively mitigated in the early development, design, and integration of solutions.

The Service Unit must forward the plan with a memorandum via its Vice President to the Vice President of AJI for approval and copy the AJI-3 Director, who will then forward the memorandum to AOV. AJI will notify AOV of any subsequent changes to the approved plan. The hazard must be documented in an SRM document that is written in accordance with this SMS Manual and uploaded to SMTS within 30 calendar days of the implementation of the final safety requirements. The responsible Service Unit must adhere to the SRM documentation approval and risk acceptance requirements documented in this SMS Manual.

3.7.4 Elements of Hazard Identification

When considering new NAS equipment and procedures or planned modifications to current NAS equipment and procedures, define the data sources and measures necessary to identify hazards. The elements of a thorough system description contain the potential sources of hazards associated with the proposed NAS change. There are numerous ways to do this, but all require at least three elements:

- Operational expertise that relates specifically to the operation or equipment,
- Training or experience in various hazard analysis techniques, and
- A defined hazard analysis tool.

3.7.4.1 Tools and Techniques for Hazard Identification

In many cases, to identify safety hazards, a Preliminary Hazard List (PHL) and the required Hazard Analysis Worksheet (HAW) will suffice. If an additional means to identify hazards and compare solutions is required, select the methodology that is most appropriate for the type of system being evaluated. The Service Center and/or an AJI SCL can provide additional guidance on which tool(s) to use for various types of NAS changes.

When selecting hazard identification/analysis tools, it is important to consider:

- The necessary information and its availability;
- The timeliness of the necessary information;
- The amount of time required to conduct the analysis; and
- The tool that will provide the appropriate systematic approach for:
  - Identifying the greatest number of relevant hazards,
  - Identifying the causes of the hazards,
  - Predicting the effects associated with the hazards, and
  - Assisting in identifying and recommending risk management strategies.

Table 3.1: Hazard Identification Tools and Techniques

Analysis Tool/Technique	Summary Description
PHL / What-If Analysis	The PHL / What-If Analysis methodology identifies hazards, hazardous situations, or specific accident events that could produce an undesirable consequence. One can use the PHL / What-If Analysis as a brainstorming method. The PHL / What-If Analysis may be a combination of hazards, causes, effects, and system states. The items listed in the PHL / What-If Analysis all have the potential to be placed into the HAW.
Failure Mode and Effect Analysis	The Failure Mode and Effect Analysis determines the results or effects of sub-element failures on a system operation and classifies each potential failure according to its severity.

Analysis Tool/Technique	Summary Description
Failure Modes, Effects, and Criticality Analysis	The Failure Modes, Effects, and Criticality Analysis is an essential function in design from concept through development. The Failure Modes, Effects, and Criticality Analysis is iterative to correspond with the nature of the design process itself. It identifies component and sub-system failure modes (including the effect of human error), evaluates the results of the failure modes, determines rates and probability, and demonstrates compliance with safety requirements.
Fault Hazard Analysis	The Fault Hazard Analysis is a deductive method of analysis that can be used exclusively as a qualitative analysis or, if desired, can expand to a quantitative one. The Fault Hazard Analysis requires a detailed investigation of sub-systems to determine component hazard modes, causes of these hazards, and resultant effects on the sub-system and its operation.
Fault Tree Analysis	A Fault Tree Analysis is a graphical design technique that can provide an alternative to block diagrams. It is a top-down, deductive approach structured in terms of events. It is used to model faults in terms of failures, anomalies, malfunctions, and human errors.
Job Task Analysis	The foundation of the performance of a Human Error Analysis is a Job Task Analysis, which describes each human task and subtask within a system in terms of the perceptual (information intake), cognitive (information processing and decision-making), and manual (motor) behaviors required of an operator, maintainer, or support person. The Job Task Analysis should also identify the skills and information required to complete tasks; equipment requirements; the task setting, time, and accuracy requirements; and the probable human errors and consequences relating to these areas. There are several tools and techniques for performing task analyses, depending on the level of analysis needed.
Operational Hazard Assessment (OHA)	The OHA is a qualitative severity assessment of the hazards associated with the system. The OHA includes tabular worksheets and the PHL.
Scenario Analysis	The Scenario Analysis tool identifies and corrects potentially hazardous situations by postulating accident scenarios in cases where it is credible and physically logical to do so.

3.7.5 Developing a HAW

When hazards are identified, the **HAW** is required as part of the ATO SRM process.[6] It is a tool used to provide an initial overview of the hazard's presence in the overall flow of the operation and is used both for Operations and Second-Level Engineering. When developing the HAW, it is crucial to consider the hazards inherent to all aspects of an operation without regard to risk. ATO safety professionals use the HAW in nearly all risk management applications, except in the most time-critical situations.

Using the HAW helps panels overcome the tendency to focus on safety risk in one aspect of an operation and overlook more serious issues elsewhere in the operation. Its broad scope guides the identification of issues that may require analysis and assessment with more detailed hazard identification tools. Refer to Annex A for a description of the expected contents of the HAW.

[6] All SRM documentation (with the exception of the PSP, Operational Safety Assessment (OSA), the Comparative Safety Assessment, and SSAR) requires the use of a HAW. Worksheets specific to these documents are contained in the SRMGSA.

3.7.6 Causes and System State Defined

Identify and document potential safety issues, their possible causes, and the conditions under which the safety issues are revealed (i.e., the system state).

A **cause** is the origin of a hazard. Causes are events occurring independently or in combination that result in a hazard. Causes include, but are not limited to, human error, latent failure, active failure, design flaw, component failure, and software error.

A **system state** is the expression of the various conditions, characterized by quantities or qualities, in which a system can exist. It is important to capture the system state that most exposes a hazard, while remaining within the confines of any operational conditions and assumptions defined in existing documentation. **Assumptions** are conclusions based on the presumed condition of a system or system state—not documented facts, desired outcomes, or mitigations. The system state can be described using a combination of, but not limited to, the following terms:

- **Operational and Procedural:** VFR versus IFR, simultaneous procedures versus visual approach procedures, etc.
- **Conditional:** Instrument Meteorological Conditions (IMC) versus Visual Meteorological Conditions (VMC), peak traffic versus low traffic, etc.
- **Physical:** Electromagnetic environment effects, precipitation, primary power source versus back-up power source, closed runways versus open runways, dry runways versus contaminated runways, environmental conditions, etc.

Risk analyses and assessments must consider all possibilities while allowing for all system states. During the SRM process, the SRM panel must consider the probability of the identified system state(s) when determining the likelihood of a hazard's effect(s) and use that determination consistently throughout the analysis. Any given hazard may have a different risk level in each possible system state.

3.7.7 Addressing Hazards that Cross FAA LOBs

FAA Order 8040.4 provides risk management policy to follow when hazards, risks, and associated SRM affect multiple LOBs. The ATO must consider and, when necessary, use the provisions in this order when coordinating SRM with other FAA organizations. AJI will function as the ATO liaison to interface with organizations outside of the ATO when the provisions of FAA Order 8040.4 are invoked.

3.7.8 Hazard Escalation and Reporting

There may be cases in which the ATO and another FAA organization disagree on key issues surrounding a NAS change. The AJI-3 Director and the Safety Management Group, AJI-31, Manager must be made aware of such NAS changes and must work to determine the appropriate course of action. The AJI-3 Director will determine whether such hazards and issues need to be elevated to an FAA-level mediation process facilitated by the FAA SMS Committee.

For more information, refer to the FAA SMS Hazard Escalation Reporting Process.

3.8 DIAAT Phase 3: Analyze Risk

A	ANALYZE RISK	Identify controls Determine the severity and likelihood of the hazard’s effect

3.8.1 Overview

An accident or incident rarely results from a single failure or event. Consequently, risk analysis is seldom a binary (e.g., on/off, open/closed, or broken/operational) process. Risk analyses can identify failures from primary, secondary, or even tertiary events.

During the risk analysis phase:

- Evaluate each hazard (identified during the “Identify Hazards” phase) and the system state (from the “Describe the System” and “Identify Hazards” phases) to determine the controls,
- Analyze how the operation would function should the hazard occur, and
- Determine the hazard’s associated severity and likelihood and provide supporting rationale.

3.8.2 Controls

A **control** is any means currently reducing a hazard’s causes or effects. Policies, procedures, hardware, software, or other tools can only be considered controls if they are part of the operating NAS and have demonstrated effectiveness. Understanding controls affects the ability to determine credible effects. Certain controls may only be in place in certain operating environments or under certain system states. Do not document safety requirements as controls; safety requirements are planned or proposed ways to reduce risk. Refer to Section 3.10.3 for information about documenting safety requirements.

Provide supporting data and/or a rationale that confirms the control’s use, applicability, and availability related to the hazard. For instance, if orders are identified as controls, cite the specific version, paragraph, and/or section number(s). Alternatively, if equipment is identified as a control, discuss how it reduces or manages the risk. Only document the controls associated with the NAS change under evaluation. When considering existing hazards identified through safety audits or post-event risk analyses, consider any control(s) that either minimized the hazard’s effect or failed.

Table 3.2 provides broad examples of controls. This is not a comprehensive list of controls; each identified control should be directly applicable to the hazard being addressed.

Table 3.2: Examples of Controls

Controller	Pilot	Technical Operations
• Radar surveillance - Ground and airborne • Controller scanning - Radar - Visual (out window) • Conflict Alert, Minimum Safe Altitude Warning, Airport Movement Area Safety System (AMASS) • Procedures - Specific SOP reference - Order reference • Triple redundant radio • Controller intervention • Management oversight • Completed training	• Traffic Collision Avoidance System (TCAS) • Ground Proximity Warning System • Visual scanning (out window) • Radar surveillance • Checklists • Redundancies / back-up systems • Pilot intervention (evasive action)	• Preventive maintenance • Failure warnings / maintenance • Alerts • Redundant systems - Triple redundant radio - Software redundancy • Diverse points of delivery • Fall-back systems - Center radar processing • Software/hardware designs

3.8.3 Determining a Credible Hazard Effect

Effect refers to the real or credible harmful outcome that has occurred or can be expected to occur if the hazard occurs in the defined system state. A single hazard can have multiple effects. **Credible** means that it is reasonable to expect that the assumed combination of conditions that define the system state will occur within the operational lifetime of a typical ATC system (i.e., 30 years) Credible effects should be determined with respect to controls. Document all identified credible effects.

Often, there is confusion when distinguishing the *possible* effects of a hazard from the *credible* effects; possible is not necessarily the same as credible. The credibility of an effect is a nuanced and key consideration in the analysis. A thorough understanding of this concept can save time in determining the risk level of a specific hazard. When determining the credibility of the effect, it is important to:

- **Recall and Understand the Defenses in Depth Model.** It is well established that incidents and accidents cannot typically be attributed to a single failure, or even to a single individual. Rather, aviation safety issues are the end result of a number of failures (causes or failures). Based on this model (see Section 2.5.1), it is critical to consider the defenses that already exist in the NAS when deciding the credibility of an effect.
- **Review History.** Check the historical record. Have there been similar NAS changes? What happened? How does the experience gained from the activities affect the credibility of the outcomes that have been identified for the NAS change?
- **Rely on Quantitative Data.** Section 3.8.4.3.3 and Section 3.8.4.3.4 discuss the use of quantitative and qualitative data, respectively. Do the quantitative data support the credibility of the outcomes identified? If so, the hazard severity determination can be based on statistical data, and the determinations of the SRM panel members will be more objective. Section 7 provides additional information about the aviation safety databases available for gathering data.

- **Visualize the Occurrence of the Accident or Incident.** Put the hazard in its proper context within the given system state and determine the sequence of events (causes) that could lead to the worst credible outcome. Given that the ATO strives to build error-tolerant systems (in accordance with the Defenses in Depth Model), consider how many controls (redundancies, procedures, warning devices, equipment, etc.) would have to fail for an identified hazard to breach every defense to result in a catastrophic event. Is it credible to expect that the necessary combination of extreme conditions will simultaneously occur within the operational lifetime of the system?

3.8.4 Defining Risk

3.8.4.1 How to Define and Determine Risk

Risk is the composite of predicted severity and likelihood of the potential effect of a hazard. While the worst credible effect may present the highest severity, the likelihood of this effect is often very low. A less severe effect may occur more frequently and therefore present a higher overall risk than the more severe effect. The ways to reduce the risk for the two effects may be different, and both must be identified. Consider all credible effects and their associated risks in order to identify the highest risk for the safety hazard.

Attempt to obtain and document objective evidence (e.g., historical evidence of similar NAS changes, testing data, modeling, or simulation results) to support the assessed level of risk. If quantitative data are not available, document the research methods—including the data sources reviewed—in addition to qualitative risk assessments. Because different system states can affect both severity and likelihood in unique ways, determine whether the hazard will exist in several system states and analyze the risk accordingly.

3.8.4.2 Determining Severity

Severity is the consequence or impact of a hazard’s effect or outcome in terms of degree of loss or harm. It is independent of likelihood and must be determined before likelihood is calculated. Determine the severity of each effect, considering the controls while doing so. For each effect, use the severity measure yielding the most conservative estimate (i.e., the highest credible severity). Table 3.3 is the severity table used by the ATO to help determine the severity of a hazard when performing SRM. Provide a rationale for the chosen severity level in the HAW. When a NAS change crosses FAA LOBs, consult with the affected parties; the provisions of FAA Order 8040.4 apply.

Table 3.3: Severity Table

	Hazard Severity Classification *Note: Severities related to ground-based effects apply to movement areas only.*				
	Minimal **5**	**Minor** **4**	**Major** **3**	**Hazardous** **2**	**Catastrophic[4]** **1**
	CONDITIONS RESULTING IN ANY ONE OF THE FOLLOWING:				
ATC Services	A minimal reduction in ATC services Category (CAT) D Runway Incursion (RI)[1] Proximity Event, Operational Deviation, or measure of compliance greater than or equal to 66 percent[2]	Low Risk Analysis Event (RAE) severity, two or fewer indicators fail[3] CAT C RI[1]	Medium RAE severity, three indicators fail[3] CAT B RI[1]	High RAE severity, four indicators fail[3] CAT A RI[1]	Ground collision[5] Mid-air collision Controlled flight into terrain or obstacles
Unmanned Aircraft Systems (UASs)	Minimal injury to those on the ground Loss of UAS control and manned aircraft were not involved	Non-serious injury to three or fewer people on the ground Loss of UAS control and manned aircraft were involved Circumstances requiring a manned aircraft to abort takeoff (i.e., rejected takeoff); however, the act of aborting takeoff does not degrade the aircraft performance capability	Non-serious injury to more than three people on the ground A reduced ability of the crew to cope with adverse operating conditions to the extent that there would be a significant reduction in safety margin Circumstances requiring a manned aircraft to abort takeoff (i.e., rejected takeoff); the act of aborting takeoff degrades the aircraft performance capability Manned aircraft making an evasive maneuver to avoid unmanned aircraft, and the proximity from unmanned aircraft remains equal to or greater than 500 feet	Incapacitation to UAS crew Manned aircraft making an evasive maneuver to avoid unmanned aircraft, and the proximity from unmanned aircraft is less than 500 feet Serious injury to persons other than the UAS crew[7] Proximity of UAS to manned aircraft causing conditions that would prevent continued safe flight and landing of the manned aircraft	A collision with a manned aircraft Fatality or fatal injury to persons other than the UAS crew[8]

	Hazard Severity Classification *Note: Severities related to ground-based effects apply to movement areas only.*				
	Minimal **5**	**Minor** **4**	**Major** **3**	**Hazardous** **2**	**Catastrophic[4]** **1**
	CONDITIONS RESULTING IN ANY ONE OF THE FOLLOWING:				
Flying Public	Minimal injury to persons on board	Physical discomfort to passenger(s) (e.g., extreme braking, clear air turbulence causing unexpected movement of aircraft resulting in injuries to one or two passengers out of their seats) Minor injury to less than or equal to 10 percent of persons on board[6]	Physical distress to passengers (e.g., abrupt evasive action, severe turbulence causing unexpected aircraft movements) Minor injury to greater than 10 percent of persons on board[6]	Serious injury to persons on board[7]	Fatal injuries to persons on board[8]
NAS Equipment (with Table 3.4)	Flight crew inconvenience Slight increase in ATC workload	Increase in flight crew workload Significant increase in ATC workload Slight reduction in safety margin	Large increase in ATC workload Significant reduction in safety margin	Large reduction in safety margin	Collision between aircraft and obstacles or terrain

	Hazard Severity Classification *Note: Severities related to ground-based effects apply to movement areas only.*				
	Minimal **5**	**Minor** **4**	**Major** **3**	**Hazardous** **2**	**Catastrophic[4]** **1**
	CONDITIONS RESULTING IN ANY ONE OF THE FOLLOWING:				
Flight Crew	Pilot is aware of traffic (identified by TCAS traffic alert, issued by ATC, or observed by flight crew) in close enough proximity to require focused attention, but no action is required Pilot deviation[9] where loss of airborne separation falls within the same parameters of a Proximity Event or measure of compliance greater than or equal to 66 percent[2] Circumstances requiring a flight crew to initiate a go-around	Pilot deviation[9] where loss of airborne separation falls within the same parameters of a low RAE severity[3] Reduction of functional capability of aircraft, but overall safety not affected (e.g., normal procedures as per Airplane Flight Manuals) Circumstances requiring a flight crew to abort takeoff (i.e., rejected takeoff); however, the act of aborting takeoff does not degrade the aircraft performance capability Near Mid-Air Collision (NMAC) encounters with separation greater than 500 feet[10]	Pilot deviation[9] where loss of airborne separation falls within the same parameters of a medium RAE severity[3] Reduction in safety margin or functional capability of the aircraft, requiring crew to follow abnormal procedures as per Airplane Flight Manuals Circumstances requiring a flight crew to reject landing (i.e., balked landing) at or near the runway threshold Circumstances requiring a flight crew to abort takeoff (i.e., rejected takeoff); the act of aborting takeoff degrades the aircraft performance capability NMAC encounters with separation less than 500 feet[10]	Pilot deviation[9] where loss of airborne separation falls within the same parameters of a high RAE severity[3] Reduction in safety margin and functional capability of the aircraft requiring crew to follow emergency procedures as per Airplane Flight Manuals NMAC encounters with separation less than 100 feet[10]	Ground collision Mid-air collision Controlled flight into terrain or obstacles Hull loss to manned aircraft Failure conditions that would prevent continued safe flight and landing

Notes:

1. Refer to FAA Order 7050.1, *Runway Safety Program*.
2. Proximity Events and Operational Deviations are no longer used to measure losses of separation, but they are applicable when validating data using those metrics.
3. FAA Order JO 7210.633, *Air Traffic Organization Quality Assurance (QA)*, removed RAEs and the process for notification and interviews associated with RAEs. Any reference to RAEs in this SMS Manual is for research and historical purposes only. RAE severity indicators are as follows:

   a. **Proximity.** Failure transition point of 50 percent or less of required separation.

   b. **Rate of Closure.** Failure transition point greater than 205 knots or 2,000 feet per minute (consider both aspects and utilize the higher of the two if only one lies above the transition point).

   c. **ATC Mitigation.** ATC able to implement separation actions in a timely manner.
   d. **Pilot Mitigation.** Pilot executed ATC mitigation in a timely manner.

4. An effect categorized as catastrophic is one that results in at least one fatality or fatal injury.
5. Ground Collision. An airplane on the ground collides with an object or person.
6. Minor Injury. Any injury that is neither fatal nor serious.
7. Serious Injury. Any injury that:

   a. Requires hospitalization for more than 48 hours, commencing within seven days from the date the injury was received;
   b. Results in a fracture of any bone (except simple fractures of fingers, toes, or nose);
   c. Causes severe hemorrhages, nerve, muscle, or tendon damage;
   d. Involves any internal organ; or
   e. Involves second- or third-degree burns, or any burns affecting more than five percent of the body's surface.

8. Fatal Injury. Any injury that results in death within 30 days of the accident.
9. Refer to FAA Order JO 8020.16, *Air Traffic Organization Aircraft Accident and Aircraft Incident Notification, Investigation, and Reporting*, for more information about pilot deviations*.*
10. NMAC definitions are derived from FAA Order 8900.1, *Flight Standards Information Management System,* Volume 7, Investigation, which defines the following categories: critical, potential, and low potential. Refer to Section 8 for the complete definitions of these categories.

3.8.4.2.1 Determining Severity of NAS Equipment Hazard Effects

SRM must be conducted throughout the AMS lifecycle in accordance with the SRMGSA and AMS policy on the FAA Acquisition System Toolset website. As such, the inherent functional severity of certain NAS equipment hazard effects has been analyzed and assessed.

When performing SRM on NAS equipment that was previously evaluated, it is recommended to use the data, methodology, and results of the previous work as the starting point for the new risk analysis. If there are differences in functionality between the original system and the system undergoing analysis, the differences should be accounted for and documented in the new risk analysis.

In general, NAS equipment can fail such that one of two effects is expected:

- **Loss of Function.** The service is no longer provided.
- **Malfunction.** The service is being provided inaccurately or with diminished integrity.

When identifying functional failures that lead to hazards, the loss of function and the malfunction of constituent parts must be considered. The severity of malfunctions and losses of function from infrastructure systems, such as telecommunications and power systems, is dependent upon the services they support.

Examples of the systems that provide services include, but are not limited to, the following:

Navigation (NAV)

- *Instrument approach systems*: Localizer, glide slope (e.g., visual glide slope indicators, such as Precision Approach Path Indicator and Visual Approach Slope Indicator), Ground-Based Augmentation System, markers, approach lights, Distance Measuring Equipment, Localizer-Type Directional Aid, and Runway Visual Range
- *En Route guidance systems*: Very-High Frequency Omnidirectional-Range Radio, Tactical Air Navigation, Distance Measuring Equipment, and Wide-Area Augmentation System

Communication (COMM)

- *Air-to-ground COMM*: Headsets/microphones, speakers, voice switches, radio control equipment, and radios
- *Ground-to-ground COMM*: Headsets/microphones, speakers, and voice switches

Surveillance

- Automatic Dependent Surveillance – Broadcast (ADS-B), Airport Movement Area Safety System (AMASS), Automated Radar Terminal System (ARTS), Airport Surface Detection Equipment (ASDE), Air Route Surveillance Radar (ARSR), Air Traffic Control Radar Beacon System (ATCRBS), Mode Select Beacon System (MODES), Wide Area Multilateration (WAM), and Standard Terminal Automation Replacement System (STARS)

Weather

- Automated Surface Observing System (ASOS), Automated Weather Observing System (AWOS), Low-Level Wind Shear Alert System, Flight Service Automation System, Operations and Supportability Implementation System, Next Generation Weather Radar, Terminal Doppler Weather Radar, Weather and Radar Processor, and Weather Message Switching Center Replacement

3.8.4.2.2 Using the NAS Equipment Worst Credible Severity Table

When determining the severity of hazards related to NAS equipment, use the “NAS Equipment” row in Table 3.3 in conjunction with Table 3.4. Table 3.4, the NAS Equipment Worst Credible Severity Table, is the starting point for determining severity of NAS equipment. The severity of hazards that result from specific equipment changes may be lower or higher than the worst case presented in Table 3.4 due to the possible controls that limit exposure or the interactions and dependencies that exist with other systems. Losses in equipment functionality and equipment malfunctions may not necessarily be traceable to a loss in separation; therefore, losses of separation should be addressed independently.

The severity levels in Table 3.4 are derived from the operational safety assessments and other documentation produced during initial safety assessments completed as part of the AMS processes that define severity based on the inherent functionality of systems. References to high or low traffic are relative indications during a period of time at any given facility.

Table 3.4: NAS Equipment Worst Credible Severity Table[7]

Service	Functionality	Failure Condition/Hazard	Environment / System State	Effect	Worst Credible Severity/Rating
NAV	Instrument approach guidance	Loss of function	IMC, CAT III, critical phase of flight (i.e., near or immediately after touchdown)	Insufficient reaction time for pilot to execute missed approach	Hazardous Large reduction in safety margin
			IMC, CAT I/II All, CAT III, non-critical phase of flight	Missed approach	Minor Increased flight crew workload
			VMC	Pilot has to take over manual control	Minimal Flight crew inconvenience
		Malfunction	Day, VMC	Hazardously Misleading Information (HMI), missed approach	Minor Increased flight crew workload
			Night, VMC	Pilot penetrates Obstacle Clearance Surface (OCS)	Major Significant reduction in safety margin
			IMC	HMI exceeds monitor limits and penetrates OCS	Catastrophic Collision between aircraft and obstacles
				HMI exceeds monitor limits but does not penetrate OCS	Hazardous Large reduction in safety margin
NAV	Visual Glide Slope Indicators (Precision Approach Path Indicator / Visual Approach Slope Indicator)	Loss of function	Night, VMC	None	No safety effect
		Malfunction	Night, VMC	Pilot penetrates OCS	Major Significant reduction in safety margin
	En route guidance	Loss of function	IMC	Pilot transitions to alternate navigation method	Minor Slight reduction in safety margin

[7] Risk should be determined with regard to its operational impact on the provision of air traffic management and/or communication, navigation, and surveillance services.

Service	Functionality	Failure Condition/Hazard	Environment / System State	Effect	Worst Credible Severity/Rating
		Malfunction	IMC	HMI exceeds minimum en route altitude	Hazardous Large reduction in safety margin
	Runway visual range	Loss of function / malfunction	IMC	Missed approach	Minor Increased flight crew workload
COMM	Air-to-ground	Loss of single frequency	High traffic	Pilots unable to communicate with ATC on that frequency	Major Large increase in ATC workload Significant or slight reduction in safety margin
			Low traffic		Minor Significant increase in ATC workload Slight reduction in safety margin
		Simultaneous loss of multiple frequencies	High traffic	Pilots unable to communicate with ATC on multiple frequencies	Hazardous Large reduction in safety margin
			Low traffic		Major Significant reduction in safety margin
	Ground-to-ground	Loss of function	All	ATC transitions to alternate communication	Minor Significant increase in ATC workload
Surveillance	Aircraft/vehicle position	Loss of function	High traffic	ATC loss of situational awareness	Major Significant reduction in safety margin
			Low traffic		Minor Slight reduction in safety margin
		Malfunction	All	ATC makes decisions based on HMI	Major Significant reduction in safety margin
	Aircraft data	Loss of function	All	ATC loss of ability to differentiate among aircraft	Minor Significant increase in ATC workload

Service	Functionality	Failure Condition/Hazard	Environment / System State	Effect	Worst Credible Severity/Rating
		Malfunction	All	ATC makes decisions based on incorrect aircraft identification information	Major Significant reduction in safety margin
	Alerts	Loss of function	All	ATC not alerted when aircraft exceed established safety parameters	Major Significant reduction in safety margin
		Malfunction	All	False alarms	Minimal Slight increase in ATC workload
	Interfacility data	Loss of function	All	ATC transitions to manual methods	Minor Significant increase in ATC workload
Weather	Adverse weather information (Adverse weather includes wind shear, thunderstorms, icing, IMC, etc.)	Loss of function	All	Adverse weather information reported as unavailable	Minimal Flight crew inconvenience
		Malfunction: failure to detect	All	Adverse weather not reported	Major Significant reduction in safety margin
		Malfunction: false detection	All	Adverse weather falsely reported	Minimal Flight crew inconvenience

3.8.4.3 Determining Likelihood

3.8.4.3.1 Likelihood versus Frequency

Likelihood is defined as the estimated probability or frequency, in quantitative or qualitative terms, of a hazard's effect or outcome. More specifically, the concept of likelihood can be separated into two components: likelihood/probability and frequency. **Frequency** is an expression of how often a given effect occurs; it is a known value determined (for example) by monitoring a hazard and its effects to identify initial, current, or residual risk (see Section 4.3.1 and Section 4.3.4). Conversely, likelihood is an expression of the probability of a hazard's effects occurring (i.e., a rate of how often a given effect is expected to occur), which is used to estimate initial and predicted residual risk. Provide a rationale for likelihood estimations in the HAW.

3.8.4.3.2 What to Consider When Defining Likelihood

Frequency and Modeling

Frequency is sometimes used to help estimate likelihood, but historical data do not always represent future conditions. Historical frequency may be zero for a given procedure, but that does not mean that the future likelihood is also zero. For example, a facility may conduct a procedure that has unreported incidents that could lead to an undesirable outcome, such as a loss of separation or a collision. Likewise, a facility may not have encountered the scenario or system state that exposes the more severe outcome. Consider all potential effects that are derived from indicators of the operation in all credible scenarios. This practice is required to challenge the philosophy of, “It has not happened in the past, so it will not happen in the future.”

When possible, use modeling to examine the effects of hazards that are too rare to have significant historical statistical data available.[8] If modeling is required and data are available, the risk analysis should be based on statistical or observational data (e.g., radar tracks). Where there are insufficient data to construct statistical risk assessments, input from SRM panel members and Subject Matter Experts (SMEs) can be used. This means that if the true rate of a particular type of operation is unknown, it can be estimated using expert judgment. It is important to note that complex proposed NAS changes, such as changes to separation standards, require quantitative data to support the associated risk analysis.

Credible Effects and Controls

Analyze the likelihood of all credible effects to: (1) Determine the highest potential risk and (2) Identify all system states that expose the risk. Remember that less severe effects may occur more frequently, producing a higher risk; this is why it is important to determine the likelihood of all credible effects. Consider controls when determining likelihood because they may minimize the likelihood of an effect.

Crossing FAA LOBs

When a NAS change crosses FAA LOBs, consult with the affected parties; the provisions of FAA Order 8040.4 apply.

3.8.4.3.3 Calculating Likelihood with Quantitative Data

Once the credible effects and the estimated rates of occurrence have been determined, it is possible to calculate a likelihood rating. The Operations Network database is the official source of NAS air traffic operations data.

To estimate the likelihood, first determine the expected number of times the credible effect will occur (i.e., the number of times that the hazard will occur in the system state that will expose the risk). Then, divide that value by the number of ATO operations, flight hours, or operational hours in which the effect is exposed (i.e., the number of ATO operations, flight hours, or operational hours affected by the proposed NAS change or the existing hazard). Finally, compare the result of this calculation (presented below) to the ranges presented in Table 3.5 to determine the likelihood rating.

[8] For guidance on how to design and conduct modeling in support of safety risk analyses, refer to AOV Safety Oversight Circular 07-05A, *Guidance on Safety Risk Modeling and Simulation of Hazards and Mitigations*.

$$\textbf{Likelihood} = \frac{\text{Expected number of occurrences of } \textbf{the effect}}{\text{Known number of } \textbf{affected operations}}$$

Identify which likelihood unit to use to analyze the effect's maximum exposure rate (i.e., the number of ATO operations, flight hours, or operational hours). For example, for the following environments, the number of ATO operations will often be the most appropriate likelihood unit to use when analyzing the exposure of an effect: a Terminal Radar Approach Control (TRACON) facility; ARTCC with small, busy sectors; or an ATCT. However, when determining occurrences of an effect in the Oceanic domain or for an ARTCC with a larger sector, often the number of flight hours may be more appropriate. System acquisitions or modifications will use units of operational hours. Whether the NAS change applies to a single facility or to an entire NAS domain, it is important to use the relevant number of ATO operations in which the hazard may occur when calculating likelihood.

Table 3.5: Likelihood of the Effect Standards – ATO Operations and NAS Equipment

	Operations: Expected Occurrence Rate (per operation / flight hour / operational hour[9])
	Quantitative (ATC / Flight Procedures / Systems Engineering)
Frequent A	(Probability) ≥ 1 per 1,000
Probable B	1 per 1,000 > (Probability) ≥ 1 per 100,000
Remote C	1 per 100,000 > (Probability) ≥ 1 per 10,000,000
Extremely Remote D	1 per 10,000,000 > (Probability) ≥ 1 per 1,000,000,000
Extremely Improbable E	1 per 1,000,000,000 > (Probability) ≥ 1 per 10^{14}

The values in Table 3.5 are derived from an analysis of historical ATC data mapped to the established engineering standard (Advisory Circular 25.1309-1, *System Design and Analysis*) and can be applied to both ATC and Flight Procedures. The ratios binding each expected occurrence rate range were determined through calculations made using ten years of aviation data. In each calculation, the numerator was the number of occurrences of a given severity level occurring during a ten-year period, as obtained from various relevant databases. The denominator was the number of ATO operations (or flight hours) in that ten-year period, as obtained through the Operations Network database or the National Transportation Safety Board database. The value was adjusted to reflect a forecasted air traffic increase. A cut-off point of 10^{-14} was established to define the boundaries of credible events for the purposes of calculating likelihood. Figure 3.6 depicts the likelihood continuum and the expected occurrence rate ranges.

[9] It is important to note that the close correlation between flight hours and operations is entirely coincidental; average flight time is roughly two hours, and each flight has about two Tower and two TRACON operations. The two numbers are not interchangeable.

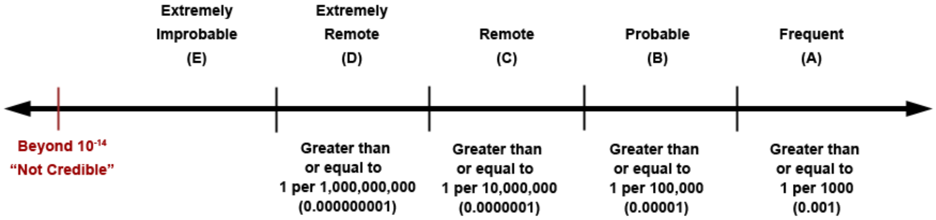


Figure 3.6: Likelihood Continuum

3.8.4.3.4 Determining Likelihood When No Data Are Available

For some NAS changes, the necessary data are not available. There may not be a similar enough change/procedure/situation in the NAS to provide similar data from which to estimate a rate of occurrence. When unable to use modeling, SME input can be utilized by SRM panel members to provide a qualitative approach to determine likelihood. This approach is only recommended when all avenues of data collection have been exhausted or when the change proponent is attempting to implement a new operation for which no data exist. For a majority of changes to the NAS, data from a similar NAS change may be collected and analyzed to determine the number of expected occurrences of an effect.

Table 3.6 presents calendar-based approximations of NAS-wide effect occurrences. This table only applies if the proposed NAS change or existing hazard affects all ATO operations in a particular air traffic domain.

Table 3.6: Calendar-Based Likelihood of the Effect Definitions – Operations/Domain-Wide

	Operations: Expected Occurrence Rate (Calendar-based)
	(Domain-wide: NAS-wide, Terminal, or En Route)
Frequent **A**	Equal to or more than once per week
Probable **B**	Less than once per week and equal to or more than once per three months
Remote **C**	Less than once per three months and equal to or more than once per three years
Extremely Remote **D**	Less than once per three years and equal to or more than once per 30 years
Extremely Improbable **E**	Less than once per 30 years

3.9 DIAAT Phase 4: Assess Risk

A	**ASSESS RISK**	Assign risk level for each hazard based on severity and likelihood

3.9.1 Overview

In this phase, identify each hazard's associated initial risk and plot each hazard on a risk matrix.

When assessing and mitigating safety risk, first determine the risk level prior to the implementation of any safety requirements (see Section 3.10.3). **Initial risk** describes the composite of the severity and likelihood of a hazard's effect, considering only controls and documented assumptions for a given system state. It describes the risk before any of the proposed mitigations are implemented.

When analyzing and assessing NAS equipment or existing hazards, the initial risk may be equated to the **current risk**, which is defined as the composite of severity and frequency of a hazard's effects in the present state.

3.9.2 Risk Levels and Definitions

Record all hazards and their associated risk levels. Hazards are assigned one of three risk levels: high, medium, or low. The ATO and its employees are responsible for identifying and mitigating hazards with unacceptable risk (i.e., high risk). Likewise, the ATO should determine if hazards with acceptable risk (i.e., medium and low risk) can be further mitigated.

3.9.2.1 High Risk

This is unacceptable risk, and the NAS change cannot be implemented unless the hazard's associated risk is mitigated to medium or low. Existing high-risk hazards also must be reduced to medium- or low-risk hazards. The predicted residual risk must be monitored and tracked in relation to the safety performance targets. The predicted residual risk must be confirmed with objective evidence suggesting an impact to the hazard's causes or effects.

Hazards with catastrophic effects that are caused by single point failures, common cause failures, or undetectable latent events in combination with single point or common cause failures are considered high risk, even if the possibility of occurrence is extremely improbable.

When a system has a **single point failure**, there is a failure of one independent element of the system that causes or could cause the whole system to fail. The system does not have a back-up, redundancy, or alternative procedure to compensate for the failed component. An example of a single point failure is found in a system with redundant hardware, in which both pieces of hardware rely on the same battery for power. In this case, if the battery fails, the entire system will fail.

A **common cause failure** is a failure that occurs when a single fault results in the corresponding failure of multiple system components or functions. An example of a common cause failure is found in a system with redundant computers running on the same software, which is susceptible to the same software bugs.

3.9.2.2 Medium Risk

Although initial medium risk is acceptable, it is recommended and desirable that safety requirements be developed to reduce severity and/or likelihood. The risk must be monitored and tracked in relation to the safety performance targets. The predicted residual risk must be confirmed with objective evidence suggesting an impact to the hazard's causes or effects. Refer to Section 4.2 for information on monitoring.

A catastrophic severity and corresponding extremely improbable likelihood qualify as medium risk, provided that the effect is not the result of a single point or common cause failure. If the cause is a single point or common cause failure, the hazard is categorized as high risk.

3.9.2.3 Low Risk

This is acceptable risk without restriction or limitation. It is not mandatory to develop safety requirements for low-risk hazards; however, develop a monitoring plan with at least one safety performance target.

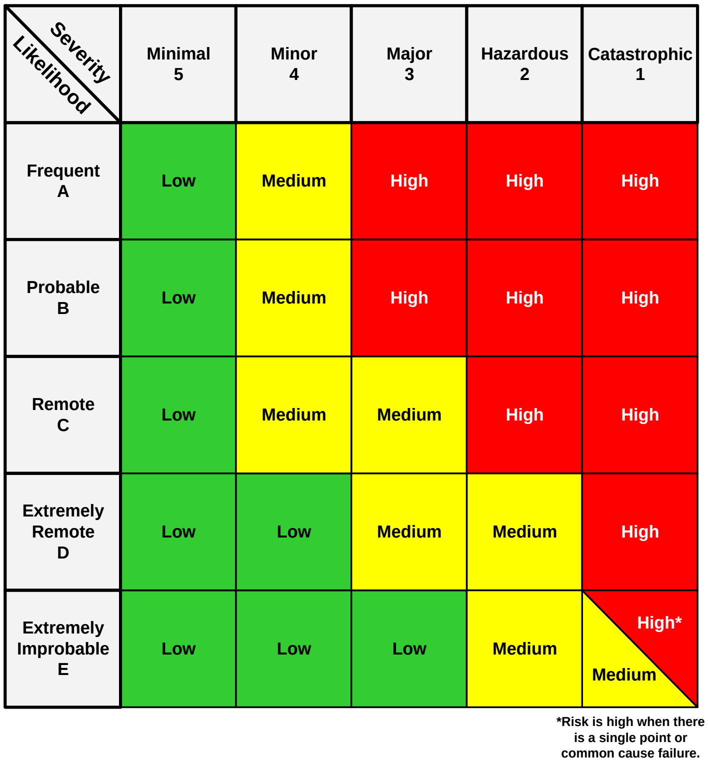
3.9.3 Plotting Risk for Each Hazard

The risk matrix shown in Figure 3.7 is used to determine risk levels. Plotting the risk for each hazard on the matrix helps to prioritize treatment. The rows in the matrix reflect the likelihood categories, and the columns reflect the severity categories. Adhere to the following guidelines when plotting risk for each hazard:

- Plot a hazard's risk according to its associated severity and likelihood.
- To plot the risk for a hazard on the risk matrix, select the appropriate severity column (based on the severity definitions in Table 3.3) and move down to the appropriate likelihood row (based on the likelihood definitions used from either Table 3.5 or Table 3.6).
- Plot the hazard in the box where the severity and likelihood of the effect associated with the hazard intersect.
- If the plotted box is red, the risk associated with the hazard is high; if the box is yellow, the risk associated with the hazard is medium; and if the box is green, the risk associated with the hazard is low. As shown in the split cell in the bottom right corner of the matrix, hazards with a catastrophic severity and extremely improbable likelihood can be medium or high risk, depending on the cause, as explained in Section 3.9.2.1.

Use this SMS Manual and the risk matrix in Figure 3.7 for all SRM panels in which the ATO accepts the risk. When an FAA LOB other than the ATO is required to accept the safety risk, FAA Order 8040.4, and the risk matrices therein, apply. FAA Order 8040.4 also applies with regard to acceptability of risk levels at the agency level when crossing LOBs.

FAA Order 8040.4, and the risk matrices therein, apply. FAA Order 8040.4 also applies with regard to acceptability of risk levels at the agency level when crossing LOBs.



Severity / Likelihood	Minimal 5	Minor 4	Major 3	Hazardous 2	Catastrophic 1
Frequent A	Low	Medium	High	High	High
Probable B	Low	Medium	High	High	High
Remote C	Low	Medium	Medium	High	High
Extremely Remote D	Low	Low	Medium	Medium	High
Extremely Improbable E	Low	Low	Low	Medium	High* Medium

*Risk is high when there is a single point or common cause failure.

Figure 3.7: Risk Matrix

3.10 DIAAT Phase 5: Treat Risk

T	**TREAT RISK**	Choose risk management strategies Develop safety performance targets Develop monitoring plan

3.10.1 Overview

In this phase, identify appropriate means to mitigate or manage the safety risk. Treating risk involves:

- Identifying appropriate safety requirements,
- Defining safety performance targets or a sound alternate method to verify the predicted residual risk for each hazard, and
- Developing a monitoring plan that prescribes tasks and review cycles for comparing the current risk to the predicted residual risk.

3.10.2 Risk Management Strategies

To address safety risk, identify and evaluate means that either manage the risk or reduce it to an acceptable level. The four risk management strategies are risk control, risk avoidance, risk transfer, and risk assumption. Assess how the proposed risk management strategy affects the overall risk. Consider using a combination of actions to best manage or reduce the risk to an acceptable level.[10] When determining the appropriate strategy, consider how the safety performance target (see Section 4.1) will be used to evaluate the safety performance of the chosen course of action.

3.10.2.1 Risk Control

A **risk control strategy** involves the development of **safety requirements**, defined as planned or proposed means to reduce a hazard's causes or effects. Examples include policies or procedures, redundant systems and/or components, and alternate sources of production. Refer to Section 3.10.3 for information on documenting safety requirements.

An explanation of how a safety requirement reduced the hazard's risk level—ultimately supported with objective evidence through testing, monitoring, or another method—must be provided for each safety requirement. All safety requirements that are implemented and are determined to have successfully addressed the hazard or safety issue become part of the operating NAS. At that time, they will be considered controls that form the basis for future SRM efforts. Refer to Section 3.8.2 for information on controls.

3.10.2.2 Risk Avoidance

The **risk avoidance strategy** averts the potential occurrence and/or consequence of a hazard by either selecting a different approach or not implementing a specific proposal. This technique may be pursued when multiple alternatives or options are available, such as determining where to construct an ATCT. In some cases, a decision may be made to limit the NAS change to certain conditions or system states, thereby avoiding the risk associated with other conditions. An example of this is allowing simultaneous operations on one runway that is overflown by three other runway flight paths. It may be discovered that the risk associated with the simultaneous operation can be mitigated to an acceptable level for two of the runways but not for the third. It may be decided that aircraft will not be allowed to operate on the third runway while simultaneously landing on the crossing runway, thereby avoiding risk.

A Comparative Safety Assessment (CSA) may be used when multiple systems or procedures are available.[11] If one alternative cannot be mitigated to an acceptable level, then another system, method, or procedure may be chosen. When no alternatives are available, the risk avoidance strategy is more likely to be used as the basis for a "go" or "no-go" decision at the start of an operation or program. Risk must be avoided from the perspective of all affected stakeholders. Thus, an avoidance strategy is one that involves all of the stakeholders associated with the proposed NAS change.

3.10.2.3 Risk Transfer

The **risk transfer strategy** shifts the ownership of risk to another party; the recipient may be better equipped to mitigate the risk at the operational or organizational level. Organizations transfer risk primarily to assign responsibility to the organization or operation most capable of managing it. The recipient must accept the risk, and the transfer must then be documented (e.g., through a Letter of Agreement or Memorandum of Agreement).

Examples of risk transfer may include:

- The transfer of aircraft separation responsibility in applying visual separation from the air traffic controller to the pilot,

[10] Refer to Section 2.8 for information about the Safety Order of Precedence.
[11] See the SRMGSA for more information on CSAs.

- The development of new policies or procedures to change ownership of a NAS component to a more appropriate organization,
- The procurement of contracts for specialized tasks from more appropriate sources (e.g., contract maintenance), and
- The transfer of ATC systems from the acquisition organization to the organization that provides maintenance.

Transfer of risk cannot be the only method used to treat a high-risk hazard. Identify safety requirements to lower the safety risk to medium or low before it can be accepted in the NAS. All transferred risks must be monitored until the predicted residual risk is verified by the appropriate organization.

3.10.2.4 Risk Assumption

The **risk assumption strategy** simply means accepting the risk. The risk acceptor assumes responsibility for the risk as it is. When a risk acceptor agrees to implement a NAS change, they agree to implement it based on the predicted residual risk being medium or low and assume responsibility for the risk. When this management strategy is used, the predicted residual risk is derived from the controls. Under this strategy, controls serve as the basis on which safety performance targets or alternate methods to verify predicted residual risk are developed. *It is recommended and desirable that safety requirements be developed to further mitigate risk or reduce likelihood or severity.*

It is not permissible to use a risk assumption strategy to treat an initial or current high risk associated with a hazard. The predicted residual risk for initial high-risk hazards must be medium or low before it can be accepted into the NAS.

3.10.3 Documenting Safety Requirements

All safety requirements identified by the SRM panel attendees and included in the HAW are considered to be recommendations for review and approval by the appropriate signatories. After appropriate means of managing risk have been developed and documented, management officials may identify the effect of safety requirements on other organizations and coordinate with the affected organizations.

If any safety requirement affects the safe provision of air traffic management services, it may be necessary for the safety requirement to undergo the SRM process to determine its effect on the NAS.

Refer to Section 5.3 for more information on safety requirements’ approval and implementation decision-making and signatures.

3.10.4 Determining Predicted Residual Risk

Predicted residual risk is the risk that is estimated to exist after the safety requirements are implemented or after all avenues of risk mitigation have been explored. The predicted residual risk is based on the assumption that controls are in place and/or all safety requirements are implemented and are valid. If safety requirements are not documented in the HAW, predicted residual risk should be the same as the initial risk.

If the risk cannot be reduced to an acceptable level after attempting all possible risk reduction strategies, either revise the original objectives or abandon the proposed NAS change. If an acceptable proposal is not identified, the NAS change cannot be implemented. Similarly, if a

NAS change was implemented without safety requirements and the predicted residual risk was not met, refer to Section 4.3.2 for more information.

4.1 Developing Safety Performance Targets

Safety performance targets[1] are measurable goals used to verify the predicted residual risk of a hazard. A safety performance target is the preferred means to relate the performance of risk reduction efforts to the expected risk level. The safety performance target is included as part of the monitoring plan (see Section 4.2).

Safety performance targets are used to assess safety performance with respect to controls and newly implemented safety requirements. Do not define the worst credible effect or effects producing the highest risk level as the safety performance target; instead, look at the less severe effects or indicators (e.g., the number of unauthorized vehicle deviations on taxiways per a specific number of airport operations over a period of time). Safety performance targets should be related to the hazard or National Airspace System (NAS) change.

When developing safety performance targets, the Safety Risk Management (SRM) panel attendees should apply the data used during the “Analyze Risk” phase to determine the appropriate metrics to monitor. If there is no established data source to support a proposed safety performance target, then a means to begin collecting the data should be identified and documented as a safety requirement. Data used during the SRM process also serve as the basis for comparison against the post-implementation metrics.

Mapping a hazard to a specific safety performance target may not be possible in terms of establishing a causal relationship. In such cases, identify a sound alternate method to verify the predicted residual risk and determine whether controls and/or safety requirements are appropriate and functioning as intended.

It is important to retain objective evidence that the safety requirements have been implemented. Objective evidence is simply documented proof. The evidence must not be circumstantial; it must be obtained through observation, measurement, testing, or other means.

4.2 Developing the Monitoring Plan

The monitoring plan[2] should be comprehensive enough to verify the predicted residual risk. The monitoring plan includes either the safety performance targets or another sound method for verifying the predicted residual risk. The SRM panel should create a plan for each hazard that defines:

- Monitoring activities;
- The frequency and duration of tracking monitoring results; and
- How to determine, measure, and analyze any adverse effects on adjoining systems.

4.2.1 Monitoring Activities

The risk acceptor, or the monitoring Point of Contact (POC) identified by the risk acceptor, must verify that the controls and/or safety requirements were implemented and are functioning as designed. Specifically, this means that procedures must be stringently followed and hardware or software must function within the established design limits.

Detail the methods by which the risk acceptor, or the monitoring POC identified by the risk acceptor, will gather the performance data and monitoring results. The organization that

[1] Acquisition programs should refer to the Safety Risk Management Guidance for System Acquisitions (SRMGSA) for guidance on safety performance targets.

[2] Segmented or phased acquisition programs should refer to the SRMGSA for guidance on monitoring.

accepted the risk is accountable for ensuring that the monitoring plan is being upheld (i.e., that the monitoring results are being compared to the defined safety performance targets (or the results alone are being used) to determine whether predicted residual risk is being met). Refer to Section 5.4 for information about risk acceptance.

4.2.2 Frequency and Duration of Monitoring

When considering the frequency and duration of tracking monitoring results, account for:

- The complexity of the NAS change,
- The hazard’s initial risk level,
- How often the hazard’s effect is expected to occur in the defined system state (i.e., likelihood),
- Controls,
- The types of safety requirements that are being implemented (if any), and
- The amount of time needed to verify the predicted residual risk.

For example, when considering a hazard associated with the familiarity of a new procedure, a relatively short tracking period would be required until a person or population could reasonably be expected to adapt to the new procedure and the predicted residual risk could be verified. However, the monitoring plan for a hazard associated with new separation criteria may require several years of tracking to verify the predicted residual risk.

Refer to Annex A for documentation requirements of a complete monitoring plan for an individual hazard.

4.3 Post-SRM Monitoring

It is critical to obtain feedback on safety performance indicators through continuous monitoring. Organizations responsible for performing Quality Control and/or Quality Assurance use audits and assessments to monitor the safety risk and performance of an implemented NAS change documented in the monitoring plan. The responsible organization determines whether an implemented NAS change is meeting the safety performance targets documented in the monitoring plan.

Results of post-implementation monitoring help determine whether a change can be made part of the operating NAS or must be readdressed through the SRM process.

4.3.1 Monitoring and Current Risk

A hazard’s current risk is updated at each monitoring interval (in accordance with stated monitoring frequency). Current risk provides an indicator of whether safety requirements are meeting the predicted residual risk. The risk acceptor is accountable for ensuring that the monitoring plan is being upheld and that monitoring reports, as dictated by the monitoring frequency, are being analyzed to determine whether the safety performance targets are being met.

4.3.2 Predicted Residual Risk Is Not Met

Through monitoring current risk and the safety performance of a recently implemented NAS change, it may become clear that the predicted residual risk is not being met. If this occurs, notify the risk acceptor. The risk acceptor may choose to accept the current risk as the new predicted residual risk or to reconvene the SRM panel for additional safety requirement considerations. In either case, the SRM document must be revised with the new safety requirements (if identified) and new predicted residual risk, and approval and risk acceptance signatures must be reobtained (refer to Section 5.4.1 for information on risk acceptance authority).

There are several reasons why the predicted residual risk may not be met:

- The safety requirements or controls may not be properly mitigating the risk,
- The initial risk may have been analyzed inaccurately,
- Unintended consequences may have occurred, or
- New hazards may have been identified.

Refer to Section 5.7 for information on updating SRM documentation.

4.3.3 Predicted Residual Risk Is Met

The successful completion of monitoring is a prerequisite to hazard and NAS change closeout. This includes the achievement of safety performance targets and/or the predicted residual risk.

The monitoring procedures used to verify the predicted residual risk must also be documented, as they will be used to evaluate the safety performance of the change after it is added to the operating NAS. The established monitoring requirements must be followed, even after meeting the goals of the monitoring plan.

4.3.4 Residual Risk

Residual risk is the level of risk that has been verified by completing a thorough monitoring plan with an achieved measurable safety performance target(s). It is the composite of the severity of a hazard’s effect and the frequency of the effect’s occurrence.

4.3.5 Monitoring and Tracking of Changes Added to the Operating NAS

A change is considered part of the operating NAS only after monitoring through existing Safety Assurance processes is completed, the safety performance target is achieved and maintained, and/or the predicted residual risk is verified. The NAS change and all the associated safety requirements become part of the operating NAS, which will become the basis from which all future NAS changes will be measured. If a safety requirement is altered or removed from a NAS change that was made part of the operating NAS, SRM must be performed.

The documentation that was developed during the SRM process is critical to Safety Assurance functions, which often use SRM documents as inputs to assessments and evaluations.

5.1 Risk Acceptance and Approval

The review and approval of Safety Risk Management (SRM) documents and acceptance of any safety risk is designed to maintain and assure the quality of Air Traffic Organization (ATO) risk management activities. There are key variables that affect safety risk acceptance and SRM documentation review and signature requirements. They include the organization(s) affected by the proposed National Airspace System (NAS) change, the organization that developed the document, the risk(s) associated with the NAS change, and whether the NAS change is considered national or local in scope. There are several signature authorities associated with SRM documentation: concurrence, approval, risk acceptance, and safety requirement implementation. Refer to Section 5.2 for information regarding nationally and locally scoped changes.

For guidance on specific signature types, refer to Sections 5.3 through 5.6. Tables 5.1 through 5.4 summarize the SRM document signature requirements. The terms “affected facilities” and “affected Service Units” refer to the facilities or organizations that are impacted by the safety risk associated with the NAS change or existing safety issue.

Note: Table 5.1 is not to be used for SRM documents with an unacceptable (high) predicted residual risk (see Table 5.4).

Table 5.1: Signatures for SRM Document Approval and Risk Acceptance (Use with Annex A, Section 1.4, Completing the SRM Documentation) (1) (2) (14) (15)

Type of Change	Requires AOV Approval/Acceptance? (3)	Initial Predicted Risk Level	Required SRM Document Approval Signatures (4)	Required Safety Risk Acceptance Signatures (16)
Local	No	Low/Medium (5)	Support Managers or System Support Center Managers of the affected facilities (6)	ATMs or Technical Operations Managers of the affected facilities
	Yes	Low/Medium (5)	Support Managers (6) or System Support Center Managers, AJI-3 Director (8) (9)	ATMs or Technical Operations Managers of the affected facilities
		High (7)	Headquarters Director(s) or Technical Operations Service Area Director, AJI-3 Director (8)	Vice President of the affected Service Unit
National	Yes/No	Low/Medium (5)	Headquarters Group Manager of the change proponent, AJI-3 Director (8)	Headquarters Director(s) of the affected Service Unit(s)
		High (7)	Headquarters Director(s) of the affected Service Unit(s), AJI-3 Director (8)	Vice President(s) of the affected Service Unit(s)

Type of Change	Requires AOV Approval/Acceptance? (3)	Initial Predicted Risk Level	Required SRM Document Approval Signatures (4)	Required Safety Risk Acceptance Signatures (16)
Acquisitions (10)	Yes/No	Low/Medium (5)	Director of Mission Support Services Strategy, Director of Program Management Organization, AJI-3 Director (11) (12)	Headquarters Director(s) of the affected Service Unit(s) (13)
		High (7)	Director of Mission Support Services Strategy, Director of Program Management Organization, AJI-3 Director (11) (12)	Vice President(s) of the affected Service Unit(s) (13)

Notes:

(1) The change proponent must ensure that the SRM document is entered into the Safety Management Tracking System (SMTS) for tracking and monitoring the status of the NAS change / existing safety issue.

(2) Signature responsibility may only be delegated from a Director to a Deputy Director.

(3) The changes that require Air Traffic Safety Oversight Service (AOV) approval are listed in Federal Aviation Administration (FAA) Order 1100.161, *Air Traffic Safety Oversight*. If there is an initially identified high-risk hazard, AOV must approve the means to reduce safety risk and the Service Area Director of Operations or Technical Operations Service Area Director and the Director of Safety and Technical Training (AJI) Policy and Performance, AJI-3, (8) must sign the document.

(4) If the AJI-3 Director’s approval is required, then the proponent of an air traffic change / existing safety issue must send a copy of the SRM document to the Director of Air Traffic Operations (Service Area) for informational purposes only before submitting the SRM document to the AJI-3 Director.

(5) In cases where medium or low safety risk and/or controls go outside of the ATO, the mitigations must be approved by the designated management officials within the other Lines of Business (LOBs) and accepted by AOV.

(6) If a facility does not have a Support Manager, the Assistant General Manager or General Manager of the affected facility shall designate an SRM document approver.

(7) The AJI-3 Director must submit safety cases with means to reduce safety risk of any initially identified high-risk safety hazards to AOV for approval.

(8) If the change or existing safety issue meets the criteria for AOV approval, the AJI-3 Director must submit it to AOV accordingly.

(9) SRM documents that accompany air traffic waiver requests must also be signed by the Service Area Director of Air Traffic Operations.

(10) See the Safety Risk Management Guidance for System Acquisitions (SRMGSA) for details on which safety deliverables must be approved by the AJI-3 Director or by the Program Management Organization (AJM).

(11) Some safety documentation developed for acquisition programs must undergo a peer review before signature, as described in the SRMGSA. Refer to Section 8 of the SRMGSA for more information.

(12) The Director of Mission Support Services (AJV) Strategy, AJV-S, or their designee must provide their approval when the safety requirements are not already documented in an approved Program Requirements Document (PRD).

(13) Risk acceptance must be obtained for SRM documents in which risk is identified, except for the Operational Safety Assessment and the Comparative Safety Assessment.

(14) For approval and/or risk acceptance outside of the ATO, AOV may facilitate signatures on behalf of the ATO. However, the Service Unit change proponent should obtain signatures from the affected organization (user) participating on the SRM panel.

(15) Second-Level Engineering should start with Table 5.2 for their signature requirements.

(16) Federal Contract Towers (FCTs) can concur with but cannot accept risk into the NAS. The General Manager or Assistant General Manager accepts risk on the behalf of the FCT.

Table 5.2: Signatures for Second-Level Engineering SRM Document Approval and Risk Acceptance (1) (2) (3)

Proposed Modification to Approved System-Level Requirements? (4)	Previous SRM Document Identifying Safety Implications of the Proposed Modification?	Facilitated by AJI or Requires AOV Approval or Acceptance? (5) (6) (7)	Hazard(s) Identified?	Required SRM Document Approval Signatures	Required Safety Risk Acceptance Signatures
No	Yes	No additional SRM required			
	No	No	Yes	Headquarters Group Manager of the change proponent	Headquarters Director(s) of the affected Service Unit(s)
			No	Headquarters Group Manager of the change proponent	None
		Yes	Yes	See signature requirements in Table 5.1	
			No	Headquarters Group Manager of the change proponent, AJI-3 Director	None
Yes	Yes/No	Yes	Yes	See signature requirements in Table 5.1	
			No	Headquarters Group Manager of the change proponent, AJI-3 Director	None
		No	Yes	See signature requirements in Table 5.1	
			No	Headquarters Group Manager of the change proponent, AJI-3 Director	None

Notes:

(1) This table applies to national-level NAS changes only. For local changes, refer to Table 5.1.

(2) The change proponent must ensure that the SRM document is entered into SMTS for tracking and monitoring the status of the NAS change / existing safety issue.

(3) Signature responsibility may only be delegated from a Director to a Deputy Director.

(4) System Level Requirements refer to the requirements listed in the Final PRD.

(5) The changes that require AOV approval are listed in FAA Order 1100.161.

(6) In cases where medium or low safety risk and/or controls go outside of the ATO, the means to reduce safety risk must be approved by the designated management officials within the other LOBs and accepted by AOV.

(7) The AJI-3 Director must submit the means to reduce safety risk of any initially identified high-risk safety hazards to AOV for approval.

Table 5.3: Signatures for SRM Document Approval (Use with Annex A, Section 1.4, Completing the SRM Documentation) (1) (2) (4)

Type of Change	Required SRM Document Approval Signatures
Local (3)	Director of Air Traffic Operations (Service Area); Assistant General Manager or General Manager; or Technical Operations Manager or Assistant General Manager
National	Headquarters Director(s) of affected Service Unit(s), AJI-3 Director
Acquisitions (5)	Headquarters Director(s) of affected Service Unit(s), AJI-3 Director

Notes:

(1) The change proponent must ensure that the SRM document is entered into SMTS for tracking and monitoring the status of NAS changes.

(2) Signature responsibility may only be delegated from a Director to a Deputy Director.

(3) For local changes, the SRM document is signed one level above the Air Traffic Manager (ATM) at the facility completing the SRM document.

(4) This table does not apply to Second-Level Engineering.

(5) See the SRMGSA for details on which safety deliverables must be approved by the AJI-3 Director or by AJM.

Table 5.4: Signatures for SRM Document Approval for Proposed NAS Changes Only (Use with Unacceptable (High) Predicted Residual Risk) (1) (2) (3)

Type of Change	Required SRM Document Approval Signatures
Local (4)	ATMs or Technical Operations Managers of the affected facilities
National	Headquarters Director(s) of the affected Service Unit(s), AJI-3 Director

Notes:

(1) When the predicted residual risk is unacceptable (high), AOV approval is not required.

(2) Per ATO Safety Management System (SMS) policy, a high predicted residual risk is unacceptable and the NAS change in question must not be implemented. The SMTS submitter is responsible for notating this in SMTS and closing out the project. (See the SMTS User Manual.)

(3) Signature responsibility may only be delegated from a Director to a Deputy Director.

(4) For local changes, the SRM document is signed one level above the ATM at the facility completing the SRM document.

5.2 Scope of NAS Changes

NAS changes are considered either local or national. A national NAS change is one for which an AJI Safety Case Lead (SCL) facilitates or leads the SRM effort or that meets at least one of the following criteria:

- The NAS change has high visibility or a potential political, economic, or financial impact to the FAA, the NAS, or the flying public.[1]
- The NAS change is the result of financial or operational decisions made by FAA executive management, Cabinet-level executives, or Congress.
- The NAS change includes means to reduce any safety risk identified as part of the Top 5 Program.
- The NAS change modifies safety policy that must be incorporated into a directive.
- The NAS change could or does present operational or technical conflicts to multiple affected Service Units or FAA LOBs.
- The NAS change will be implemented on a national level, affecting multiple facilities.

Note: There may be cases in which an AJI SCL facilitates a local SRM panel and none of the aforementioned criteria apply. These changes will be considered local.

A NAS change is considered to be local if:

- It does not meet any of the preceding criteria and it affects three or fewer Service Delivery Points within a single Service Area, or
- It is a change proposed by Technical Operations that involves a single piece of equipment that is restricted to one district.

In cases where a NAS change affects two adjacent Service Delivery Points in different Service Areas or a single Terminal Radar Approach Control / Air Route Traffic Control Center with more than two underlying Airport Traffic Control Towers, the change proponent has the authority to determine if the change will be considered local or national in scope.

Note: Many systems and facilities that provide service in the NAS are not procured, owned, or maintained by the FAA or another federal entity. The FAA has the authority and responsibility to assure the safety of these services in accordance with Title 49 of the United States Code Section 44505, *Systems, procedures, facilities, and devices*, and Title 14 of the Code of Federal Regulations Part 171, NON-FEDERAL NAVIGATION FACILITIES. Although a system/service

[1] AJI will typically identify these types of changes.

may not be procured by the FAA, implementation into the NAS is considered a NAS change and requires appropriate SRM as if the FAA were acquiring the system/service.

5.2.1 Local Implementation of National NAS Changes

When the local implementation of a nationally scoped SRM document cannot follow the national standard, local SRM is required for the local deviations. If formal waivers are required in such cases, local SRM does not eliminate the waiver requirement.

5.3 Approving Safety Requirements

An organization’s safety requirement approval signature represents its commitment to implementing the safety requirement in accordance with the associated SRM document. For acquisition systems, if the approved PRD contains the safety requirements referenced in the SRM document, no Point of Contact (POC) signature is required. If the requirements are not listed in the approved PRD, the SRM document must include a POC signature for each additional safety requirement.

5.3.1 Appropriate Signatories

Safety requirement signature authority must be at the managerial level with the ability to fund and ensure the implementation of the safety requirement. The appropriate signing official may be determined by the FAA organization. When multiple officials are responsible for providing safety requirements signatures for an SRM document, they must share similar managerial statuses or responsibilities.

When an organization outside of the FAA is responsible for a safety requirement, a signature on file is required. This requirement may be met through a memorandum or an SRM document. The change proponent is responsible for following up on the status of the implementation of safety requirements identified in the SRM document.

5.3.2 Endorsing Implementation of Safety Requirements

All safety requirements that the SRM panel attendees identify must be accounted for in the SRM document. The change proponent and appropriate safety requirement(s) POC(s) must collaborate to determine which safety requirements will be approved for implementation and notate that decision in the SRM document. The risk acceptor is accountable for ensuring that all approved safety requirements are implemented and all monitoring activities are recorded in SMTS.

5.3.2.1 Safety Requirements Planned for Implementation

All safety requirements included in the Hazard Analysis Worksheet (HAW) of the signed SRM document must be implemented before or in conjunction with the NAS change, even when the risk is classified as medium or low. All organizations responsible for implementing a safety requirement must:

1. Sign the SRM document for the safety requirement approval,
2. Document the status of the safety requirement (e.g., implemented, not implemented, or in progress), and
3. Record objective evidence supporting the safety requirement’s implementation.

Only safety requirements that are to be implemented must have an accompanying signature.[2]

5.3.2.2 Safety Requirements Not Planned for Implementation

If a safety requirement is not going to be implemented, SRM panel attendees must be contacted to verify that the predicted residual risk, safety performance target(s), and/or monitoring plan have not been affected. If changes are required, the SRM panel attendees must reconvene to update any impacted section of the SRM document, including the HAW,[3] and the SRM document must be revised to include these changes and the rationale for not implementing the safety requirement. In addition, if any of the SRM panel members dissent with the removal of the safety requirement or the resulting changes to the predicted residual risk, safety performance target(s), and/or monitoring plan, the dissention must be included in the SRM document.

5.3.3 Safety Recommendations

Safety recommendations do not rise to the level of safety requirements. They are not used when determining predicted residual risk and do not require any endorsement but may be recorded within the SRM document.

5.4 Risk Acceptance

Risk acceptance is confirmation by the appropriate management official that they understand the safety risk associated with the NAS change or existing safety issue and that they accept that safety risk into the NAS. Safety risk must be accepted before the implementation of a proposed NAS change and the execution of the monitoring plan. Risk acceptance is based on the predicted residual risk. Risk acceptance and other inputs (e.g., cost-benefit analysis) are necessary before a change to the NAS can be implemented. When an individual or organization accepts a risk, it does not mean that the risk is eliminated; some level of risk will remain.

Risk acceptance requires:

- Signed confirmation from the appropriate management official that they understand and accept the predicted residual safety risk(s) associated with the hazard(s) identified in the SRM document;
- Signatures for the safety requirements identified in the SRM document;
- Approval of the safety performance target(s) or alternate method(s) identified to verify the predicted residual risk associated with each hazard, confirming that the safety performance target(s) or identified alternate method(s) can be used to measure the current risk; and
- A comprehensive monitoring plan that the risk acceptor agrees to follow to verify the predicted residual risk.

For nationally implemented NAS changes, risk can be accepted at the national level. However, if a facility is not able to comply with all of the safety requirements or has additional hazards and/or causes that were not identified in the national SRM document, the facility must perform

[2] A PRD may be used in lieu of providing signatures for safety requirements; see the SRMGSA for more information.

[3] This reconvene can be conducted in person or via telephone or video conference.

SRM (with local risk acceptance) prior to the implementation of the NAS change. Refer to Section 5.2.1 for information on local versus national implementation of safety requirements.

5.4.1 Authority to Accept Safety Risk

The acceptance of the safety risk depends on the span of the program or NAS change and the associated risk. The responsibility for risk acceptance ultimately lies with the organization(s) affected by the NAS change. Risk acceptance authority also depends on whether a NAS change is local or national in scope.

By signing the SRM document, the risk acceptor is confirming the following are understood and accepted:

- The identified safety risk(s);
- The safety requirements that will be implemented;
- The predicted residual risk(s) associated with the hazard(s);
- The safety performance target(s) identified to measure the predicted residual risk associated with each hazard, thus confirming that the safety performance target(s) may be used to measure the current risk level; and
- The information contained in the monitoring plan.

The risk acceptor is accountable for:

- Ensuring that all monitoring activities are being recorded in SMTS;
- Ensuring that performance data needed for the monitoring activities are being collected and analyzed to verify that the safety performance target(s) are being met;
- Determining the need to reconvene SRM panel attendees[4] or choosing to accept the current risk as the new predicted residual risk if performance data indicate that the predicted residual risk is not met and/or if the risk management strategy is proven to be inadequate; and
- Reconvening the SRM panel attendees if a safety requirement identified by the attendees cannot be implemented.

5.4.2 Risk Acceptance Outside of the ATO

If the affected party is outside of the ATO (e.g., navigation or weather services), each organization responsible for establishing requirements for contracted services accepts the risk into the NAS. LOBs/organizations outside of the ATO (e.g., Office of Airports, Office of NextGen, Office of Commercial Space Transportation, or Office of Aviation Safety) are also responsible for components of the NAS and have a role in accepting safety risk.

ATO vice presidents, directors, managers, and supervisors must work closely with their counterparts in LOBs/organizations outside of the ATO to help ensure that the appropriate party or parties accept and manage any safety risk resulting from NAS changes. Again, it is not in compliance with ATO policy to implement a NAS change without having first accepted any associated safety risk. Refer to FAA Order 8040.4, *Safety Risk Management Policy*, for policy on cross-LOB risk acceptance.

[4] This reconvene can be conducted in person or via telephone or video conference.

5.5 SRM Document Concurrence

Concurrence is used to represent a technical review of the SRM document and to confirm the rationale used throughout is consistent with the SRM process. The concurrence signature comes from an SRM expert who is well versed in the ATO SMS Manual and familiar with the terminology and processes therein. The concurrence signature is not a required signature; however, Service Areas, District Offices, or individual facilities may require a concurrence signature on their respective SRM documents.

5.6 SRM Document Approval

Approval of an SRM document with hazards requires and represents that:

- The SRM document was developed in accordance with policy and guidance;
- Hazards were systematically identified using a structured approach;
- Risk was appropriately analyzed and assessed;
- If identified, safety requirements were deemed valid;
- Safety performance targets or other methods to verify predicted residual risk were approved by the responsible Service Unit; and
- A monitoring plan was prepared.

Approval of an SRM document without hazards requires and represents that:

- The SRM document was developed in accordance with policy and guidance,
- The NAS change did not introduce new hazards or increase safety risk, and
- The SRM document includes a detailed rationale to support the finding of no hazards.

In approving SRM documentation, the approval authority affirms that the aforementioned items have been performed and agrees that the underlying assumptions are reasonable and the findings are complete and accurate. SRM documentation approval does not constitute approval for implementation or acceptance of any risk associated with the NAS change or existing safety issue.

5.6.1 Service Unit SRM Documentation Approval or Concurrence

Affected or stakeholder Service Units must assign an appropriate management official to provide approval or concurrence of the SRM document. The person selected must be available to provide input to the management official(s) who will accept the risk associated with the NAS change or existing safety issue.

If SRM documentation must be sent outside of the Service Unit for approval (to another Service Unit, another LOB, AJI, or AOV), the documentation must have an approval or concurrence signature before it leaves the Service Unit. All identified means to reduce safety risk requiring approval and acceptance by AOV must first be sent through AJI.

If SRM documentation requires the approval or concurrence of more than one Service Unit, discrepancies in the approval standards or processes may exist between the organizations. In these cases, the change proponent should request that AJI adjudicate the discrepancies.

If an AJI SCL managed the development of an SRM document (see Annex A), no other Service Unit concurrence is required; however, the risk acceptor must still review and sign the SRM document before the NAS change can be implemented. If an AJI SCL develops the SRM document, the relevant/affected operational Service Unit(s) that accepted the associated risks of the NAS change or existing safety issue must follow the monitoring plan documented in the SRM document.

5.6.2 AJI Review and Approval

AJI SCLs verify that the SRM process has been followed, that the safety documentation is complete, and that the safety documentation adheres to the SMS Manual principles and guidelines.

Any documentation forwarded to the AJI-3 Director for approval must first go through an AJI peer review. For an AJI peer review, forward SRM documentation to the AJI SCL in draft form and without signatures. At this point, the AJI SCL will facilitate the remaining steps in the review process. When the SRM document is ready for signature, the AJI SCL will notify the change proponent, who will obtain the appropriate signatures. Finally, when the SRM document has all signatures except for that of the AJI-3 Director, the AJI SCL will present the SRM document to the Safety Management Group, AJI-31, Manager. The AJI-31 Group Manager will forward the SRM document to the AJI-3 Director for signature. Other SRM document signature requirements that are documented in this SMS Manual remain.

When a NAS change or existing safety issue facilitated by AJI crosses FAA LOBs/organizations, an AJI SCL reviews the SRM document to verify that affected LOBs/organizations have reviewed and approved the documentation. In addition, the AJI-3 Director must approve and sign the SRM document.

5.6.2.1 AJI Participation in System Acquisition SRM

AJI SCLs will be involved with NAS change efforts from concept development through In-Service Management. An AJI SCL will be assigned to a portfolio or program to provide safety guidance and advice, as appropriate. The AJI SCL will be familiar with the portfolio or program, its possible interfaces, its position within the Enterprise Architecture, its milestones, and its safety documentation requirements. The AJI SCL will stay with that portfolio or program throughout its lifecycle.

The AJI SCL will ensure that all required safety documentation meets the requirements of this SMS Manual and the SRMGSA and will request subject matter experts to review (i.e., peer review) certain documentation before it is presented to the AJI-3 Director for approval.

The AJI-3 Director reviews certain SRM documentation and the associated acquisition safety assessments, analyses, reports, and plans, providing approval or comments (see the SRMGSA for information regarding specific documentation reviews and approval requirements).

5.6.3 AOV Approval and Acceptance

5.6.3.1 Items Requiring AOV Approval

AOV approval is the formal act of approving of a NAS change submitted by a requesting organization. This action is required prior to the proposed NAS change being implemented. This is not the same as approval of the SRM document itself. All NAS changes or existing safety issues submitted to AOV for approval first require approval and concurrence by AJI and any applicable Service Units. Refer to Section 5.6.2 for information on AJI approval.

The following items require AOV approval before implementation:

- Controls that are defined to mitigate or eliminate initial and current high-risk hazards. (For specific guidance regarding the AOV high-risk hazard acceptance/approval process and modeling requirements, see FAA Order 8000.365, *Safety Oversight Circulars (SOC)*; AOV Safety Oversight Circular (SOC) 07-02, *AOV Concurrence/Approval at Various Phases of Safety Risk Management Documentation and Mitigations for Initial High-Risk Hazards*; and AOV SOC 07-05A, *Guidance on Safety Risk Modeling and Simulation of Hazards and Mitigations.*)
- Changes or waivers to provisions of handbooks, orders, and documents that pertain to separation minima, including FAA Order JO 7110.65, *Air Traffic Control* (see the ATO Safety Guidance (ATO-SG) on separation minima)
- Waiver renewals pertaining to approved separation
- Changes to NAS equipment availability and any changes to the program
- Specific ATO-SG documents pertaining to the SMS, as explained in FAA Order JO 1030.1, *Air Traffic Organization Safety Guidance*

5.6.3.2 Items Requiring AOV Acceptance

The following require acceptance by AOV:

- Mitigations to reduce high safety risk to medium or low and/or mitigations that span FAA LOBs
- Exclusions to SMS requirements granted by AJI
- Changes to the criteria in FAA Order 8200.1, *United States Standard Flight Inspection Manual*, including:
    - The flight inspector’s authority and responsibilities
    - Facility status classification and issuance of Notices to Air Missions
    - Records and reports
    - Extensions in the periodicity or interval of inspections
    - Changes in required checklist items for the inspection of specific system areas
    - Changes in established tolerances, or tolerances proposed for new equipment or new functionality
    - Changes in the procedures for evaluating the safety and flyability of instrument flight procedures
- Changes to the personnel certification requirements
- Changes to the certification criteria in FAA Order 6000.15, *General Maintenance Handbook for National Airspace System (NAS) Facilities*
- Changes to the personnel certification requirements in FAA Order JO 3000.57, *Air Traffic Organization Technical Operations Training and Personnel Certification*

5.6.4 Coordination of SRM Documentation

AJI will collaborate with AOV to obtain the necessary reviews, approval, and risk acceptance signatures for SRM documentation with all applicable organizations outside of the ATO for all NAS changes. The scope of potential changes includes products, services, systems, and procedures associated with federal and non-federal facilities. Service Unit change proponents may initiate these reviews and signatures through outside ATO organizations. However, the Service Unit change proponent must inform the appropriate AJI SCL of such action.

5.7 Revising an SRM Document

Through post-implementation monitoring, a need to modify the previously approved SRM document may arise (see Section 4.3.2). This requires a revision of the SRM document and new SRM document approval and risk acceptance signatures.

Table 5.5: Signature Requirements for SRM Document Revisions (1)

Part of SRM Document Changed	Type of Change	Version Protocol	New SRM Document Approval Signature and Risk Acceptance Required?
HAW	New hazard; change to predicted residual risk	Whole number revisions (e.g., 1.0 to 2.0)	Yes
HAW to include safety requirements	Adding, changing, removing, or not implementing new or existing safety requirements	Whole number revisions	Yes
System description	Updating charts, maps, airport layout, and approach plates, as long as change does not affect hazards or risk levels	Decimal revisions (e.g., 1.0 to 1.1, 1.2)	No
Hazard and risk analysis	Adding rationale or data for risk analysis when risk is not changed and/or means to reduce safety risk are not added or changed	Decimal revisions	No
Safety requirements, monitoring plan, and appendices	Clarification of safety requirements, including Standard Operating Procedures, Letters of Agreement, letters to airmen, and implementation and monitoring reports, as long as risk is not changed and means to reduce safety risk are not added or changed	Decimal revisions	No

Notes:

(1) If an SRM document revision does not necessitate a new approval/acceptance signature from AOV, a new signature from the AJI-3 Director is not required.

The risk acceptor(s), in coordination with the change proponent, may need to update or change an SRM document as a project progresses and decisions are modified. Monitoring may indicate that the NAS change does not meet the predicted residual risk, that the risk management strategy is less effective than expected, or that additional hazards exist. In this case, additional safety requirements may be necessary. Any change that may affect the assumptions, hazards, causes, or estimated risk in an SRM document necessitates a revision, including new signatures. A change page (containing a description of each change to the SRM document and the number of each affected page) must be included with each SRM document.

Based on the results of external assessments (e.g., Independent Operational Assessments, Flight Inspections, post-implementation safety assessments, AJI audits and assessments, and the NAS Technical Evaluation Program), the change proponent may need to reconvene the SRM panel attendees and update the SRM document as needed.

6.1 Audit and Assessment Programs

Safety and Technical Training (AJI) Safety Assurance programs evaluate compliance with Safety Management System (SMS) requirements and Federal Aviation Administration (FAA) and/or Air Traffic Organization (ATO) orders, standards, policies, and directives. Findings from these assessments could require that the change proponent reconvene the Safety Risk Management (SRM) panel attendees and update the SRM document as needed.

Audit and assessment programs evaluate:

- The effectiveness of each Service Unit's performance and operations;
- The effectiveness of Air Traffic Control (ATC) facilities' and Technical Operations (AJW) Districts' internal Quality Control efforts (e.g., operational skills assessments, system service reviews, certification, periodic maintenance, data integrity, modification, and availability);
- The effectiveness of Quality Control mitigation efforts in response to identified trends and risks;
- Trends identified from safety data analysis;
- The effectiveness of safety-related policies and procedures; and
- Compliance with and maturity of the ATO's SMS.

6.1.1 ATO Compliance Verification Evaluation Program

FAA Order JO 7210.633, *Air Traffic Organization (ATO) Quality Assurance (QA)*, and FAA Order JO 7210.634, *Air Traffic Organization (ATO) Quality Control*, describe the current ATC facility evaluation and assessment programs that involve assessments and audits focusing on compliance and safety. Air Traffic Service Area Directors, Air Traffic Managers (ATMs), and AJW Districts are responsible for conducting internal evaluations of their respective facilities. The Quality Assurance Group, AJI-12, retains oversight of the ATC evaluation process and performs program assessments.

6.1.2 Difference between ATC Facility Audits and Assessments

The ATM conducts internal compliance verifications of their facility in accordance with FAA Order JO 7210.634. AJI conducts audits based on identified or suspected safety issues and noncompliance in accordance with FAA Order JO 1000.37, *Air Traffic Organization Safety Management System*. The office determines priorities by soliciting input from the Service Areas and other FAA Lines of Business (LOBs) and by analyzing objective criteria from sources such as occurrence reports and risk analysis results. In addition, AJI conducts no-notice spot inspections of ATC facilities and AJW activities, including the Aviation System Standards group.

6.1.3 National Airspace System Technical Evaluation Program

FAA Order 6000.15, *General Maintenance Handbook for National Airspace System (NAS) Facilities*; FAA Order JO 6040.6, *National Airspace System Technical Evaluation Program*; and FAA Order 8200.1, *United States Standard Flight Inspection Manual*, describe the equipment evaluation and auditing programs that are part of the National Airspace System (NAS) Technical Evaluation Program.

The NAS Technical Evaluation Program provides AJI with asset management and safety decision-making information based on an independent review of:

- How well facilities and services meet their intended objectives:
    - Evaluators check key performance parameters and certification parameters at selected facilities.
    - Evaluators review NAS Performance Analysis and NAS Performance Index data.
- How well the maintenance program is executed:
    - Evaluators review facility logs to verify certification, periodic maintenance accomplishments, and documentation of corrective and scheduled maintenance activities.
    - Evaluators review the completion of required modifications.
    - Evaluators review facility documentation, such as Technical Performance Records, and required reference data.
- How well customer needs are being met:
    - Evaluators solicit customer feedback through interviews and surveys.
    - Evaluators review the outage coordination process.

Evaluators may also review specialist certification records and credentials. These reviews are either part of a special inspection or are random spot checks of documentation in a location that is geographically convenient to the routine evaluation.

6.1.4 Independent Operational Assessments

AJI supports the agency's commitment to field-safe and operationally ready solutions by conducting Independent Operational Assessments (IOAs) on designated new or modified systems or capabilities before the In-Service Management phase. An IOA is a full system- or capability-level evaluation conducted in an operational environment. An IOA's purpose is to confirm the readiness of a system from an operational and safety perspective. IOAs are independent of the Program Management Organization (AJM) implementing the solution. IOAs evaluate systems against pre-determined critical operational issues. Hazards identified by an IOA must still undergo all necessary phases of the SRM process by the change proponent.

The Vice President of AJI directs the commencement of an IOA after the acceptance of an IOA Readiness Declaration from the Vice President of AJM. To assess the system/capability, AJI collaborates with the organizations that will operate, maintain, or otherwise be operationally affected by the solution. AJI reports any new or previously identified hazards, as well as operational concerns, based on data observed and collected during the IOA.

At the conclusion of an IOA, the team assesses the solution's operational readiness based on the identified hazards and any observed operational concerns. The team reports and briefs the results of the IOA to affected stakeholders, including the Vice President of AJI, AJM, the affected operating service(s), and any other affected organizations. The results are also provided to the In-Service Decision authority. The change proponent is responsible for the treatment and monitoring phases of SRM for the hazards identified during the IOA.

6.1.5 Independent Assessments

AJI performs independent assessments to evaluate operational procedures, order compliance, fielded systems, and safety benefits. An AJI independent assessment is independent of the Program Office or operating service responsible for the program or operation. They are post-implementation evaluations of NAS changes that assess actual performance.

During independent assessments, the teams verify that any previously documented hazards were rated accurately (based on observed data) and that no unacceptable safety risks exist. In addition, teams may identify operational issues and other findings.

Independent assessments may involve several facility or program assessments over a long period of time, one assessment that lasts for an extended period of time, or multiple brief assessments. The processes and procedures are tailored according to the duration of the assessment and the complexity of the operation or program being assessed. The assessment may be conducted at one or multiple sites, and data may be collected on site or remotely. Results and/or recommendations are based on the assessment team's analysis of data collected during and, if applicable, before the assessment. The conclusions and recommendations are independent from external sources.

6.2 Safety Data Reporting, Tracking, and Analysis

SMSs require the collection and analysis of data from different sources and various vantage points to determine if hazards exist. An important aspect of safety data analysis is developing the capability to sort and analyze a vast array of data and transforming that data into information that permits the identification and mitigation of hazards, thus preventing future incidents and accidents.

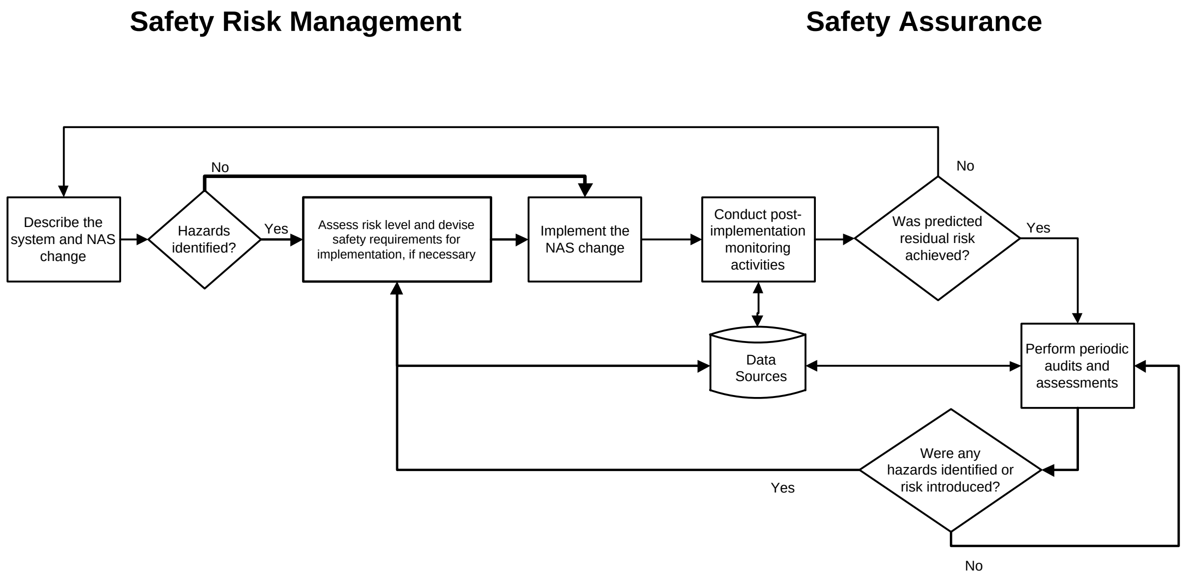
6.2.1 Purpose of Safety Data Collection and Evaluation

The tracking and analyzing of safety data to enhance the ATO's awareness of potentially hazardous situations is a critical aspect of the SMS. AJI assists with the collection and analysis of agency-wide safety data and supports sharing the data to continually improve the safety of the NAS.

Safety data are used to:

- Identify risks, systemic trends, and vulnerabilities in the system;
- Determine the effects of a NAS change on the operation as a whole;
- Assess the performance of safety requirements in managing risk;
- Identify areas where safety could be improved;
- Contribute to accident and incident prevention; and
- Assess the effectiveness of training.

In most cases, if the analysis of safety data leads to the identification of issues or hazards, the resolution or corrective action constitutes a NAS change, which requires SRM. This is an example of the continuous, closed-loop process for managing safety risk.


Safety Risk Management
Safety Assurance
Describe the system and NAS change
Hazards identified?
No
Yes
Assess risk level and devise safety requirements for implementation, if necessary
Implement the NAS change
Conduct post-implementation monitoring activities
Was predicted residual risk achieved?
No
Yes
Data Sources
Perform periodic audits and assessments
Were any hazards identified or risk introduced?
Yes
No

6.2.2 AJI's Role in Safety Data Collection and Evaluation

AJI obtains safety data through various sources within and outside the FAA. AJI measures safety by tracking safety metrics to produce reports on NAS safety, which are shared with appropriate LOBs and/or external stakeholders.

6.2.3 Safety Data Collection and Reporting Processes

The FAA collects and reports on safety data from various sources in the NAS. Section 7 lists many of the existing FAA and ATO orders, processes, and databases related to safety data collection and reporting.

- FAA Order JO 7210.632, *Air Traffic Organization Occurrence Reporting*, provides specific direction regarding the recording, reporting, and investigation of air traffic incidents.
- FAA Order JO 6040.15, *National Airspace Performance Reporting System*, and FAA Order 6000.30, *National Airspace System Maintenance Policy*, cover reporting on the serviceability of ATO facilities and systems, such as failures and degradations of communications, surveillance, and other systems and equipment that affect safety. Maintenance guidelines, directives, checklists, configuration management, and the NAS Technical Evaluation Program all contribute to the periodic review and maintenance of equipment and procedures.
- The Safety Recommendation Reporting System provides FAA aviation safety inspectors with a method to develop and submit safety recommendations directly to the Office of Accident Investigation and Prevention. (See FAA Order 8020.16, *Air Traffic Organization Aircraft Accident and Aircraft Incident Notification, Investigation, and Reporting*.)
- The Risk Analysis Process[1] quantifies the level of risk present in any air traffic incident. It provides a method for consistent and coherent identification of risk elements and

[1] FAA Order JO 7210.633 removed Risk Analysis Events (RAEs) and the process for notification and interviews associated with RAEs. Any reference to RAEs in this SMS Manual are for research and historical purposes only.

allows users to prioritize actions designed to reduce the effect of those elements. The process uses the Risk Analysis Tool developed by EUROCONTROL to analyze each RAE. RAEs are assessed by a panel of air traffic and flight operations personnel (e.g., controllers and air-transport rated pilots). This panel is responsible for conducting the analysis of RAEs and coordinating the post-assessment reporting, mitigating, and tracking. The Risk Analysis Tool produces a numerical value of severity and repeatability on a risk matrix. The Risk Analysis Tool also captures any associated causal, systemic, and contributing factors.

- Aviation Risk Identification and Assessment (ARIA) identifies and assesses latent risk in the NAS and helps prioritize event analysis. Barrier Analysis Review (BAR) is the assessment of safety data to determine systemic risk and includes an evaluation of safety barrier resiliency. The aggregate data produced by this process assists in the identification of systemic trends and potential risk in the NAS. Referred ARIA Reports, potential operational risk identified during the Quality Assurance (QA) validation process, service area QA manager referral, National Air Traffic Controllers Association service area or national safety representative referral, AJI Headquarters manager referral, and random QA selections are all means by which safety data may be referred for BAR.

Several non-punitive, voluntary reporting programs allow pilots and ATO personnel to report an incident or event without reprisal. These programs include the Aviation Safety Action Program (refer to the Air Traffic Safety Oversight Service Safety Oversight Circular 07-04, *Aviation Safety Action Program (ASAP) for Credentialed ATO Personnel*), the Aviation Safety Reporting Program, the Technical Operations Safety Action Program, and the Air Traffic Safety Action Program. They are designed to foster consistent reporting and higher quality data.

Other mechanisms employed by the FAA for employees to report issues include the Unsatisfactory Condition Report program, the Aviation Safety Hotline, and the Administrator’s Hotline. Both hotlines can be reached by calling 1-800-255-1111.

7.1 Safety Data and Information Repositories

Federal Aviation Administration (FAA) employees populate several aviation safety databases with information regarding National Airspace System (NAS) safety events and serviceability. Many professionals use aviation safety data and information as input for the development of NAS safety enhancements. For assistance in collecting safety data, contact the Safety and Technical Training (AJI) Safety Analysis Group, AJI-32. Sources for gathering safety data and information include:

- National Transportation Safety Board (NTSB) recommendations;
- FAA recommendations;
- Air Traffic Safety Oversight Service compliance issues;
- Requirements for new communication, navigation, surveillance, and automation services to enhance or expand airspace management;
- Unsatisfactory Condition Reports;
- Employee suggestions;
- Applications for procedural changes;
- Research and development;
- Acquisition of new systems and equipment;
- Industry advocacy;
- Participation in international forums;

Table 7.1 provides an overview of various safety databases and recording systems used by the FAA, and Table 7.2 outlines data types and applicable reporting requirements.

Table 7.1: Safety Databases and Reporting Systems

System Name	Overview
Mandatory Reporting Data	
Accident/Incident Data System	The Accident/Incident Data System contains data records for all general aviation and commercial air carrier incidents since 1978.
Air Traffic Quality Assurance database	Formerly known as the National Airspace Incidents Monitoring System, the Air Traffic Quality Assurance database is a collection of databases specific to the following subjects: Near Mid-Air Collisions (NMACs), pilot deviations, vehicle/pedestrian deviations, and Area Navigation / Required Navigation Performance deviations. The NMAC database contains reports of in-flight incidents where two aircraft have closed to an unsafe distance but avoided an actual collision. The pilot deviation database contains incident reports in which the actions of a pilot violated a Federal Aviation Regulation or a North American Aerospace Defense Command Air Defense Identification Zone tolerance. The vehicle/pedestrian deviation database contains incident reports of pedestrians, vehicles, or other objects interfering with aircraft operations on runways or taxiways.
Aviation Risk Identification and Assessment (ARIA) System	ARIA is an automated system that helps employ risk-based, data-driven decision-making, facilitating better insight into potential risk in the NAS via the Barrier Analysis Review process, which assesses severity, likelihood, and barrier effectiveness in Referred ARIA Reports. Barrier analysis is also used to identify and assess factors (mitigating, aggravating, or observed) for air traffic operations where at least one aircraft is receiving Air Traffic Control (ATC) services.
Aviation Safety Information Analysis and Sharing (ASIAS) System	ASIAS is a data warehouse and integrated database system. It enables users to perform queries across multiple databases and display queries in useful formats. It includes accidents, incidents, and pilot reports of NMACs.
Compliance Verification Tool (CVT)	The CVT replaces the Facility Safety Assessment System. Facilities conduct internal compliance verifications and enter the information in the tool. The Quality Control groups in the Service Units conduct external compliance verifications and enter the information in the tool. Service delivery points also develop risk mitigation plans that communicate how specific risks will be mitigated for all checklist items contained in the CVT determined to be noncompliant.
Comprehensive Electronic Data Analysis and Reporting (CEDAR)	The CEDAR system provides an electronic means of assessing employee performance, managing resources, and capturing safety-related information and metrics. The tool provides a standard interface for the collection, retrieval, and reporting of data from multiple sources. It also automates the creation, management, and storage of facility activities, events, briefing items, Quality Assurance Reviews, Technical Training discussions, and FAA forms.
Facility Safety Assessment System	The Facility Safety Assessment System is a national database that contains historical information related to the Facility Safety Assessment process. This information includes evaluation checklists, reports, facility information, tracking information, and response data.
Integrated NAS Technical Evaluation Program Application	This national database contains reports, findings, and mitigation plans from NAS Technical Evaluation Program audits and assessments. It is maintained by the NAS Quality Assurance and Performance Group in the Services Management Group.
NTSB Accident and Incident Database	The NTSB accident and incident database is the official repository of aviation accident data and causal factors. In this database, personnel categorize events as accidents or incidents.

System Name	Overview
Mandatory Reporting Data	
Facility Directives Repository	This database contains Letters of Agreement, Standard Operating Procedures, and facility orders for all facilities nationwide.
Operations Network	The Operations Network is the official source of NAS air traffic operations and delay data. The data collected through the Operations Network are used to analyze the performance of the FAA's ATC facilities' traffic count and delay information, airport traffic control tower and Terminal Radar Approach Control operations, etc.
Performance Data Analysis and Reporting System (PDARS)	PDARS calculates a range of performance measures, including traffic counts, travel times, travel distances, traffic flows, and in-trail separations. It turns these measurement data into information useful to FAA facilities through an architecture that features: • Automatic collection and analysis of radar tracks and flight plans, • Automatic generation and distribution of daily morning reports, • Sharing of data and reports among facilities, and • Support for exploratory and causal analysis.
Risk Analysis Tool	FAA Order JO 7210.633, *Air Traffic Organization (ATO) Quality Assurance (QA)*, removed Risk Analysis Events (RAEs) and the process for notification and interviews associated with RAEs. Any references to RAEs in this Safety Management System Manual are for research and historical purposes only. RAE severity indicators are as follows: a. **Proximity.** Failure transition point of 50 percent of required separation or less. b. **Rate of Closure.** Failure transition point greater than 205 knots or 2,000 feet per minute (consider both aspects and utilize the higher of the two if only one lies above the transition point). c. **ATC Mitigation.** ATC able to implement separation actions in a timely manner. d. **Pilot Mitigation.** Pilot executed ATC mitigation in a timely manner.
Voluntary Reporting	
Air Traffic Safety Action Program (ATSAP)	ATSAP is a non-punitive, voluntary reporting program modeled after the Aviation Safety Action Program for employees delivering air traffic services. It allows for employees to submit safety concerns and deficiencies so issues can be resolved before a major error occurs. This voluntary reporting helps promote a strong safety culture within the ATO.
Aviation Safety Action Program (ASAP)	ASAP promotes voluntary reporting of safety issues and events that come to the attention of employees of certain certificate holders. It includes enforcement-related incentives to encourage employees to voluntarily report safety issues, even though the issues may involve an alleged violation of Title 14 of the Code of Federal Regulations.
Aviation Safety Reporting System (ASRS)	ASRS collects voluntarily submitted aviation safety incident/situation reports from pilots, controllers, and other personnel. It identifies system deficiencies and issues messages to alert individuals in a position to correct the identified issues.
TechNet	The TechNet website provides a means for expediently distributing NAS operational information within the FAA. It contains information such as NAS delay information by service (e.g., automation, surveillance, navigation, and communication) and active equipment outages (i.e., full interruptions to service).

System Name	Overview
Technical Operations Safety Action Program (T-SAP)	T-SAP is a voluntary, non-punitive safety reporting program for ATO Technical Operations personnel. Employees at the point of service have a unique understanding of safety and can better identify threats and risks to their particular operations. By studying the data gained from voluntary reports, safety issues can be more efficiently identified and mitigated.

Table 7.2: Data Types and Applicable Reporting Requirements

Data	Overview	References
Aircraft incident or accident	This order contains reporting requirements regarding safety issues, concerns, incidents, and accidents.	FAA Order JO 8020.16, *Air Traffic Organization Aircraft Accident and Accident Incident Notification, Investigation, and Reporting*
Mandatory occurrence reports	This order mandates that personnel collect and analyze data concerning air traffic incidents.	FAA Order JO 7210.632, *Air Traffic Organization Occurrence Reporting*
Oceanic altitude and navigation errors	This order establishes procedures for processing reports and for collecting system data for analysis.	FAA Order JO 7210.632, *Air Traffic Organization Occurrence Reporting*
Safety recommendations	This order establishes procedures for Aviation Safety Inspectors to report safety recommendations directly to the Office of Accident Investigation and Prevention.	FAA Order JO 8020.16, *Air Traffic Organization Aircraft Accident and Aircraft Incident Notification, Investigation, and Reporting*
Significant system events	This order mandates that significant events be reported and contributes to daily system performance and incident reporting.	FAA Order JO 6030.41, *Technical Operations Notification of System and Service Interruptions and Other Significant Events*
System outages	This order mandates that outage reports be filed and contributes to daily system performance and incident reporting.	FAA Order JO 6040.15, *National Airspace Performance Reporting System (NAPRS)*
Unsatisfactory conditions	This order provides FAA employees with a means of informing management of unsatisfactory conditions.	FAA Order 1800.6, *Unsatisfactory Condition Report*
Voluntary Safety Reports	This order defines the policy and procedures for ATO Voluntary Safety Reports. It identifies the responsibilities of individuals and organizations and the requirements, expectations, and policies under which the identified programs operate.	FAA Order JO 7200.20, *Voluntary Safety Reporting Programs*

8.1 Definitions

Acceptable Level of Safety Risk. Medium or low safety risk.

Accident. An unplanned event or series of events that results in death; injury; or damage to, or loss of, equipment or property.

Active Failure. An error of omission or commission that is made in the course of a particular operation. An active failure can also be a known problem or a known mechanical deficiency or fault.

Acquisition Management System (AMS). A Federal Aviation Administration (FAA) policy dealing with any aspect of lifecycle acquisition management and related disciplines. The AMS also serves as the FAA's Capital Planning and Investment Control process.

Air Traffic Safety Oversight Service (AOV) Acceptance. The process whereby the regulating organization has delegated the authority to the service provider to make changes within the confines of approved standards and only requires the service provider to notify the regulator of those changes within 30 days. Changes made by the service provider in accordance with their delegated authority can be made without prior approval by the regulator.

Analysis. The process of identifying a question or issue to be addressed, examining the issue, investigating then interpreting the results, and possibly making a recommendation. Analysis typically involves using scientific or mathematical methods for evaluation.

AOV Approval. The formal act of approving a National Airspace System (NAS) change submitted by a requesting organization. This action is required prior to the proposed NAS change being implemented.

Assessment. A process of measuring or judging the value or level of something.

Assumptions. Conclusions based on the presumed condition of a system or system state—not documented facts, desired outcomes, or mitigations.

Audit. A review of an organization's safety programs or initiatives to verify completion of tasks and to determine the organization's compliance with FAA directives and procedures.

Aviation Risk Identification and Assessment (ARIA). An automated system that helps employ risk-based, data-driven decision-making, which facilitates better insight into potential risk in the NAS.

Barrier Analysis Review (BAR). The process used to assess severity, likelihood, and barrier effectiveness in Referred ARIA Reports. Barrier analysis is also used to identify and assess factors (mitigating, aggravating, or observed) for air traffic operations where at least one aircraft is receiving Air Traffic Control (ATC) services.

Baseline. The written processes, procedures, specifications, and other conditions of the system that were accepted as the starting point for oversight of safety in the NAS on March 14, 2005. The Air Traffic Organization (ATO) must maintain the NAS at a safety level that is at least equal to that state, in compliance with current policies, processes, and procedures that are documented in its orders, handbooks, and manuals. (Note: "Acceptance of the baseline did not imply or state that the NAS was or was not inherently safe as configured on that date, nor did it imply that the NAS had no existing high risks," AOV Safety Oversight Circular 07-01, *Acceptance of the Air Traffic Organization (ATO) Baseline*.)

Bounding. A process of limiting the analysis and assessment of a change or system to only the elements that affect or interact with each other to accomplish the central function of that change or system.

Cause. The origin of a hazard.

Change Proponent. An individual, Program Office, facility, or organization within the FAA that has identified the need for Safety Risk Management (SRM) or has proposed or is sponsoring a NAS change or means to address an identified existing safety issue. The SRM panel members are selected at the discretion of the change proponent and/or SRM panel facilitator.

Common Cause Failure. A failure that occurs when a single fault results in the corresponding failure of multiple system components or functions.

Compliance Audit. An audit that evaluates conformance to established criteria, processes, and work practices. The objective of a compliance audit is to determine whether employees and processes have followed established policies and procedures.

Continuous Loop. SRM processes are repeated until the safety risk associated with each hazard is acceptable and has met its predicted residual risk.

Concurrence. The concurrence signature is used to represent a technical review of the SRM document and to confirm the rationale used throughout is consistent with the SRM process. The concurrence signature comes from an SRM expert who is well versed in this Safety Management System (SMS) Manual and familiar with the terminology and processes therein.

Configuration Management. A process for establishing and maintaining the consistency of a product's performance, function, and physical attributes with its requirements, design, and operational information throughout its life.

Confirmation. The act of using a written response from a non–SRM panel attendee to confirm the integrity of a specific item or assertion.

Consensus. The judgement arrived at by a majority of panel members.

Control. Any means currently reducing a hazard's causes or effects. (See "Mitigation.")

Credible. It is reasonable to expect that the assumed combination of conditions that define the system state will occur within the operational lifetime of a typical ATC system (i.e., 30 years).

Critical NAS System. A system that provides functions or services that, if lost, would prevent users of the NAS from exercising safe separation and control over aircraft.

Current Risk. The composite of severity and frequency of a hazard's effects in the present state.

Development Assurance. All the planned and systematic actions used to substantiate, at an adequate level of confidence, that errors in requirements, design, and implementation have been identified and corrected such that the system satisfies the applicable approval or certification basis.

Dissention. If any SRM panel member disagrees with the SRM panel's official findings (i.e., group consensus cannot be reached), that panel member should provide the nature and summary of the disagreement for inclusion in this part of the SRM document.

Effect. The real or credible harmful outcome that has occurred or can be expected to occur if the hazard occurs in the defined system state.

Equipment. A complete assembly—operating either independently or within a system/sub-system—that performs a specific function.

Error-Tolerant System. A system that is designed and implemented in such a way that, to the maximum extent possible, errors and equipment failures do not result in an incident or accident. An error-tolerant design is the human equivalent of a fault-tolerant design.

Existing Safety Issue. Existing contributing factors or findings that led to, or could lead to, an unsafe outcome.

Facility. Generally, any installation of equipment designated to aid in the navigation, communication, or control of air traffic. Specifically, the term denotes the total electronic equipment, power generation, or distribution systems and any structure used to house, support, and/or protect these equipment and systems. A facility may include a number of systems, sub-systems, and equipment.

Fail Operational. A system designed such that if it sustains a fault, it still provides a subset of its specified behavior.

Fail Safe. A system designed such that if it fails, it fails in a way that will cause no harm to other devices or will not present a danger to personnel.

Fault Tolerance. The ability of a system to respond without interruption or loss of capabilities in the event of an unexpected hardware or software failure.

Frequency. An expression of how often a given effect occurs.

Hazard. Any real or potential condition that can cause injury, illness, or death to people; damage to or loss of a system, equipment, or property; or damage to the environment. A hazard is a prerequisite to an accident or incident.

Hazard Analysis Worksheet (HAW). A tool used to provide an initial overview of the hazard's presence in the overall flow of the operation.

Hazard Identification. The determination of the hazard scenarios and associated consequences (undesired events) as a result of introducing a new system into the NAS. This provides an intermediate product that expresses the hazards that will be used during risk analysis and assessment.

High-Risk Hazard. A hazard with an unacceptable level of safety risk; the NAS change cannot be implemented unless the hazard's associated risk is mitigated and reduced to medium or low.

Hull Loss. An aircraft that is destroyed / substantially damaged beyond economic repair, missing, or completely inaccessible.

Human-Centered. The structured process during concept and requirement definition, design, development, and implementation that identifies the user as the focal point of the effort for which procedures, equipment, facilities, and other components serve to support human capabilities and compensate for human limitations; also called "user-centered."

Human Factors. A multidisciplinary effort to generate and compile information about human capabilities and limitations and apply that information to equipment, systems, facilities, procedures, jobs, environments, training, staffing, and personnel management for safe, comfortable, and effective human performance. (See FAA Order 9550.8, *Human Factors Policy*.)

Incident. An occurrence other than an accident that affects or could affect the safety of operations.

Initial Risk. The composite of the severity and likelihood of a hazard's effect, considering only controls and documented assumptions for a given system state. It describes the risk before any of the proposed mitigations are implemented.

Inquiry. The technique of asking questions and recording responses.

Inspection. The act of critically examining documents to determine the content and quality of a transaction, such as inspecting leases, contracts, meeting minutes, requirements, and organization policy.

Latent Failure. An error or failure with adverse consequences that may lie dormant within a system for a long time, becoming evident when combined with other factors.

Likelihood. The estimated probability or frequency, in quantitative or qualitative terms, of a hazard's effect or outcome.

Maintenance. Any repair, adaptation, upgrade, or modification of NAS equipment or facilities. This includes preventive maintenance.

Management Strategy. Actions designed to reduce or manage the risk associated with a NAS change or operation.

Mitigation. Any means to reduce the risk of a hazard.

National Airspace System (NAS). A complex system that is composed of airspace, airports, aircraft, pilots, air navigation facilities, and ATC facilities; communication, navigation, and surveillance services and supporting technologies and systems; operating rules, regulations, policies, and procedures; and people who implement, sustain, or operate the system components.

NAS Change. A modification to any element of the NAS that pertains to, or could affect, the provision of air traffic management and/or communication, navigation, and surveillance services.

Near Mid-Air Collision Categories. FAA Order 8900.1, *Flight Standards Information Management System*, Volume 7, Chapter 4, identifies the following definitions of Critical, Potential, and Low categories:

1) **"A" – Critical.** A situation in which collision avoidance was due to chance, rather than a pilot's evasive act or action. Situations where large evasive maneuvers are necessary to avoid collision and/or situations where little or no time is available to recognize the threat and react appropriately. Encounters of less than 100 feet separation are considered to be critical risk.
2) **"B" – Potential.** A situation which would probably have resulted in a collision if no action had been taken by the pilot; a situation in which a Traffic Alert and Collision Avoidance System (TCAS) Resolution Advisory was received and followed; or where a Traffic Information Services (TIS) alert or the pilot sighting the traffic without electronic aid caused pilot evasive action. A "potential" risk is a situation in which a collision would probably occur eventually if no action is taken by either pilot. Situations of encounters of less than 500 feet separation may be considered potential risk.
3) **"C" – Low Potential.** A situation in which a collision is unlikely, however, one or both pilots was surprised by the proximity of the other; one in which the course of the aircraft bring them closer than required approved separation; a situation where whether or not the pilot took evasive action a collision probably would not occur; or a situation in which there is ample time to take action to avoid a collision. A TIS alert or TCAS traffic advisory may cause the pilot to take action after sighting the traffic either with or without the aid of an electronic alert system; situations of encounters of 500 feet or greater; slowly converging flightpaths may be considered low potential collision risks.

Objective Evidence. Documented proof; the evidence must not be circumstantial and must be obtained through observation, measurement, testing, or other means.

Observation. The process of witnessing an organization's process. It differs from a physical examination in that the auditor only observes the process; no physical evidence is obtained.

Operational Assessments. An assessment to address the effectiveness and efficiency of an organization. The objective of an operational assessment is to determine the organization's ability to achieve its goals and accomplish its mission.

Opposing Opinion. An opinion submitted in writing if a Subject Matter Expert (SME) participating in an SRM panel disagrees with that SRM panel's official findings; opposing opinions are attached to the SRM document as part of the distribution.

Oversight. Regulatory supervision to validate the development of a defined system and verify compliance to a pre-defined set of standards.

Physical Examination. The act of gathering physical evidence. It is a substantive test involving the counting, inspecting, gathering, and inventorying of physical and tangible assets, such as cash, plants, and equipment.

Preconditions. The system states or variables that must exist for a hazard or an accident to occur in an error-tolerant system.

Predicted Residual Risk. The risk that is estimated to exist after the safety requirements are implemented or after all avenues of risk mitigation have been explored.

Preliminary Hazard List (PHL). A hazard identification tool used to list all potential hazards in the overall operation. Development of a PHL typically begins with a brainstorming session among the individuals participating in the SRM panel.

Process. A set of interrelated or interacting activities that transform inputs into outputs.

Program Assessment. A Safety Assessment's review of an organization's safety programs or initiatives. Programs and initiatives include, but are not limited to, Service Area Quality Assurance (QA), Air Traffic Facility Quality Control, Runway Incursion Prevention Plans, Equipment Availability Programs, and Contractor QA programs for Federal Contract Towers (FCT).

Qualitative Data. Subjective data expressed as a measure of quality; nominal data.

Quality Assurance (QA). A program for the systematic monitoring and evaluation of the various aspects of a project, service, or facility to ensure that standards of quality are being met. It is a process to assess and review the processes and systems that are used to provide outputs (whether services or products) and to identify risks and trends that can be used to improve these systems and processes.

Quality Control. A process that assesses the output (whether a product or service) of a particular process or function and identifies any deficiencies or problems that need to be addressed.

Quantitative Data. Objective data expressed as a quantity, number, or amount, allowing for a more rational analysis and substantiation of findings.

Recording. The process of documenting the identified hazards and the associated safety information.

Redundancy. A design attribute in a system that ensures duplication or repetition of elements to provide alternative functional channels in case of failure. Redundancy allows the service to be provided by more than one path to maximize the availability of the service.

Requirement. An essential attribute or characteristic of a system. A requirement is a condition or capability that must be met or passed by a system to satisfy a contract, standard, specification, or other formally imposed document or need.

Residual Risk. The level of risk that has been verified by completing a thorough monitoring plan with an achieved measurable safety performance target(s). Residual risk is the composite of the severity of a hazard's effect and the frequency of the effect's occurrence.

Risk. The composite of predicted severity and likelihood of the potential effect of a hazard.

Risk Acceptance. The confirmation by the appropriate management official that they understand the safety risk associated with the NAS change or existing safety issue and that they accept that safety risk into the NAS. Risk acceptance requires that signatures have been obtained for the safety requirements identified in the SRM document and that a comprehensive monitoring plan has been developed and will be followed to verify the predicted residual risk.

Risk Analysis Event (RAE). A loss of approved separation between two aircraft in a radar environment that results in less than 66 percent of the applicable separation minima maintained. FAA Order JO 7210.633, *Air Traffic Organization (ATO) Quality Assurance (QA)*, removed RAEs and the process for notification and interviews associated with RAEs. Any reference to RAEs in this SMS Manual are for research and historical purposes only.

Risk Assumption Strategy. A risk management strategy used to accept the risk.

Risk Avoidance Strategy. A risk management strategy used to avert the potential occurrence and/or consequence of a hazard by either selecting a different approach or not implementing a specific proposal.

Risk Control Strategy. A risk management strategy used to develop options and take actions to lower the risk.

Risk Mitigation. Refer to “Mitigation.”

Risk Transfer Strategy. A risk management strategy used to shift the ownership of a risk to another party.

Safety. The state in which the risk of harm to persons or property damage is acceptable.

Safety Assurance. A set of processes within the SMS that verify that an organization meets or exceeds its safety performance objectives and that function systematically to determine the effectiveness of safety risk controls through the collection, analysis, and assessment of information. Safety Assurance is one of the four components of the SMS.

Safety Culture. The way safety is perceived and valued in an organization. It represents the priority given to safety at all levels in the organization and reflects the real commitment to safety.

Safety Case Lead (SCL). An expert in SMS policy and guidance that pertain to the ATO.

Safety Directive. A mandate from AOV to the ATO to take immediate corrective action to address a noncompliance issue that creates a significant unsafe condition.

Safety Management System (SMS). An integrated collection of policies, processes, procedures, and programs used to manage safety risk in the provision of air traffic management and communication, navigation, and surveillance services.

Safety Margin. The buffer between the actual minimum-level requirement and the limit of the hardware or software system.

Safety Performance Indicators. Metrics identified to determine how risk mitigations are performing.

Safety Performance Monitoring. The act of observing the safety performance of the NAS to ensure an acceptable level of safety risk.

Safety Performance Targets. Measurable goals used to verify the predicted residual risk of a hazard. They should quantifiably define the predicted residual risk.

Safety Policy. The documented organizational policy that defines management’s commitment, responsibility, and accountability for safety. One of the four components of the SMS, Safety Policy identifies and assigns responsibilities to key safety personnel.

Safety Promotion. The communication and distribution of information to improve the safety culture and the development and implementation of programs and/or processes that support the integration and continuous improvement of the SMS within the ATO. One of the four components of the SMS, Safety Promotion allows the ATO to share and provide evidence of successes and lessons learned.

Safety Requirement. A planned or proposed means to reduce a hazard’s causes or effects.

Safety Requirement Approval. Certification that the safety requirements can and will be implemented.

Safety Risk Management (SRM). A process within the SMS composed of describing the system; identifying the hazards; and analyzing, assessing, and treating risk. One of the four components of the SMS, SRM includes processes to define strategies for monitoring the safety risk of the NAS. SRM complements Safety Assurance.

SRM Document. A document that records the SRM panel attendees’ determinations for NAS changes and existing safety issues. It presents evidence supporting whether the NAS change and/or risk management strategies should be accepted by ATO or FAA management officials from a safety risk perspective.

SRM Document Approval (for SRM Documents With Hazards). Indication that the SRM document was developed in accordance with policy and guidance; hazards were systematically identified using a structured approach; risk was appropriately analyzed and assessed; if identified, safety requirements were deemed valid; safety performance targets or other methods to verify predicted residual risk were approved by the responsible Service Unit; and a monitoring plan was prepared. SRM document approval does not constitute acceptance of the risk associated with the NAS change or existing safety issue or approval to implement the NAS change.

SRM Document Approval (for SRM Documents Without Hazards). Indication that the SRM document was developed in accordance with policy and guidance, the NAS change did not introduce new hazards or increase safety risk, and the SRM document includes a detailed rationale to support the finding of no hazards.

SRM Panel. A meeting of a diverse group of SRM panel members, SMEs, observers, and facilitators from the various organizations affected by the NAS change or existing safety issue. They objectively identify potential hazards and effects associated with the NAS change or existing safety issue and provide findings and recommendations to decision-makers, which are captured in an SRM document.

SRM Panel Co-Facilitator. A person who shares responsibilities with the SRM panel facilitator in supporting the SRM panel.

SRM Panel Facilitator. A trained expert on the SRM process who moderates the deliberations of the SRM panel attendees from a neutral position. They invoke participation, mediate discussion, ensure any dissenting opinions are documented, keep the meeting organized and on topic, remain neutral throughout the process without advocating for a specific outcome, and may support the development of the SRM document.

SRM Panel Member. An SRM panel member is an FAA employee[1] or other representative (as specified in an FAA Memorandum of Agreement)[2] who objectively performs the SRM process. The SRM panel members are selected at the discretion of the change proponent and/or SRM panel facilitator.

SRM Panel Observer. An individual who is not part of the SRM panel meeting and does not participate in the deliberation process (only observes the proceedings). They have an objective to obtain a better understanding of the SRM process—not the NAS change or existing safety issue being addressed. SRM panel observers are permitted at the discretion of the change proponent.

Safety Risk Tracking. A closed-loop means of ensuring that the requirements and mitigations associated with each hazard that has associated medium or high risk are implemented. Safety risk tracking is the process of defining safety requirements, verifying implementation, and readdressing the risk to make sure the hazard meets its risk level requirement before being accepted.

Severity. The consequence or impact of a hazard’s effect or outcome in terms of degree of loss or harm.

Single Point Failure. The failure of an item that would result in the failure of the system and is not compensated for by redundancy or an alternative operational procedure.

SMS Continuous Improvement Plan. The plan that specifies the activities required for individual ATO Service Units to allocate sufficient resources toward the integration and maturation of the ATO SMS.

Source (of a Hazard). Any real or potential origin of system failure, including equipment, operating environment, human factors, human-machine interface, procedures, and external services.

Stakeholder. A group or individual that is affected by or is in some way accountable for the outcome of a safety undertaking; an interested party having a right, share, or claim in a product or service or in its success in possessing qualities that meet that party’s needs and/or expectations.

Subject Matter Expert (SME). An FAA employee or third-party stakeholder who serves as a technical expert on the NAS change, procedure, hardware/software, or proposed solution

[1] Inclusive of FCT employees or other contractors who have been given explicit authority to represent (i.e., make decisions for / speak on behalf of) the FAA.

[2] This includes FAA bargaining unit representatives or Department of Defense (DoD) representatives. Note: DoD representatives participate as panel members when DoD ATC procedures/airspace are impacted.

undergoing SRM. SMEs are not SRM panel members and do not participate in the consensus-driven decisions regarding initial / predicted residual risk levels while analyzing or assessing safety risks to the NAS.

System. Integrated elements that are combined in an operational or support environment to accomplish a defined objective. These elements include people, hardware, software, firmware, information, procedures, facilities, services, and other support facets.

System State. An expression of the various conditions, characterized by quantities or qualities, in which a system can exist.

Tracking. The continued process of documenting the results of monitoring activities and the change's effect on the safety of the NAS.

Unacceptable Level of Safety Risk. A high-risk hazard or a combination of medium/low risks that collectively increase risk to a high level.

Worst Credible Effect. The most unfavorable, yet believable and possible, condition given the system state.

8.2 Acronyms

ADS-B	Automatic Dependent Surveillance–Broadcast
AJG	Management Services
AJI	Safety and Technical Training
AJM	Program Management Organization
AJV	Mission Support Services
AJW	Technical Operations
AMASS	Airport Movement Area Safety System
AMS	Acquisition Management System
AOV	Air Traffic Safety Oversight Service
ARIA	Aviation Risk Identification and Assessment
ARP	Office of Airports
ARSR	Air Route Surveillance Radar
ARTCC	Air Route Traffic Control Center
ARTS	Automated Radar Terminal System
ASAP	Aviation Safety Action Program
ASDE	Airport Surface Detection Equipment
ASIAS	Aviation Safety Information Analysis and Sharing
ASR	Airport Surveillance Radar
ASRS	Aviation Safety Reporting System
ATC	Air Traffic Control
ATCRBS	Air Traffic Control Radar Beacon System
ATCT	Airport Traffic Control Tower
ATM	Air Traffic Manager / Air Traffic Management
ATO	Air Traffic Organization
ATO-SG	Air Traffic Organization Safety Guidance
ATSAP	Air Traffic Safety Action Program
BAR	Barrier Analysis Review

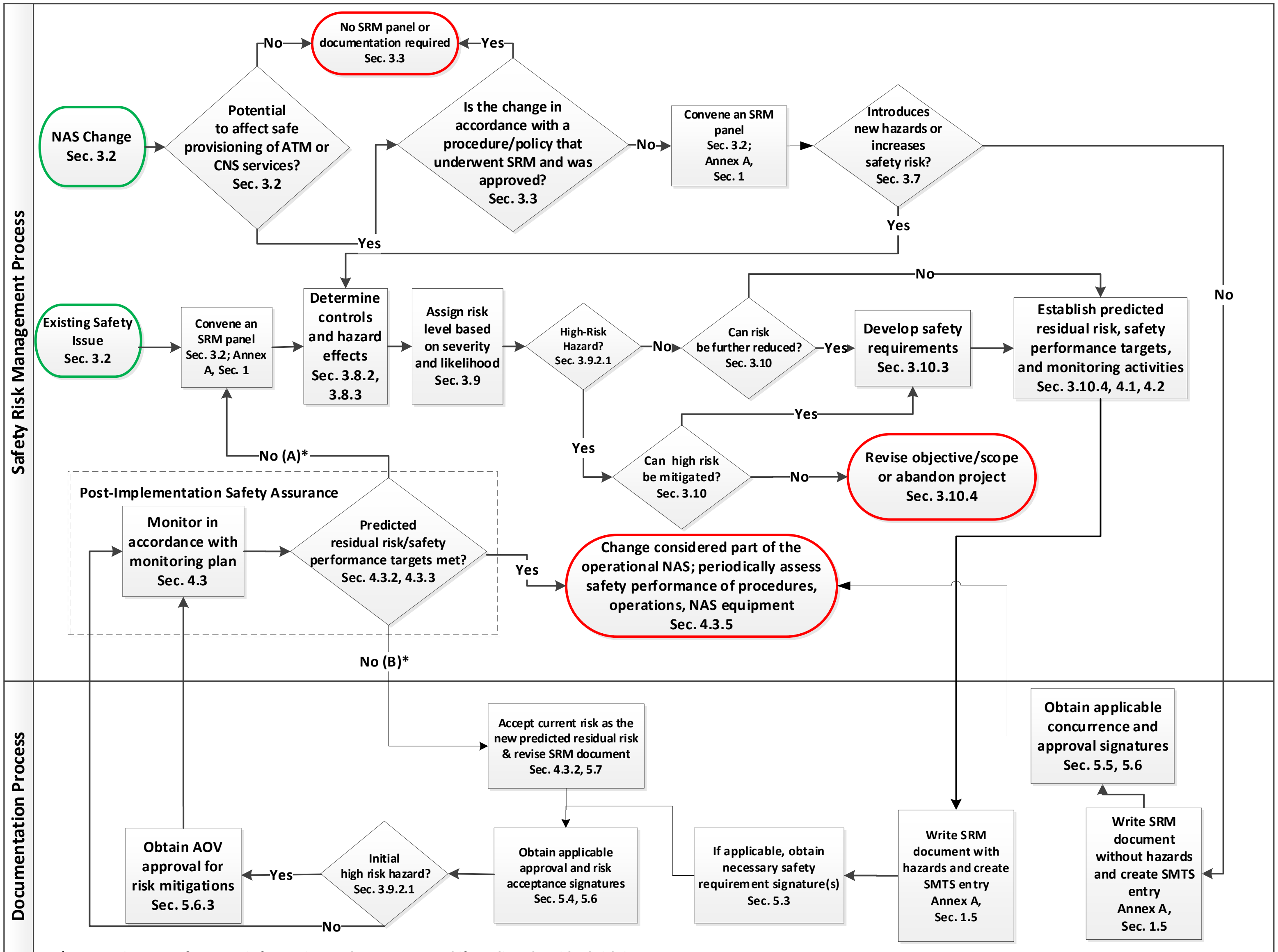
CAP	Corrective Action Plan
CAT	Category
CEDAR	Comprehensive Electronic Data Analysis and Reporting
CISP	Confidential Information Share Program
COMM	Communications
COO	Chief Operating Officer
CSA	Comparative Safety Assessment
CVT	Compliance Verification Tool
DoD	Department of Defense
FAA	Federal Aviation Administration
FCT	Federal Contract Tower
HAW	Hazard Analysis Worksheet
HMI	Hazardously Misleading Information
ICAO	International Civil Aviation Organization
IFR	Instrument Flight Rules
IMC	Instrument Meteorological Conditions
IOA	Independent Operational Assessment
LOB	Line of Business
MODES	Mode Select Beacon System
NAS	National Airspace System
NATCA	National Air Traffic Controllers Association
NAV	Navigation
NCP	NAS Change Proposal
NMAC	Near Mid-Air Collision
NTSB	National Transportation Safety Board
OCS	Obstacle Clearance Surface
OHA	Operational Hazard Assessment
OSA	Operational Safety Assessment
PDARS	Performance Data Analysis and Reporting System
PHL	Preliminary Hazard List
POC	Point of Contact
PRD	Program Requirements Document
QA	Quality Assurance
RAE	Risk Analysis Event
RAP	Risk Analysis Process
RI	Runway Incursion
SCL	Safety Case Lead
SME	Subject Matter Expert
SMS	Safety Management System

SMTS	Safety Management Tracking System
SOC	Safety Oversight Circular
SRM	Safety Risk Management
SRMGSA	Safety Risk Management Guidance for System Acquisitions
STARS	Standard Terminal Automation Replacement System
T-SAP	Technical Operations Safety Action Program
TCAS	Traffic Alert and Collision Avoidance System
TIS	Traffic Information Services
TRACON	Terminal Radar Approach Control
VFR	Visual Flight Rules
VMC	Visual Meteorological Conditions
WAM	Wide Area Multilateration

Annex A

Safety Risk Management Application and Guidance

Contents


Safety Risk Management Process
Documentation Process
NAS Change Sec. 3.2
Potential to affect safe provisioning of ATM or CNS services? Sec. 3.2
No
No SRM panel or documentation required Sec. 3.3
Yes
Is the change in accordance with a procedure/policy that underwent SRM and was approved? Sec. 3.3
No
Convene an SRM panel Sec. 3.2; Annex A, Sec. 1
Introduces new hazards or increases safety risk? Sec. 3.7
Yes
Yes
No
Existing Safety Issue Sec. 3.2
Convene an SRM panel Sec. 3.2; Annex A, Sec. 1
Determine controls and hazard effects Sec. 3.8.2, 3.8.3
Assign risk level based on severity and likelihood Sec. 3.9
High-Risk Hazard? Sec. 3.9.2.1
No
Can risk be further reduced? Sec. 3.10
Yes
Develop safety requirements Sec. 3.10.3
No
Establish predicted residual risk, safety performance targets, and monitoring activities Sec. 3.10.4, 4.1, 4.2
Yes
Yes
Can high risk be mitigated? Sec. 3.10
No
Revise objective/scope or abandon project Sec. 3.10.4
No (A)*
Post-Implementation Safety Assurance
Monitor in accordance with monitoring plan Sec. 4.3
Predicted residual risk/safety performance targets met? Sec. 4.3.2, 4.3.3
Yes
Change considered part of the operational NAS; periodically assess safety performance of procedures, operations, NAS equipment Sec. 4.3.5
No (B)*
Accept current risk as the new predicted residual risk & revise SRM document Sec. 4.3.2, 5.7
Obtain applicable concurrence and approval signatures Sec. 5.5, 5.6
Obtain AOV approval for risk mitigations Sec. 5.6.3
Yes
Initial high risk hazard? Sec. 3.9.2.1
No
Obtain applicable approval and risk acceptance signatures Sec. 5.4, 5.6
If applicable, obtain necessary safety requirement signature(s) Sec. 5.3
Write SRM document with hazards and create SMTS entry Annex A, Sec. 1.5
Write SRM document without hazards and create SMTS entry Annex A, Sec. 1.5

*See Section 4.3.2 for more information on how to proceed if predicted residual risk is not met.

Figure A.1: Overview of the Safety Risk Management Process

1. Guidance for Preparing for and Convening a Safety Risk Management Panel

1.1 Overview

This section provides practical guidance for applying the Safety Risk Management (SRM) process, which is depicted in Figure A.1. This section outlines information regarding how to:

- Determine whether an SRM panel is required,
- Prepare for and convene an SRM panel, and
- Produce the resulting SRM documentation.

1.2 SRM Planning and Initial Decision-Making

The scope of an SRM effort is based on the type, complexity, and effect of the National Airspace System (NAS) change or existing safety issue. The following steps are essential to performing any initial decision-making as well as planning and preparing for SRM of all NAS changes and existing safety issues:

- Define the NAS change or existing safety issue and the scope of the operational system and/or environment affected.
- Determine the need for an SRM panel.
- Identify an SRM panel facilitator and appropriate SRM panel attendees.

To support these activities, each of which are detailed below, the change proponent for the SRM effort should consult their Service Center Quality Control Group; the Safety and Technical Training (AJI) Safety Engineering Team, AJI-314, Manager (who can be contacted through the Air Traffic Organization (ATO) Safety Management System (SMS) mailbox); or a local safety Point of Contact (POC) when initiating the process.

1.2.1 Define the NAS Change / Existing Safety Issue

The change proponent must properly define the purpose and scope of the NAS change or existing safety issue using input from technical experts. The change proponent should consider the impact of the NAS change on relevant NAS equipment, operations, and procedures. This includes:

- The NAS change or existing safety issue,
- The system state(s) in which the change will be operational / in which the existing safety issue exists,
- Assumptions (not controls), and
- The components of the 5M Model.

1.2.2 Determine the Need for an SRM Panel

After defining the scope of the NAS change, the change proponent should determine if the NAS change pertains to or has the potential to affect safe provision of air traffic management or communication, navigation, and surveillance services using input from the technical experts. If it does not, then no further analysis is required (i.e., an SRM panel, SRM document, and Safety Management Tracking System (SMTS) entry are not required). Conversely, if there is potential for the NAS change to affect the safety of the NAS, then an SRM panel and SMTS entry are required. The SRM panel only determines the safety of the NAS change—not its suitability, validity, or necessity. Panel deliberations must not be used to define what the NAS change should be or to change the purpose or intent of the NAS change defined by the organization(s) sponsoring the NAS change.

Likewise, when using SRM to address an existing safety issue, convening an SRM panel is warranted. When addressing existing safety issues, it is still necessary to identify hazards and causes associated with the issue, but it is not necessary to assess the validity or current risk level if it has already been identified and confirmed by a safety audit or post-event safety risk analysis.

1.2.3 Identify SRM Panel Attendees

The change proponent works closely with the SRM panel facilitator/co-facilitator to identify the SRM panel attendees necessary to perform SRM. The size and composition of the SRM panel will vary based on the type and complexity of the proposed NAS change or existing safety issue, and it should be limited to an appropriately sized yet diverse team of stakeholders and Subject Matter Experts (SMEs). A stakeholder is considered to be an entity that could be affected by the proposed NAS change or existing safety issue from a safety risk perspective (i.e., an entity responsible for any of the following tasks: implementing the NAS change when approved, accepting the residual risk, implementing safety requirements, or affirming controls).

The change proponent, with the SRM panel facilitator, should obtain information on the knowledge, experiences, and positions of each attendee. The following list, though not all-inclusive, provides types of experts to consider for participation on an SRM panel:

- Employees directly responsible for developing the NAS change or managing the existing safety issue,
- Employees with current knowledge of and experience with the system or NAS change,
- Hardware/Software engineering and/or automation experts (to provide knowledge on equipment performance),
- Human factors specialists,
- Systems specialists,
- System operators,
- Employees skilled in collecting and analyzing hazard and error data and using specialized tools and techniques (e.g., operations research, data, and human factors),
- Quality Control / Quality Assurance employees (to help ensure that the safety performance target is measurable and auditable or to help develop an alternate means to verify predicted residual risk),
- Air traffic procedures specialists,
- Information and cyber-security specialists,
- Third-party stakeholders (e.g., pilots, pilot organizations, and industry representatives),
- Air traffic controllers,
- Maintenance technicians,
- Traffic management specialists, and
- Bargaining unit representatives.

Although not required, the 5M Model is useful for identifying potential SRM panel members and SMEs. Note that it may be necessary to elevate a request for participation to an appropriate management level to ensure participation by all affected stakeholders.

Any SRM panel meeting attendee should fulfill one of the roles specified in the following subsections.

1.2.3.1 Change Proponent

A **change proponent** is an individual, Program Office, facility, or organization within the Federal Aviation Administration (FAA) that has identified the need for SRM or has proposed or is sponsoring a NAS change or means to address an existing safety issue.

Among other responsibilities, the change proponent works with the SRM panel facilitator to define the purpose and scope of the NAS change or existing safety issue, capture the safety findings from the SRM panel meeting in an SRM document, and ensure that the SRM document is recorded in SMTS. The change proponent may record the information directly, designate a responsible individual, or work with the SRM panel facilitator or organization responsible for accepting safety risk to enter the SRM document into SMTS.

Unless circumstances warrant doing so, the change proponent should not function as an SRM panel member at their SRM panel.

1.2.3.2 SRM Panel Facilitator

An **SRM panel facilitator** is a trained expert on the SRM process who moderates the deliberations of the SRM panel attendees from a neutral position.

The change proponent selects or requests an SRM panel facilitator. After, the change proponent and the facilitator (and co-facilitator if one is identified) will have an initial meeting to prepare for the SRM panel. During this time, the facilitator will provide a briefing to the change proponent on the SRM process and work with the change proponent to develop the scope of the SRM panel. The SRM panel facilitator should also become well-versed in the subject matter (e.g., by requesting briefings and collecting all available and relevant safety information), as necessary, before the SRM panel convenes.

This coordination and preparation between the change proponent and facilitator/co-facilitator results in the development of a briefing package to provide to SRM panel attendees before the panel meeting. The briefing package should include all relevant information about the NAS change or existing safety issue, the SRM panel meeting invitation, an agenda, briefing materials, and directions to the meeting venue.

An effective SRM panel facilitator ensures the SRM process is followed in an unbiased manner and works to achieve consensus, a judgement by a majority of panel members. They invoke participation, mediate discussion, ensure differences of opinions are documented, keep the meeting organized and on topic, and remain neutral throughout the process without advocating for a specific outcome. The facilitator (or their designee) may assist the change proponent in writing the SRM document, which describes the safety findings of the SRM panel meeting. Facilitator duties and responsibilities must be discussed with the change proponent and communicated to the SRM panel attendees.

1.2.3.2.1 SRM Panel Co-Facilitator

An **SRM panel co-facilitator** is a person who shares responsibilities with the SRM panel facilitator in supporting the SRM panel.

An SRM panel co-facilitator, if one is assigned, assists the facilitator. A co-facilitator is especially helpful when the panel size exceeds 12 attendees and/or the subject matter is complex. Like the facilitator, the co-facilitator (or their designee) may assist the change proponent in writing the SRM document describing the safety findings of the SRM panel meeting. Co-facilitator duties and responsibilities must be discussed with the change proponent and communicated to the SRM panel attendees.

1.2.3.2.2 Facilitation by AJI Safety Case Leads

An AJI **Safety Case Lead (SCL)** is an expert in SMS policy and guidance that pertain to the ATO. They may facilitate SRM efforts for existing safety issues and NAS changes that meet any of the following criteria:

- It has a high (potentially political, economic, or financial) impact on the FAA, the NAS, or the flying public.
- It is the result of financial or operational decisions made by FAA executive management, cabinet-level executives, or Congress.
- The NAS change is a proposed means of addressing any safety issues identified as part of the Top 5 Program.
- The NAS change modifies safety policy that must be incorporated in a directive.
- It can or does present operational or technical conflicts to multiple affected Service Units or FAA Lines of Business (LOBs).

1.2.3.3 SRM Panel Member

An **SRM panel member** is an FAA employee[1] or other representative (as specified in an FAA Memorandum of Agreement)[2] who objectively performs the SRM process.

An SRM panel member represents the program, facility, organization, or constituency potentially affected by the safety risk, the safety requirements associated with the proposed NAS change and/or the existing safety issue. Among other responsibilities, SRM panel members evaluate safety risk associated with the NAS change or existing safety issue objectively, thoroughly, and fairly; do not debate the validity of the NAS change; and review and comment on SRM documents.

1.2.3.4 SME

An **SME** is an FAA employee or third-party stakeholder who serves as a technical expert on the NAS change, procedure, hardware/software, or proposed solution undergoing SRM.

SMEs share data, detailed information, and experience about the subject being discussed during the SRM panel meeting; partake in technical dialogue with SRM panel members; and review and comment on the aspects of SRM documents for which their expertise is applicable.

[1] Inclusive of federal contract tower employees or other contractors who have been given explicit authority to represent (i.e., make decisions for / speak on behalf of) the FAA.

[2] This includes FAA bargaining unit representatives or Department of Defense (DoD) representatives. Note: DoD representatives participate as panel members when DoD Air Traffic Control procedures / airspace are impacted.

They are not panel members and do not participate in the consensus-driven decisions regarding initial / predicted residual risk levels while analyzing or assessing safety risks to the NAS.

Note: In other areas of the ATO SMS Manual, the term “subject matter expert” is used generically. Each SRM panel attendee is expected to have technical knowledge in a subject area that would suggest their participation in the panel meeting is appropriate.

1.2.4 SRM Panel Observer

An **SRM panel observer** is an individual who is not part of the SRM panel meeting and does not participate in the deliberation process (only observes the proceedings).

An observer has an objective to obtain a better understanding of the SRM process—not the NAS change or existing safety issue being addressed. They are not active members of the SRM panel meeting; do not provide input during the deliberations; and, like all other attendees, may not use electronic recording devices during the panel meeting. The presence of panel observers is permitted at the discretion of the change proponent.

1.2.4.1 Air Traffic Safety Oversight Service Attendance

The SRM panel facilitator or change proponent must evaluate the NAS change or existing safety issue to determine whether it will require approval or acceptance from the Air Traffic Safety Oversight Service (AOV) and consider their attendance at the SRM panel. Contact the Safety Management Group, AJI-31, Manager for guidance, if necessary. If AOV approval or acceptance is required, then the SRM panel facilitator or change proponent must coordinate with AJI to ensure compliance with AOV requirements.

1.2.4.2 Guidance for Bargaining Unit Participation

When selecting SRM panel attendees, adhere to the Collective Bargaining Agreement between the FAA and affected bargaining unit representatives. When a NAS change or existing safety issue crosses Service Area boundaries and LOBs, the change proponent will ensure the Management Services (AJG) Technical Labor Group, AJG-L1, is notified.

Ensure that all facilities, including their respective bargaining units, are given notification of the upcoming SRM panel. Labor organizations, such as the National Air Traffic Controllers Association and Professional Aviation Safety Specialists, represent several different bargaining units (engineers, controllers, attorneys, etc.). In some cases, multiple bargaining units may need to attend the panel to ensure that the appropriate expertise is available. Multiple bargaining unit members, when represented by the same labor union, may be SRM panel members, but the labor organization representative will identify a lead representative that speaks for the labor organization during the SRM panel.

For assistance finding a labor union representative, contact AJG-L1 for more information.

1.2.4.3 Participation on SRM Panels Outside of a Service Unit or the ATO

ATO employees are often requested to participate as stakeholders or SMEs on SRM panels sponsored by organizations outside of their Service Unit or the ATO. It is important to support these requests, whether they originate within or outside of the ATO. Participation as an SME or stakeholder does not necessarily mean that the organization represented by an SRM panel member is responsible for developing or implementing safety requirements, accepting risk, or approving the SRM document.

When requesting the participation of an ATO Service Unit, the requestor should contact the appropriate Program Office or Service Unit for coordination.

1.3 Convening the SRM Panel

Following the identification and invitation of SRM panel attendees, the SRM panel convenes. On the first day of the SRM panel meeting, the SRM panel facilitator or a designee must present an SRM panel orientation that includes:

- The agenda for the meeting,
- A summary of the goals and objectives for the SRM panel,
- A brief review of the SRM process,
- SRM panel ground rules,
- The method(s) by which the SRM panel will identify hazards (if known), and
- A draft or summary of the “Current System” and “Description of Change” sections of the SRM document, if available, provided by the change proponent (see Sections 1.4.1.3 and 1.4.1.4 of Annex A).

1.3.1 SRM Panel Meeting Logistics

The SRM panel facilitator may perform or delegate the function of time keeper in order to manage start times and breaks. The facilitator may also delegate the recording of meeting notes, the writing of the SRM document, and the provision of audio/visual support.

The SRM panel should be conducted using in-person meetings, if possible; however, stakeholders can participate in SRM panel meetings via other methods, such as web meetings or teleconferences. In the event that the invited stakeholders cannot participate in an SRM panel, consult with the change proponent and, if feasible, continue the SRM panel as scheduled. The findings should then be forwarded to the absent stakeholders to gather additional input, comments, or concerns.

1.3.2 SRM Panel Deliberations

During the SRM panel, the SRM panel facilitator will lead attendees in objectively examining, identifying, and mitigating potential safety hazards and effects associated with the NAS change or existing safety issue. If hazards are identified, the SRM panel facilitator will guide the attendees through the five-step DIAAT process using the Hazard Analysis Worksheet (HAW) and monitoring plan (see Sections 1.3.2.1 and 1.3.2.2 of Annex A).

SRM panel members should strive for unanimous agreement on risk determinations; however, there may be instances in which not all SRM panel members agree with the panel’s consensus. In those cases, record the difference of opinions from the SRM panel members in the SRM document. Dissenting SRM panel members should provide, in writing, their own rationale and data for why their risk determination differs from that of the other SRM panel members. The written dissention must be included in the SRM document.

The SRM panel facilitator must mediate and assist SRM panel members in working through differences of opinion. The facilitator should be able to recognize, acknowledge, and use differences of opinion to help the SRM panel members consider different points of view.

1.3.2.1 HAW

Use the HAW to organize the SRM panel's deliberations into 16 key categories. It is at the panel's discretion to decide which items belong in the HAW. It provides a snapshot of the SRM panel conclusions and will be included in the SRM document for each hazard identified.[3]

Table A.1: HAW

Hazard Description:

1.	2.	3.	4.
Hazard ID	**Hazard Description**	**Cause**	**System State**
Alpha-numeric identifier (under 10 characters)	Any real or potential condition that can cause injury, illness, or death to people; damage to or loss of a system, equipment, or property; or damage to the environment	The origin of a hazard	An expression of the various conditions, characterized by quantities or qualities, in which a system can exist

Controls:

5.	6.
Controls	**Control Justification**
Any means currently reducing a hazard's causes or effects	A justification for each control, indicating its effect on the identified hazard's causes or effects

Initial Risk:

7.	8.	9.	10.	11.	12.
Effect	**Severity**	**Severity Rationale**	**Likelihood**	**Likelihood Rationale**	**Initial Risk**
The real or credible harmful outcome that has occurred or can be expected if the hazard occurs in a defined system state	The consequences or impact of a hazard's effect or outcome in terms of degree of loss or harm	Explanation of how severity was determined	The estimated probability or frequency, in quantitative or qualitative terms, of a hazard's effect or outcome	Explanation of how likelihood was determined	The composite of the severity and likelihood of a hazard, considering only controls and documented assumptions for a given system state

Safety Requirements:

13a.	13b.	14a.	14b.
Safety Requirement Description	**Planned for Implementation?**	**Organization Responsible for Implementing Safety Requirement**	**POC**
A planned or proposed means to reduce a hazard's causes or effects	Denotes whether the safety requirement is planned for implementation (yes/no)	The organization's name / routing code	POC's name and telephone number

[3] All SRM documentation (with the exception of the Program Safety Plan, Operational Safety Assessment, Comparative Safety Assessment, and System Safety Assessment Report) requires the use of a HAW. Worksheets specific to these documents are contained in the Safety Risk Management Guidance for System Acquisitions.

Predicted Residual Risk:

15a.	**15b.**
Predicted Residual Risk	**Predicted Residual Risk Rationale**
The risk that is estimated to exist after the safety requirements are implemented or after all avenues of risk mitigation have been explored	If necessary, any additional explanation needed to help the reader understand how the predicted residual risk was determined

Safety Performance Target:

16.
Safety Performance Target
The measurable goals that will be used to verify the predicted residual risk of a hazard

1.3.2.2 Monitoring Plan

Use a monitoring plan table to organize the SRM panel's plan for monitoring the safety performance target and verifying the predicted residual risk for each hazard identified. Information from the monitoring plan will be needed for the SRM document and entry into SMTS.

Table A.2: Monitoring Plan

1.	**Safety Performance Target**	Provide a safety performance target (as documented in the HAW) that can be used to verify the predicted residual risk for the hazard
2.	**Hazard ID(s)**	Provide the hazard ID(s) from the HAW that is associated with this safety performance target
3.	**Initial Risk**	Include the initial risk from the HAW
4.	**Safety Requirements**	Include the means that will be implemented to reduce the hazard's causes or effects from the HAW
5.	**Organization Responsible for Implementing Safety Requirements**	Include information on the responsible organization / POC documented in the HAW
6.	**Predicted Residual Risk**	Include the predicted residual risk from the HAW
7.	**Monitoring POC(s)**	Enter the name and contact information of the person who will be responsible for conducting the monitoring of this safety performance target
8.	**Monitoring Activities**	Describe the tasks that will be led by the monitoring POC to collect and analyze data to verify the predicted residual risk
9.	**Monitoring Start Date**	Enter the date when the monitoring activities should begin
10.	**Reporting Frequency**	Specify how often the monitoring activities will be reported
11.	**Reporting Duration**	Specify the total length of time for the monitoring effort

1.3.3 Factors that Jeopardize SRM Panel Results

Failure to adequately describe the system and scope the NAS change or existing safety issue can negatively affect the fidelity of the SRM process. Change proponents, SRM panel facilitators, and SRM panel members should adhere to the following guidelines to help ensure that SRM panel deliberations are relevant to the NAS change or existing safety issue:

- Sufficiently define the scope.
- Involve relevant stakeholders.
- Identify drivers and constraints.
- Define product boundaries and external interfaces.
- Baseline the scope before writing requirements.

1.4 Completing the SRM Documentation

An **SRM document** records the SRM panel attendees' determinations for NAS changes and existing safety issues. The SRM document presents evidence supporting whether the NAS change and/or risk management strategies should be accepted by ATO or FAA management officials from a safety risk perspective. There are two types of SRM documents: safety findings with hazards and safety findings without hazards.[4]

- **Safety Finding With Hazards:** When an SRM panel determines that a NAS change or existing safety issue could introduce hazards or increase safety risk, the panel must complete each phase of the DIAAT process. Typically, this results in new means to reduce risk (i.e., safety requirements) being devised and proposed for implementation. Safety risk and overall safety performance must be monitored after implementation of the NAS change and/or safety requirements to address the identified hazards. This information should be contained in an SRM document with hazards.[5]
- **Safety Finding Without Hazards:** When an SRM panel determines that no hazards will be introduced or that safety risk will not increase with the implementation of the NAS change being assessed, an SRM document without hazards is used. The SRM document should include a description of the system and NAS change and a rationale explaining why the change does not introduce hazards or increase safety risk.

1.4.1 Writing the SRM Document[6]

The change proponent, the SRM panel facilitator, or a designated individual should begin drafting the SRM document immediately after the SRM panel meeting. The draft SRM document should be presented to the SRM panel to verify that the SRM panel members' discussions have been correctly recorded and consensus has been achieved. In the event that an SRM panel member does not concur with a determination made during the risk analysis or risk assessment phases of the process, they are encouraged to submit a dissent in writing. Such dissents are included in the SRM document for evaluation by the risk acceptance official.

The change proponent, the SRM panel facilitator, a designated individual, or the organization responsible for accepting safety risk must enter the SRM document into SMTS.

[4] The purpose of SRM is not to record all modifications to elements of the NAS but rather to assess the risk potentially caused by proposed changes to or existing safety issues in the NAS. SRM documentation should strictly consider and document safety concerns and safety findings. Certain modifications may not necessarily be considered NAS changes under the purview of this SMS Manual. The change proponent must consider potential safety ramifications when making any modification to the NAS (see Section 3.2). Modifications that do not relate to safety will not require SRM and do not need to be documented. Contact an AJI SCL for assistance, if necessary.

[5] When addressing existing safety issues, the approach for safety findings with hazards is the most appropriate.

[6] Refer to the Safety Risk Management Guidance for System Acquisitions for guidance on writing SRM documents for acquisitions.

The following list reflects the applicable sections and criteria for SRM documents:

- Executive Summary
- SRM Document Signatures
- Current System
- Description of Change / Existing Safety Issue
- Rationale for a Safety Finding Without Hazards (if no hazards are identified)
- Hazard Identification and Risk Determination (if hazards are identified)
- Monitoring Plan (if hazards are identified)
- Dissention (when applicable)
- SRM Panel Attendees
- Appendices

For additional guidance about writing either type of document, consider using the SRM document templates available in SMTS and on the ATO SMS Toolbox.

1.4.1.1 Executive Summary

Use the Executive Summary to provide only the substantive information necessary for decision-makers to understand the current system; NAS change / existing safety issue; and, if applicable, the associated safety risk and proposed ways to address the hazards and safety risk. Provide detailed information and supporting narrative on these items in the body of the SRM document.

Include the following administrative information regarding the SRM document:

- **Title.** Include a clear, concise name of the document with which the document's subject can be easily understood.
- **Change Proponent Organization.** Provide the organization that is initiating the NAS change or that has taken responsibility for addressing the existing safety issue. Include the organization's name and FAA routing code.
- **Document Type.** Indicate the document type, such as Operations, Second-Level Engineering, etc.

For SRM documents with hazards, use the tables below to summarize the hazards identified and proposed means of mitigation/monitoring:

Table A.3: Hazard Summary

Hazard ID	Hazard Description	Initial Risk	Predicted Residual Risk

Table A.4: Safety Requirements

Safety Requirement	Associated Hazard ID(s)	Organization Responsible	POC Signature

Table A.5: Monitoring Plan Summary

Safety Performance Target	Associated Hazard ID

If no hazards are identified, do not include the above tables. Instead, provide a brief rationale for a safety finding without hazards.

1.4.1.2 SRM Document Signatures

Listed below are the signatures required on the SRM document signature page. For each signatory, include the printed name, signature (handwritten or electronic), organization, and date. Signatures should be obtained and must be listed in the following order: concurrence (when appropriate); approver; risk acceptor; and the Director of Policy and Performance, AJI-3, when necessary.

1. **Concurrence.** Include a concurrence signature from an SRM expert who is well-versed in this SMS Manual and familiar with the terminology and processes therein. This signature is used to represent a technical review of the SRM document and to confirm the rationale used throughout is consistent with the SRM process.
2. **Approval.** Include an approval signature from an official representing the organization responsible for implementing the NAS change (and from the AJI-3 Director, if required). An approver provides a technical and administrative quality control review of the SRM document, its findings, and the identified results.

   Note: The official responsible for the approval signature cannot have been an SRM panel member.
3. **Risk Acceptance.** Include a risk acceptance signature from an appropriate official representing the organization that will be using the safety-assessed NAS equipment, policy, or procedure. This signature indicates confirmation by the official that they understand the safety risk associated with the NAS change or existing safety issue and that they accept that safety risk into the NAS. Risk acceptance requires that signatures have been obtained for the safety requirements identified in the SRM document and that a comprehensive monitoring plan has been developed and will be followed to verify the predicted residual risk.

The safety requirements signatures from the responsible organization(s) and associated POC(s) are contained within the Executive Summary.

1.4.1.3 Current System

Provide a detailed description of the hardware/software system, operation, or procedure that constitutes the NAS change or the environment in which the existing safety issue has manifested. Include the following information, when applicable:

- A brief background on what triggered the need for a NAS change or the evaluation of an existing safety issue. If there is an associated SRM document, compliance issue, or Top 5 issue that necessitated this NAS change, briefly summarize it here, and include the associated reference or documentation as attachments.
- The current hardware or software system or existing procedures/operations and the corresponding (operational) system states.

- The current procedure and its operational environment and, when applicable, a discussion about elements of this issue that make it particularly unique or challenging.
- Equipment or procedures needed to accommodate the implementation of the NAS change.
- Future configuration, system, or procedural changes that might affect the proposed change/procedure or existing safety issue.

1.4.1.4 Description of Change / Existing Safety Issue

Provide a description of the proposed NAS change or the existing safety issue being addressed. Include the following information, when applicable:

- A description of the proposed NAS change/procedure or existing safety issue and any critical safety parameters that are involved (e.g., prohibited/restricted airspace, noise abatement area, and operational limitations).
- When applicable, discuss the types of verifications that will be performed throughout the development process to review whether the finalized proposed NAS change will be safe, operational, and effective once implemented. Evaluation can consist of simulator modeling, live testing, or a combination thereof.
- A depiction of the proposed NAS change/procedure or existing safety issue (if visual illustration is beneficial).
- Assumptions that make evaluating the NAS change or existing safety issue more manageable or that better scope the change or issue undergoing SRM.
- A summary of the relevant results of any related or preceding safety analyses (i.e., an acquisition program or operational change). Include any references and/or associated documentation mentioned in Section 1.4.1.10 of Annex A.
- The traceability between the proposed change and the NAS Enterprise Architecture.

1.4.1.5 Rationale for a Safety Finding Without Hazards (If No Hazards Are Identified)

There may be cases in which, through performing elements of the SRM process (i.e., describing the system / NAS change and identifying hazards), the SRM panel does not identify hazards associated with the implementation of the NAS change, or the SRM panel determines that the NAS change does not increase the current risk level. In such cases, include a detailed rationale that explains how the SRM panel came to that conclusion. When the provisions of this section apply, the SRM document is nearly complete. Follow the guidance for Dissention (when applicable), SRM Panel Attendees, and Appendices, and prepare the SRM document for signatures.

1.4.1.6 Hazard Identification and Risk Determination (If Hazards Are Identified)

Provide a detailed explanation of each hazard identified. Provide the completed HAW for each hazard (see Section 1.3.2.1 of Annex A for instructions on creating a HAW) and the information necessary to support the risk overview in the Executive Summary.

1.4.1.7 Monitoring Plan (If Hazards Are Identified)

Complete a monitoring plan for each hazard identified (see Section 1.3.2.2 of Annex A for instructions on creating a monitoring plan). Provide the completed monitoring plan table for each hazard and the information necessary to support the monitoring overview in the Executive Summary.

1.4.1.8 Dissention (When Applicable)

The SRM panel process strives for agreement by all panel members with official findings, such as risk ratings. If any SRM panel member disagrees with the SRM panel's official findings, that panel member should provide the nature and summary of the disagreement for inclusion in this part of the SRM document. SRM panel member discussions and disagreements that take place while working toward consensus are not dissentions if the SRM panel member ultimately agrees with or can live with the panel's official findings, but such proceedings should be detailed in the body of the SRM document.

If an SME disagrees with the SRM panel's official findings, and submits, in writing, an opposing opinion, this opposing opinion is not included in the dissention section of the SRM document. However, the opinion should be attached to the SRM document as part of the distribution.

1.4.1.9 SRM Panel Attendees

Include a table with each SRM panel attendees' name and relevant information including their position, facility, and FAA routing code. Clarify each attendees' role (i.e., facilitation team member, change proponent, SRM panel member, SME, or SRM panel observer).

1.4.1.10 Appendices

Use appendices to include the following, as appropriate:

- Supporting documentation, such as simulations, modeling, and other technical analyses;
- Relevant references; and
- Acronyms, terms, and definitions.

1.4.2 SMTS

SMTS is the official repository for all completed ATO SRM documents.[7] The change proponent is responsible for ensuring that the SRM document is entered into SMTS before the initiation of monitoring activities, the full implementation of the NAS change, or the achievement of an FAA Acquisition Management System decision point. The change proponent may record the information directly, designate a responsible individual, or work with the SRM panel facilitator or organization responsible for accepting safety risk to enter the SRM document into SMTS. See the Safety Risk Management Guidance for System Acquisitions for a more detailed description of mandatory entry requirements for acquisition programs.

1.4.2.1 Implementation Dates in SMTS

Once the SRM document has been completed and all required signatures have been obtained, the change proponent is responsible for providing a monitoring start date (i.e., the date after all safety requirements are implemented). This date must be entered into SMTS to trigger the automated email notification process for the monitoring plan.

2. Special SRM Considerations for Waiver Renewals and Approvals

2.1 Overview

The section provides guidance for SRM considerations specific to waiver renewals and approvals.

[7] A completed SRM document includes all required signatures (both ink and digital signatures are accepted).

2.2 Documentation, Review, and Approval Process for Waivers to Separation Minima

A waiver to separation minima can result in aircraft being allowed closer than approved separation from terrain, obstacles on the surface of the earth, airspace, or other aircraft. The current ATO Safety Guidance (ATO-SG) on separation minima lists the requirements in FAA Order JO 7110.65, *Air Traffic Control*, that pertain to separation minima. The ATO-SG also details which NAS changes related to separation minima requirements need approval from AOV.

Any new waiver request or waiver renewal request that pertains to separation minima requires a new SRM document or an SRM document on file that is developed in accordance with the ATO SMS Manual. The SRM document should include a quantitative analysis (e.g., scientific study, Flight Standards Service report, detailed modeling, or Monte Carlo simulation) to support the information provided.

2.2.1 Initiate the Request for a New Waiver or Waiver Renewal

Waivers must be kept to a minimum as they contribute to a nonstandard NAS. Before developing or renewing a waiver, coordinate with the appropriate Service Area and Service Unit to obtain their commitment to the effort. The Service Unit will coordinate with AJI to determine whether additional information is warranted to support the request and SRM document.

2.2.2 Waiver Development Guidance: Identify Appropriate Hazards

Most paragraphs in FAA and ATO orders mitigate a potential safety hazard. Attempt to identify the hazard that the relevant order intends to mitigate to determine the appropriate hazard(s) to address in the SRM document. If the waiver request is intended to reduce safety risk, then ensure there is sufficient justification in the SRM document, and show the waived procedures as a means to reduce risk in the HAW.

2.2.3 Relationship between the Waiver Request and the SRM Document

All of the following waiver requirements should be covered in the SRM document:

- The “Affected Directive” and “Operations Authorized” sections of the waiver should match the “Description of Change” section of the SRM document.
- The “Special Provisions, Conditions, and Limitations” section of the waiver should flow out of the HAW section of the SRM document, specifically from the controls, system states, and/or the safety requirements.
- Remember to include any new safety requirements in the SRM document.

2.2.4 Waiver Renewals

Waivers must be renewed every two years. When submitting a waiver renewal request, read the current SRM document to determine whether any updates are necessary. Keep in mind that an SRM document must be updated to reflect the current operational environment. All required means to reduce risk (including the publication of information and any refresher training requirements, as delineated in the original SRM document) must be in place.

For each waiver renewal request:

- Determine whether the level of safety risk that was introduced with the initial waiver remains acceptable,

- Use the safety performance monitoring results per the monitoring plan to allow the responsible organization to determine whether the waiver is working as intended, and
- Determine whether the provisions of the waiver have matured sufficiently that they should be made available to all others in the NAS through inclusion in FAA Order JO 7110.65.

Before submitting a waiver renewal request, ensure the monitoring information pertaining to the existing waiver is up to date in SMTS. All proposed modifications to any provision of the current waiver will require a new waiver to be developed with a new SRM document.

2.2.5 Waiver Approval

All new waivers and waiver renewal requests will be approved by AJI. AJI will coordinate the approved waiver with AOV, if necessary. Ensure that new waivers and information pertaining to waiver renewals are entered in SMTS.