NUCLEAR SECTOR

Cybersecurity Framework Implementation Guidance

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U.S. Department of Homeland Security
Cybersecurity and Infrastructure Security Agency

Table of Contents

Cautionary Note

This publication is not intended for regulatory use. It is not intended to replace or subsume other cyber security-related activities, programs, processes, or approaches that Nuclear Sector organizations have implemented or intend to implement, including any cyber security activities associated with legislation, regulations, policies, programmatic initiatives, or mission and business requirements. Additionally, this publication uses the words "adopt," "use," and "implement" interchangeably. These words are not intended to imply compliance or mandatory requirements.

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Terms in this Document

A note on the use of terms within this document:

- The terms "reactor" and "plant" are used interchangeably in this document to refer to nuclear power reactor facilities.
- The term "cyber security" rather than "cybersecurity" is used primarily in this document to reflect the norm among nuclear asset owners and operators.

1. Introduction and Framework Overview

The National Institute of Standards and Technology (NIST) Cybersecurity Framework provides a policy framework of computer security guidance for how private sector organizations in the United States can assess and improve their ability to prevent, detect, and respond to cyberattacks.[1] It can be used to help identify and prioritize actions for reducing cyber security risk, and it is a tool for aligning policy, business, and technological approaches to managing that risk. Different types of entities—including sector coordinating structures, associations, and organizations—can use the Framework for different purposes.

In 2018, NIST released Version 1.1 of the Framework for Improving Critical Infrastructure Cybersecurity. The update encourages maturity in cyber security assessments and the vulnerability disclosure process, outlines an expanded scope of identity management and access control, and provides supply-chain risk management guidance to help mitigate risks associated with industrial control systems and connected devices.[2]

The Nuclear Sector embraces the flexibility the Framework offers. The Cybersecurity and Infrastructure Security Agency (CISA) within DHS, as the Sector-Specific Agency, worked with the Nuclear Sector Coordinating Council (SCC) and Government Coordinating Council (GCC) to develop this Implementation Guidance.

Framework Overview

The United States depends on the reliable functioning of critical infrastructure. Cyber security threats exploit the increased complexity and connectivity of critical infrastructure systems, placing the Nation's security, economy, and public safety and health at risk. Similar to financial and reputational risks, cyber security risk affects a company's bottom line. It can drive up costs and affect revenue, potentially harming an organization's ability to innovate and gain and maintain customers. Cyber security can be an important and amplifying component of an organization's overall risk management.[3]

To better address these risks, the Cybersecurity Enhancement Act of 2014[4] (CEA) updated the role of NIST to include identifying and developing cyber security risk frameworks for voluntary use by critical infrastructure owners and operators. In 2014, NIST released Version 1.0 of the Framework for Improving Critical Infrastructure Cybersecurity to provide a structure that organizations, regulators, and customers can use to create, guide, assess, or improve comprehensive cyber security programs.[5]

Version 1.1 of the Framework, released in 2018, refines, clarifies, and enhances Version 1.0. Updates include clarification of terms; a section on self-assessment; an expanded explanation of how to use the Framework for Cyber Supply Chain Risk Management; refined language for authentication, authorization, and identity proofing; an improved explanation of the relationship between the Implementation Tiers and the Profiles; and a new subcategory

[1] National Institute of Standards and Technology (NIST), "Cybersecurity Framework," Updated June 13, 2018, https://www.nist.gov/cyberframework.
[2] Thu Pham, "Updated NIST Cybersecurity Framework Emphasizes Access Control & Supply Chain Risk," Decipher, May 3, 2018, https://duo.com/decipher/updated-nist-cybersecurity-framework-emphasizes-access-control-and-supply-chain-risk.
[3] National Institute of Standards and Technology (NIST), *Framework for Improving Critical Infrastructure Cybersecurity*, Version 1.1, April 16, 2018, https://nvlpubs.nist.gov/nistpubs/CSWP/NIST.CSWP.04162018.pdf.
[4] *See* 15 U.S.C. § 272(e)(1)(A)(i). The Cybersecurity Enhancement Act of 2014 (S.1353) became public law 113-274 on December 18, 2014 and may be found at: https://www.congress.gov/bill/113th-congress/senate-bill/1353/text.
[5] National Institute of Standards and Technology (NIST), *Framework for Improving Critical Infrastructure Cybersecurity*, Version 1.0, February 12, 2014.

concerning vulnerability disclosures. Version 1.1 can be implemented by first-time and current Framework users with minimal or no disruption.[6]

The Framework provides a common mechanism for organizations to:

1) describe their current cyber security posture,
2) describe their target state for cyber security,
3) identify and prioritize opportunities for improvement within the context of a continuous and repeatable process,
4) assess progress toward the target state, and
5) communicate among internal and external stakeholders about cyber security risk.

The Framework offers a flexible way to address cyber security. It is applicable to organizations relying on technology, including information technology (IT), industrial control systems (ICS), cyber-physical systems (CPS), or connected devices more generally, including the Internet of Things (IoT). It complements, but does not replace, an organization's risk management process, cyber security program, or related framework implementation; every organization must decide how to individually implement the Framework. The Framework can aid organizations in addressing cyber security as it affects the privacy of customers, employees, and other parties. It may also serve to assist suppliers that perform physical work on mission-critical equipment (e.g. software updates, firmware replacement, equipment maintenance, refurbishments, and replacements). Additionally, the Framework's outcomes serve as targets for workforce development and evolution activities.

Potential Benefits of Implementing the Framework

Choosing to implement the Framework means that an organization wishes to take advantage of the benefits that the Framework offers; it does not imply that an existing cyber security and risk management approach is ineffective or needs to be replaced.[7] Specifically, implementing the Framework provides a mechanism for an organization to:

- assess and specifically **describe its current and targeted cyber security posture**;
- **identify gaps** in its current programs and processes;
- identify and **prioritize opportunities for improvement** using a continuous and repeatable process;
- **assess progress** toward reaching its target cyber security posture;
- **demonstrate the organization's alignment** with nationally recognized best practices;
- highlight any current practices that might **surpass the Framework's recommended practices**; and
- **communicate its cyber security posture in a common, recognized language** to internal and external stakeholders—including customers, regulators, investors, and policymakers.

NIST designed the Framework to provide a nationally recognized approach to cyber risk management using best practices and proven processes. As more sectors and organizations implement the Framework, its approach will serve as an accepted baseline for cyber security practices in critical infrastructure organizations. Early adoption of the Framework's principles may better position Nuclear Sector organizations to receive additional potential benefits in the future:

- **More attractive cyber security insurance coverage:** As cyber risks grow, insurance agencies are developing new and refined approaches to evaluate clients' premiums based on their use of sound cyber security

[6] National Institute of Standards and Technology (NIST), *Framework for Improving Critical Infrastructure Cybersecurity*, Version 1.1, April 16, 2018, https://nvlpubs.nist.gov/nistpubs/CSWP/NIST.CSWP.04162018.pdf.
[7] U.S. Department of Energy (DOE) Office of Electricity Delivery and Energy Reliability, *Energy Sector Cybersecurity Framework Implementation Guidance*, January 2015, https://www.energy.gov/sites/prod/files/2015/01/f19/Energy%20Sector%20Cybersecurity%20Framework%20Implementation%20Guidance_FINAL_01-05-15.pdf.

practices. Framework implementation provides an additional, widely accepted means for an organization to measure its cyber security posture and demonstrate continuous improvement.

- **Availability of technical assistance:** The Federal Government provides several hands-on tools that will help an organization assess its current state of cyber security practices and identify areas to grow its cyber security resilience.
- **Demonstration of commitment to cyber security:** The Framework does *not* protect any organization from liability in the event of a cyber incident. However, implementation of the Framework provides an organization with a mechanism to demonstrate its proven track record of implementing and continuously evaluating cyber risk management practices appropriate for its individual risks.
- **Government recognition:** For interested organizations, DHS seeks to recognize those organizations and sectors—regardless of size and maturity level—that use the Framework to enhance their risk management practices.
- **Workforce development:** Organizations that use the Framework will have a better understanding of the technical capabilities their organization requires and, therefore, the skills required of their cyber workforce such as recruiting, workforce design, and training of existing personnel.

Risk Management and the Framework

Risk management is the ongoing process of identifying, assessing, and responding to risk. To manage risk, organizations should understand the likelihood that an event will occur and the potential resulting impacts. With this information, organizations can determine the acceptable level of risk for achieving their organizational objectives and express this as their risk tolerance.

With an understanding of risk tolerance, organizations can prioritize cyber security activities, make informed decisions about cyber security expenditures, and effectively communicate cyber security risk management practices to their partners and service providers. The Framework uses risk management plans (RMPs) to enable organizations to inform and prioritize decisions regarding cyber security. It supports recurring risk assessments and validation of business drivers to help organizations select target states for cyber security activities that reflect desired outcomes. The Framework gives organizations the ability to dynamically select and direct improvement in cyber security risk management for the IT and ICS environments.

The Framework complements, and does not replace, an organization's RMP and cyber security program. Alternatively, an organization without an existing cyber security program can use the Framework as a reference to establish one.

Organization of this Document

Section 2 provides a history and high-level overview of cyber security programs at U.S. nuclear power reactors. Section 3 provides key Framework terminology and concepts for its application. Section 4 identifies resources that inform Framework implementation. Section 5 outlines Framework implementation for U.S. nuclear power reactors based on existing requirements and implementation programs. Section 6 describes how the Framework can support sector-level goals and guidelines. Section 7 provides conclusions. Section 8 provides a detailed list of references. Finally, Appendix A maps existing cyber security and risk management approaches to the Framework's Core and Implementation Tiers, and Appendix B provides a summary table of the input, activities, and output for each step in the Framework implementation process. Appendix C includes a table of terms found within this document. Aside from the term "organization," the glossary is excerpted verbatim from the Framework.

2. History of Nuclear Power Reactor Cyber Security

The nuclear energy industry is one of the Nation's safest industries. It is protected by multiple back-up safety systems, robust physical defenses, and plant security forces which undergo rigorous training. Since the September 11 terrorist attacks, the industry has continued to improve its security systems to prepare for emerging threats, such as the impact from a wide-bodied commercial airliner, unmanned aerial vehicles, and cyberattacks on critical operational systems. Each U.S. nuclear power plant is equipped with extensive security measures to protect the facility from intruders and to protect the public from the possibility of exposure to radioactive releases caused by acts of sabotage. The U.S. Nuclear Regulatory Commission (NRC) calls nuclear power plants "among the best-protected private sector facilities in the nation."[8]

The Nuclear Sector has a long history of addressing cyber security issues. In 1997, through the Nuclear Energy Institute (NEI), the industry began looking at potential issues associated with the increasing use of digital technologies at power reactors. At that time, there was a concern regarding the potential effects associated with the change in millennia—referred to as the "Y2K" issue. Following the terrorist attacks of September 11, 2001, the industry turned its focus to potential cyber security-related issues. In January 2002, NEI established a Cyber Security Task Force (CSTF), initially composed of 23 members, to provide an industry-wide forum for identifying, discussing, and resolving cyber security issues. In March 2002, the NRC issued Interim Compensatory Measures (ICM) Orders that directed licensees to consider and address cyber safety and security vulnerabilities.

During 2003 and 2004, the industry was engaged in the development of guidance documents intended to support the uniform implementation of cyber security programs at power reactors. In July 2003, cyber security assessment pilots were completed at four U.S. nuclear power reactors. These pilots were designed to inform development of NUREG/CR-6847, "Cyber Security Self-Assessment Method for U.S. Nuclear Power Plants." The project team consisted of representatives from the Pacific Northwest National Laboratory (PNNL), the NRC, and the CSTF. NUREG/CR-6847 was released in November 2004. In November 2005, NEI released NEI 04-04, "Cyber Security Program for Power Reactors," Revision 1. NEI 04-04 provides guidance on establishing and maintaining a cyber security program and incorporates assessment methodology described in NUREG/CR-6847. The NEI 04-04 program provides for the cyber security protection of all systems in the plant, including those necessary for reliable electrical generation. The guidance provides a risk-informed approach, in which consequences to plant functions are considered, and provides guidance on establishing a site cyber security defensive strategy incorporating multiple defensive layers with increasing levels of security protection. NEI 04-04 also provides guidance on incorporating cyber security considerations into the procurement process. The NEI 04-04 program includes the following steps:

1) Define current cyber security program
2) Identify Critical Digital Assets (CDAs)
3) Validate configuration
4) Assess susceptibility
5) Assess consequences
6) Determine risk
7) Refine defensive strategy

[8] U.S. Nuclear Regulatory Commission (NRC), "Force-on-Force Security Inspections," Backgrounder, Office of Public Affairs, March 2019, https://www.nrc.gov/docs/ML0436/ML043620052.pdf.

8) Continue program management

In December 2005, the NRC informed NEI by letter that NEI 04-04, dated November 18, 2005, is an acceptable method for establishing and maintaining a cyber security program at nuclear power plants. In 2006, the North American Electric Reliability Corporation (NERC) acknowledged that the NEI 04-04 program provides cyber security protection equivalent to the NERC Critical Infrastructure Protection (CIP) Reliability Standards.

The nuclear industry established a Nuclear Strategic Issues Advisory Committee (NSIAC) that has the ability to establish initiatives binding to all nuclear power plants. The NSIAC is comprised of the Chief Nuclear Officers of each power plant site or fleet. Approved NSIAC initiatives are implemented at all U.S. nuclear power plants. In April 2006, the NSIAC established an initiative requiring nuclear power plants to implement NEI 04-04 within two years. All U.S. plants implemented the initiative by May 2008.

Power plants are required by the NRC to design, implement, and evaluate their physical and cyber security programs to defend against a Design Basis Threat (DBT). In response to the increasing threat of cyber-related attacks, the NRC amended its DBT requirements in 2007 to include a cyberattack as an attribute of the adversary. The NRC describes a cyberattack as:

"The capability to exploit site computer and communications system vulnerabilities to modify or destroy data and programming code, deny access to systems, and prevent the operation of the computer system and the equipment it controls."

In March 2009, the NRC issued revised security requirements that included comprehensive programmatic cyber security requirements, principally codified in Title 10 of the Code of Federal Regulations (CFR), Section 10 CFR 73.54, "Protection of Digital Computer and Communication Systems and Networks" (Rule). The Rule requires power plants to submit a cyber security plan and implementation schedule for NRC review and approval. To support uniform implementation, the industry developed a template for the cyber security plan and the implementation schedule. In May 2010 the NRC endorsed NEI 08-09, "Cyber Security Plan for Nuclear Power Reactors," Revision 6. NEI 08-09 provides a template for cyber security plans and a catalog of technical, operational, and management cyber security controls tailored from the NIST Special Publication (SP) 800-53, "Recommended Security Controls for Federal Information Systems," Revision 2. The template for the implementation schedule provides eight milestones—seven interim milestones and an eighth milestone for full implementation. The first seven milestones are designed to address the most prominent threats to the plant's most important systems.

These milestones include the establishment of a cyber security assessment team, hardware-based isolation of key networks and assets, tightening controls over portable media and equipment, enhancing existing insider threat mitigation, instituting protective measures for digital equipment that could affect key safety systems, and establishing ongoing monitoring and assessment activities for implemented cyber security measures. By December 31, 2012, each plant completed the initial seven milestones.

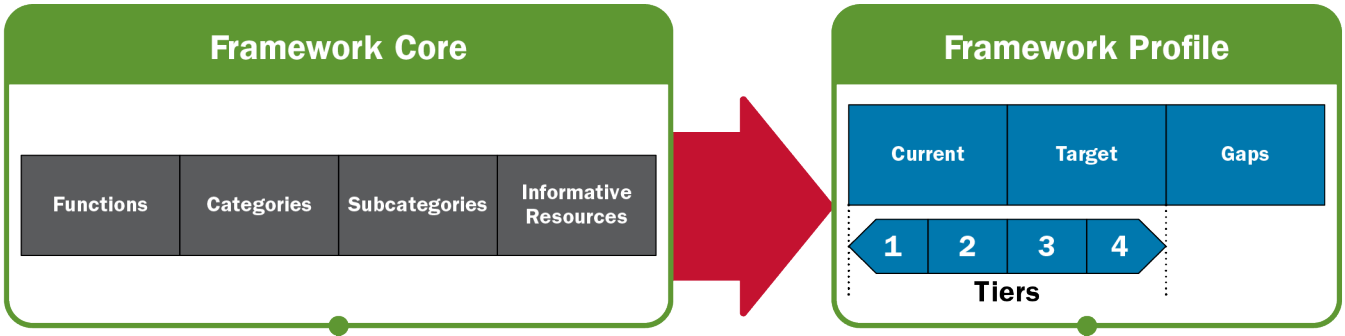
Beginning in January 2013, the NRC began conducting inspections of each plant's implementation of the first seven milestones and completed those inspections in December 2015. The NRC did not identify any significant issues—a reflection of the industry's commitment to addressing the cyber threat. The industry continued improving the program by implementing the eighth milestone. These enhancements include the completion of policy and procedural revisions that enhance existing capabilities, the completion of any remaining design-related modifications necessary to implement the cyber security plan, and the institution of protective measures for lower-consequence assets. Each plant completed milestone eight by December 31, 2017, except for those plants that received extensions approved by the NRC.

In August 2017, the NRC began inspecting the power plants' implementation of these enhanced cyber security program elements and will complete the inspections at each power plant by the end of 2020.

3. Framework Structure

The Framework is composed of three parts: the Framework Core, Informative References, and the Framework Profiles.

FIGURE 1. Framework Structure



The **Framework Core** is a set of cybersecurity activities, desired outcomes, and applicable references that are common across critical infrastructure sectors. The Core presents industry standards, guidelines, and practices in a manner that allows for communication of cybersecurity activities and outcomes across the organization from the executive level to the implementation/operations level.

The **Framework Core** consists of five concurrent and continuous Functions—Identify, Protect, Detect, Respond, Recover. When considered together, these Functions provide a high-level, strategic view of the lifecycle of an organization's management of cybersecurity risk.

The **Framework Core** then identifies underlying key Categories and Subcategories—which are discrete outcomes for each Function—and matches them with example informative references such as existing standards, guidelines, and practices for each Subcategory.

Informative References are specific sections of standards, guidelines, and practices common among critical infrastructure sectors or specific to a sector that illustrate a method to achieve the outcomes associated with each Subcategory or align their guidance or requirements with the specific Subcategory.

The Informative References presented in the Framework Core are illustrative and not exhaustive. They are based upon cross-sector guidance most frequently referenced during the Framework development process or sector-specific Cybersecurity Tools and Resources identified by sector partners to support framework implementation.

A **Framework Profile** represents the outcomes based on business needs that an organization has selected from the Framework Categories and Subcategories. The Profile can be characterized as the alignment of standards, guidelines, and practices with the Framework Core in a particular implementation scenario.

Profiles can be used to communicate within or between organizations or identify opportunities for improving cybersecurity posture by comparing a "Current" Profile (the "as is" state) with a "Target" Profile (the "to be" state).

To develop a Profile, an organization can review all of the Categories and Subcategories and, based on business/mission drivers and a risk assessment, determine which are most important.

Framework Implementation Tiers provide context on how an organization views cybersecurity risk and the processes in place to manage that risk. Tiers describe the degree to which an organization's cybersecurity risk management practices exhibit the characteristics defined in the Framework (e.g., risk and threat aware, repeatable, and adaptive). The Tiers characterize an organization's practices over a range, from Partial (Tier 1) to Adaptive (Tier 4).

Framework Core

The Framework Core elements work together as follows:

- **Functions** organize basic cyber security activities at their highest level. They aid an organization in expressing its management of cyber security risk by organizing information, enabling risk management decisions, addressing threats, and improving by learning from previous activities. The Functions also align with existing methodologies for incident management and help show the effect of investments in cyber security. For example, investments in planning and exercises support timely response and recovery actions, resulting in reduced impact to the delivery of services. The five Framework Core functions are:
    - **Identify:** Develop an organizational understanding to manage the cyber security risks to systems, people, assets, data, and capabilities;
    - **Protect:** Develop and implement appropriate safeguards to ensure delivery of critical services;
    - **Detect:** Develop and implement appropriate activities to identify the occurrence of a cyber security event;
    - **Respond:** Develop and implement appropriate activities to take action regarding a detected cybersecurity incident; and
    - **Recover:** Develop and implement appropriate activities to maintain plans for resilience and to restore any capabilities or services that were impaired due to a cyber security incident.
- **Categories** are the subdivisions of a Function into groups of cyber security outcomes closely tied to programmatic needs and particular activities. Examples of Categories include "Asset Management," "Identity Management and Access Control," and "Detection Processes." A complete list of Categories can be found in Appendix A, Table A2.
- **Subcategories** further divide a Category into specific outcomes of technical and/or management activities. They provide a set of results that, while not exhaustive, help support achievement of the outcomes in each Category. Examples of Subcategories include "External information systems are catalogued," "Data-at-rest is protected," and "Notifications from detection systems are investigated." A complete list of Subcategories can be found in Appendix A, Table A2.
- **Informative References** are specific sections of standards, guidelines, and practices common among critical infrastructure sectors that illustrate a method to achieve the outcomes associated with each Subcategory. The Informative References presented in the Framework Core are illustrative and not exhaustive. They are based upon cross-sector guidance most frequently referenced during the Framework development process. A complete list of Informative References can be found on the NIST Cybersecurity Framework Informative References page.

TABLE 1. Framework Functions, Categories, Subcategories, and Informative References

Functions	Categories	Subcategories	Informative References
IDENTIFY	Asset Management	Ex: Organizational communication and data flows are mapped	Ex: NIST SP 800-53: AC-4, CA-3, CA-9, PL-8, etc.
		Ex: Resources are prioritized based on their classification, criticality, and business value	Ex: NIST SP 800-53: CP-2, RA-2, SA-14, etc.
	Business Environment		

Functions	Categories	Subcategories	Informative References
	Governance		
	Risk Assessment		
	Risk Management Strategy		
	Supply Chain Risk Management		
PROTECT	Identity Management and Access Control		
	Awareness and Training		
	Data Security		
	Information Protection Processes and Procedures		
	Maintenance		
	Protective Technology		
DETECT	Anomalies and Events		
	Security Continuous Monitoring		
	Detection Processes		

Functions	Categories	Subcategories	Informative References
RESPOND	Response Planning		
	Communications		
	Analysis		
	Mitigation		
	Improvements		
RECOVER	Recovery Planning		
	Improvements		
	Communications		

Framework Profile

The Profile is the alignment of the Functions, Categories, and Subcategories with the business requirements, risk tolerance, and resources of the organization. A Profile enables organizations to establish a roadmap for reducing cyber security risk that is well-aligned with organizational and sector goals, considers legal/regulatory requirements and industry best practices, and reflects risk management priorities. Given the complexity of many organizations, they may choose to have multiple profiles aligned with particular organizational components to recognize the unique needs of different components.

Framework Profiles can be used to describe the current state or the desired target state of specific cyber security activities. The Current Profile indicates the cyber security outcomes that are currently being achieved. The Target Profile indicates the outcomes needed to achieve the desired cyber security risk management goals. Profiles support business/mission requirements and aid in communicating risk within and between organizations.

Framework Implementation Tiers

The Tiers provide context on how an organization views cyber security risk and the processes in place to manage that risk. Ranging from Partial (Tier 1) to Adaptive (Tier 4), Tiers describe an increasing degree of sophistication in cyber security risk management practices. They help determine the extent to which cyber security risk management is informed by business needs and is integrated into an organization's overall risk management practices.

While organizations identified as Tier 1 are encouraged to consider moving toward Tier 2 or greater, Tiers do not represent maturity levels. Tiers are meant to support organizational decision-making about how to manage cyber security risk, as well as which dimensions of the organization are higher priority and could receive additional resources. Progression to higher Tiers is encouraged when a cost-benefit analysis (CBA) indicates a feasible and cost-effective reduction of cyber security risk. An organization completes a successful implementation of the Framework when it achieves the outcomes described in its Target Profiles; however, Tier selection and designation naturally affect Framework Profiles.[9]

The Tier definitions are as follows:

Tier 1: Partial

- **Risk Management Process**: Organizational cyber security risk management practices are not formalized, and risk is managed in an *ad hoc* and sometimes reactive manner.
- **Integrated Risk Management Program**: There is limited awareness of cyber security risk at the organizational level. The organization implements cyber security risk management on an irregular, case-by-case basis due to varied experience or information gained from outside sources.
- **External Participation**: The organization does not understand its role in the larger ecosystem of its dependencies or dependents. The organization does not collaborate with or receive information (e.g., threat intelligence, best practices, technologies) from other entities (e.g., buyers, suppliers, dependencies, dependents, Information Sharing and Analysis Organizations, researchers, governments), nor does it share information.

Tier 2: Risk Informed

- **Risk Management Process**: Risk management practices are approved by management but may not be established organization-wide.
- **Integrated Risk Management Program**: There is an awareness of cyber security risk at the organizational level, but there is no established, organization-wide approach to managing cyber security risk. Cyber security information is shared within the organization on an informal basis.
- **External Participation**: Generally, the organization understands its role in the larger ecosystem with respect to either its own dependencies or dependents, but not both. The organization collaborates with and receives some information from other entities and generates some of its own information but may not share information with others.

Tier 3: Repeatable

- **Risk Management Process**: The organization's risk management practices are formally approved and expressed as policy.
- **Integrated Risk Management Program**: There is an organization-wide approach to manage cyber security risk. Risk-informed policies, processes, and procedures are defined, implemented as intended, and reviewed.
- **External Participation**: The organization understands its role, dependencies, and dependents in the larger ecosystem and may contribute to the community's broader understanding of risks. It collaborates with and regularly receives information from other entities that complements internally generated information, and shares information with other entities.

Tier 4: Adaptive

- **Management Process**: The organization adapts its cyber security practices based on previous and current cyber security activities, including lessons learned and predictive indicators.
- **Integrated Risk Management Program**: There is an organization-wide approach to managing cyber security risk that uses risk-informed policies, processes, and procedures to address potential cyber security events.

[9] National Institute of Standards and Technology (NIST), Framework for Improving Critical Infrastructure Cybersecurity, Version 1.1, April 16, 2018, https://nvlpubs.nist.gov/nistpubs/CSWP/NIST.CSWP.04162018.pdf.

The relationship between cyber security risk and organizational objectives is clearly understood and considered when making decisions.

- External Participation: The organization understands its role, dependencies, and dependents in the larger ecosystem and contributes to the community's broader understanding of risks. It receives, generates, and reviews prioritized information that informs continuous analysis of its risks as the threat and technology landscapes evolve. The organization shares that information internally and externally with other collaborators.

4. Sector Framework Guidance Resources

This section presents an overview of the NRC's risk management program and cyber security requirements and guidance.

Nuclear Sector Risk Management

The NRC was created as an independent agency by Congress in 1974 to ensure the safe use of radioactive materials for beneficial civilian purposes while protecting people and the environment. The NRC uses licensing, inspection, and enforcement of its requirements to regulate commercial nuclear power reactors and other uses of nuclear material, such as in medicine.

NRC's regulatory mission covers three main areas:

- **Reactors**—Commercial reactors for generating electric power and research and test reactors used for research, testing, and training;
- **Materials**—Uses of nuclear materials in medical, industrial, and academic settings and facilities that produce nuclear fuel; and
- **Waste**—Transportation, storage, and disposal of nuclear materials and waste, and decommissioning of nuclear facilities from service.

The NRC imposes security requirements in a risk-informed manner for their licensees with the objective of ensuring public health and safety, as well as common defense and security.

Overview of NRC Power Reactor Requirements and Guidance

The NRC has established requirements for cyber security programs for nuclear power reactors. The cyber security requirements are codified primarily in 10 CFR 73.54. These cyber security requirements are an integrated component of the NRC's overall physical protection program requirements that include physical security, cyber security, and personnel security. The requirements establish a comprehensive cyber security program for the protection of digital computer and communications systems and equipment against cyberattacks that would adversely affect operational safety, security, or emergency preparedness. Also protected are digital assets associated with electric power generation equipment. The program includes key cyber security program elements, including the identification of in-scope assets; implementation of security controls; defense-in-depth measures for detection, response, and recovery; managing cyber risks; training; integration of cyber security and physical security programs; development and maintenance of written policies and implementing procedures; reviewing the cyber security program; and records retention. Nuclear power plants and the NRC have continued to enhance the guidance based on lessons learned and operating experience.

To support implementation of the cyber security requirements in 10 CFR 73.54, the NRC has issued and endorsed a number of approaches. Although a more complete list can be found in Section 8, notable guidance documents are summarized in Table 2.

Table 2.—Key U.S. Nuclear Power Reactor Cyber Security Guidance Documents

Name	Summary	Additional Information
NEI 08-09, "Cyber Security Plan for Nuclear Power Reactors"	NEI 08-09 provides a template for the cyber security plan. The plan includes a defensive strategy that consists of a defensive architecture and set of security controls that are based on the NIST SP 800-82, Final Public Draft, Dated September 29, 2008 "Guide to Industrial Control System Security," and NIST SP 800-53, Revision 2, "Recommended Security Controls for Federal Information Systems" standards.	Cyber Security Plan for Nuclear Power Reactors (https://adamswebsearch2.nrc.gov/webSearch2/main.jsp?AccessionNumber=ML101180437)
Template for the Cyber Security Plan Implementation Schedule	Provides a template used by each operating power plant to establish the schedule for the implementation of their cyber security plans. Each operating plant has completed the first seven milestones provided in the template.	Cyber Security Plan Implementation Schedule (https://adamswebsearch2.nrc.gov/webSearch2/main.jsp?AccessionNumber=ML110600218)
NEI 13-10, "Cyber Security Control Assessments"	Provides a graded approach for addressing cyber security controls. The goal is to minimize unnecessary burdens while continuing to ensure that the plants remain adequately protected.	Cyber Security Control Assessments (https://adamswebsearch2.nrc.gov/webSearch2/main.jsp?AccessionNumber=ML13295A347)
RG 5.71, "Cyber Security Programs for Nuclear Facilities"	RG 5.71 is similar to NEI 08-09 in that it contains a template for the cyber security plan and a catalog of security controls. RG 5.71 includes additional information not found in NEI 08-09. Certain new plants use RG 5.71, rather than NEI 08-09, as the basis for their cyber security plans. Because of the similarities between RG 5.71 and NEI 08-09, this Framework mapping is applicable to new plants as well.	Cyber Security Programs for Nuclear Facilities (https://www.nrc.gov/docs/ML0903/ML090340159.pdf)

Mapping to the Framework

Section 5 details the Framework implementation using the existing practices as well as requirements and guidance applicable to nuclear power plants. A mapping of these elements to the Framework is provided in Appendix A. The mapping provides a translation between the organization's current practices and the Framework, supporting communication to external stakeholders.

5. Framework Implementation

The Framework illustrates the informational and decision flows within an organization. For example, senior executives gauge priorities for business levels to nominate Tiers to develop Profiles, which then go to the operational level of an organization that implements the Profile. An organization can use the Framework as a key part of its systematic process for identifying, assessing, and managing cyber security risk. The Framework is not designed to replace existing processes; rather, it is designed to complement existing business and cyber security operations. It can serve as the foundation for a new cyber security program or a mechanism for improving an existing program. It also provides a general set of considerations and processes for considering privacy and civil liberties implications in the context of a cyber security program.

Considerations Prior to Implementation

There are some considerations that can be considered prior to implementation. They are as follows:

- **Communicating Cyber Security Requirements with Stakeholders**: The Framework provides a common language to communicate requirements among interdependent stakeholders responsible for the delivery of essential critical infrastructure products and services. Communication is especially important among stakeholders up and down supply chains. Supply chains begin with the sourcing of products and services and extend from the design, development, manufacturing, processing, handling, and delivery of products and services to the end user. Given these complex and interconnected relationships, supply-chain risk management (SCRM) is a critical organizational function.[10]
    - Cyber SCRM is the set of activities necessary to manage cyber security risk associated with external parties. A primary objective of cyber SCRM is to identify, assess, and mitigate cyber supply chain risks associated with "products and services that may contain potentially malicious functionality, are counterfeit, or are vulnerable due to poor manufacturing and development practices" within the cyber supply chain.[11]
- **Buying Decisions**: Since a Framework Target Profile is a prioritized list of organizational cyber security requirements, Target Profiles can be used to inform decisions about acquiring products (e.g., systems) and services. This transaction varies from Communicating Cyber Security Requirements with Stakeholders in that it may not be possible to impose a set of cyber security requirements on the supplier. However, requiring tamper-proof products or evidence of tamper proofing as well as application of best practices, including quality and validation methods, may be possible. The objective should be to make the best buying decision among multiple suppliers, given a carefully determined list of cyber security requirements. Once a product or service is purchased, the Profile also can be used to track and address residual cyber security risk.[12]
- **Identifying Opportunities for New or Revised Informative References**: The Framework can be used to identify opportunities for new or revised standards, guidelines, or practices where additional Informative References would help organizations address emerging needs. An organization implementing a given Subcategory, or

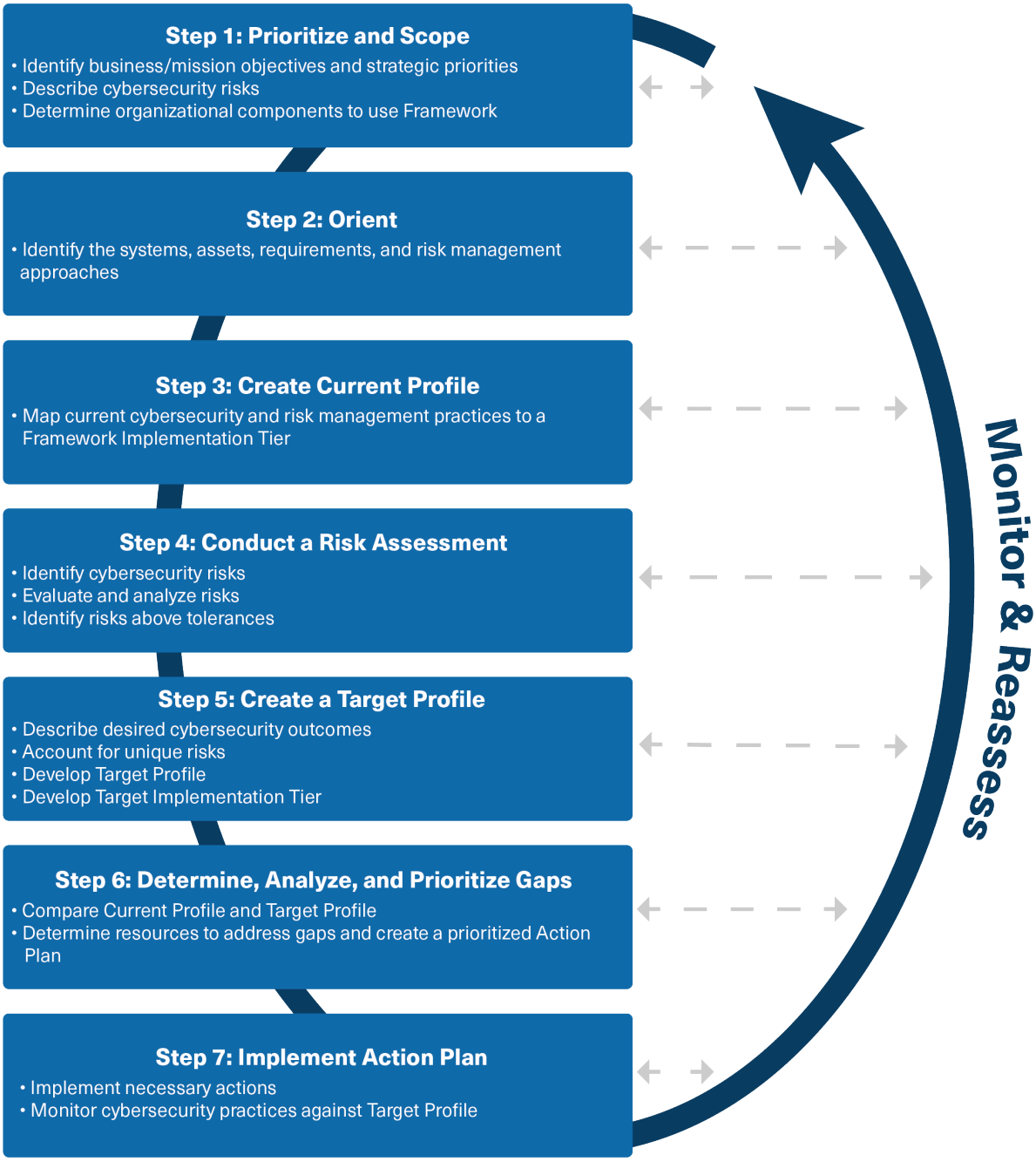
[10] Communicating Cybersecurity Requirements (Section 3.3) and Buying Decisions (Section 3.4) address only two uses of the Framework for cyber SCRM and are not intended to address cyber SCRM comprehensively.
[11] NIST Special Publication 800-161, *Supply Chain Risk Management Practices for Federal Information Systems and Organizations*, Boyens et al, April 2015, https://doi.org/10.6028/NIST.SP.800-161.
[12] Nuclear Energy Institute (NEI), *Cyber Security Plan for Nuclear Power Reactors*, April 2010, https://adamswebsearch2.nrc.gov/webSearch2/main.jsp?AccessionNumber=ML101180437

developing a new Subcategory, might discover that there are few, if any, Informative References for a related activity.

Step-by-Step Framework Implementation Guide

This section describes how the seven-step process outlined in Section 3.2 in the Cybersecurity Framework was used to demonstrate how cyber security practices at U.S. nuclear power plants align with the Framework. Established practices common at plants, as well as those necessitated by regulatory requirements, were used. Where possible, references to specific documents or requirements are provided. The seven-step process is shown below in Figure 2.

FIGURE 2. Seven-step Process for Framework Implementation



Each step is introduced by a table describing the step's inputs, activities, and outputs. Additional explanation is provided below each table as needed. A summary table of the input, activities, and output for each step is included in Appendix B.

An organization may repeat the steps as needed to continuously assess and improve its cyber security. For instance, organizations may find that frequent repetition of "Step 2: Orient" improves the quality of risk assessments. Furthermore, organizations may monitor progress through iterative updates to the Current Profile, subsequently comparing the Current Profile to the Target Profile. Organizations may also use this process to align their cyber security program with their desired Framework Implementation Tier.

U.S. nuclear power plants already have comprehensive risk management programs that establish the context for risk-based decisions by allowing them to assess risk, address identified risk, and monitor risk on an ongoing basis. The plants also use corrective action programs, assessments, and audits for continuous improvement. This section demonstrates how the activities described in these seven steps are already performed. Accordingly, this document describes how the plants implement the Framework by describing elements of their current approach and aligning them with, or "translating" them to, the Framework Core and Implementation Tiers.

Step 1: Prioritize and Scope

Inputs	Activities	Outputs
1. Risk management strategy 2. Organizational objectives and priorities 3. Threat information	1. Organization determines where it wants to apply the Framework to evaluate and potentially guide the improvement of the organization's cyber security capabilities	1. Framework usage scope

The Framework usage scope for nuclear power plants in the United States is well defined. Nuclear plants implement cyber security programs for digital computer and communications systems and networks performing the following categories of functions:

1) Safety-related functions (including assets associated with electric power generation equipment out to the intertie with the offsite transmission system)
2) Security functions
3) Emergency preparedness functions, including offsite communications
4) Support systems and equipment which, if compromised, would adversely affect safety, security, or emergency preparedness functions

Plants implement these programs in order to protect from those cyberattacks that would modify, destroy, or compromise the integrity or confidentiality of data and/or software; deny access to systems, services, and/or data; or affect the operation of systems, networks, and associated equipment.

Step 2: Orient

Inputs	Activities	Outputs

1. Framework usage scope 2. Risk management strategy	1. Organization identifies in-scope systems and assets (e.g., people, information, technology, and facilities) and the appropriate regulatory and Informative References (e.g., cyber security and risk management standards, tools, methods, and guidelines)	1. In-scope systems and assets 2. In-scope requirements (i.e., regulatory, company, organizational) 3. In-scope cyber security and risk management standards, tools, methods, and guidelines 4. Evaluation approach

The NRC requires each nuclear power plant to implement a cyber security program covering the digital assets described in Step 1, "Prioritize and Scope," above. The NRC's cyber security requirements are codified primarily in 10 CFR 73.54. Each plant has submitted, and the NRC has approved, a cyber security plan (Plan) and implementation schedule (Schedule). The Plan describes how the cyber security requirements will be met, and the Schedule describes when the Plan will be implemented. The plants have used an industry-wide template for both the Plan and Schedule.

In accordance with the Schedule, each power plant identified the digital systems and equipment in scope for their cyber security programs by December 31, 2012. Beginning in January 2013, the NRC began conducting inspections of each plant's implementation of the first seven milestones and completed those inspections in December 2015. The NRC did not identify any significant issues—a reflection of the industry's commitment to addressing the cyber threat.

The in-scope cyber security and risk management standards, tools, methods, and guidelines include the physical, cyber, and personnel security requirements codified in 10 CFR 73.54, 10 CFR 73.55, and 10 CFR 73.56, respectively. Guidance most applicable to this Framework mapping includes the industry's NEI 08-09, NEI 10-04, and NEI 13-10. The standards, tools, methods, and guidelines regarding information security are included within the requirements codified in 10 CFR 73.21 and 10 CFR 73.22 and their associated implementing guidance documents. A more detailed list of guidance and requirements can be found in Section 8.

Step 3: Create a Current Profile

Inputs	Activities	Outputs
1. Evaluation approach 2. In-scope systems and assets 3. In-scope regulatory requirements 4. In-scope cyber security and risk management standards, tools, methods, and guidelines	1. Organization identifies its current cyber security and risk management state	1. Current Profile 2. Current Implementation Tier

U.S. nuclear power plants have advanced risk management practices that are fully integrated into both the design of the facility and its operations and oversight. With a fundamental focus on safety, risk-significant systems, structures, and components (SSCs) are identified, and the plant is physically designed to ensure that those SSCs are not adversely affected by a range of hazards. This focus on safety is fed forward from the design into the operations and oversight of power plants.

Additionally, U.S. nuclear power plants have an approved Plan and Schedule, making their Current and Target Profiles and Implementation Tiers easily determined. The Current and Target Profiles and an assessment of the Implementation Tier are provided in Appendix A. The Profiles are informed by the uniform Plan and Schedule.

Although the Current Profile recognizes that the Plans are partially implemented, the Target Profile was implemented for a subset of plant equipment by December 31, 2012. Based on the Current Profile and Implementation Tier assessment described in Appendix A, the current Implementation Tier is between Tier 3, "Repeatable," and Tier 4, "Adaptive." Upon full implementation of the Plan, the Implementation Tier will be Tier 4, "Adaptive."

Step 4: Conduct a Risk Assessment

Inputs	Activities	Outputs
1. Framework usage scope 2. Risk management strategy 3. Organization-defined risk assessment approach 4. In-scope regulatory requirements 5. In-scope cyber security and risk management standards, tools, methods, and guidelines	1. Perform risk assessment for in-scope portion of the organization	1. Risk assessment reports

The concepts of risks (from both natural and manmade hazards) are well understood and established for nuclear power plants. Each plant has identified sets of plant systems and equipment that are more or less risk significant. During the development of the Implementation Schedule, this inherent understanding of risk was used to prioritize implementation. The Schedule prioritized cyber security program implementation for the subset of plant equipment determined to be most important for protecting the health and safety of the public. The Schedule also prioritized the implementation of plant-wide mitigations for certain cyber threats, including network-based attacks and attacks that promulgate through the use of portable media and portable equipment. Because each plant has identified risk-significant systems and equipment and has a risk-informed implementation schedule, a separate risk assessment was not performed during the development of this document.

Step 5: Create a Target Profile

Inputs	Activities	Outputs
1. Current Profile 2. Current Tier 3. Organizational objectives 4. Risk management strategy 5. Risk assessment reports	1. Organization identifies goals that will mitigate risk commensurate with the risk to organizational and critical infrastructure objectives	1. Target Profile 2. Target Tier

As discussed in Step 3, "Create a Current Profile," the Target Profile is determined by the approved Plan and Schedule, and is documented in Appendix A. The Target Implementation Tier is Tier 4, "Adaptive."

Step 6: Determine, Analyze, and Prioritize Gaps

Inputs	Activities	Outputs
1. Current Profile 2. Current Tier 3. Target Profile 4. Target Tier 5. Organizational objectives 6. Impact to critical infrastructure 7. Gaps and potential Consequences 8. Organizational constraints 9. Risk management strategy 10. Risk assessment reports	1. Analyze gaps between current state and Target Profile in organization's context 2. Evaluate potential consequences from gaps 3. Determine which gaps need attention 4. Identify actions to address gaps 5. Perform cost-benefit analysis (CBA) on actions 6. Prioritize actions (CBA and consequences) 7. Plan to implement prioritized actions	1. Prioritized gaps and potential consequences 2. Prioritized implementation plan

U.S. nuclear power plants are enhancing their cyber security programs using the Implementation Schedule. The Schedule prioritized early implementation of key cyber security controls for a subset of systems and equipment most important to protecting the health and safety of the public. These controls were in place by December 31, 2012. Moving toward full implementation of the program, plants are evaluating the less risk-significant assets and implementing appropriate cyber security controls. These activities will be completed by the plant-specific date specified in their Schedule and approved by the NRC.

Step 7: Implement Action Plan

Input	Activities	Outputs
1. Prioritized implementation plan	1. Implement actions by priority 2. Track progress against plan 3. Monitor and evaluate progress against key risks, metrics, and performance indicators 4. Report progress	1. Project tracking data 2. New security measures implemented

The Implementation Schedule driving cyber security program enhancements has been in place for many years. Plants have detailed project plans they are using to ensure they meet the commitments in the Schedule. These non-voluntary commitments are enforceable by the NRC. The details of these project plans were not reviewed during the development of this document. However, given the uniform nature of the industry-wide Cyber Security Plans and Implementation Schedules, there is sufficient knowledge of the implementation activities to form a reasonable basis for the conclusions in this document.

6. Informing Existing Sector Efforts

The Framework can be used to enhance the success of existing sector-specific programs and inform sector-level goals and guidelines. The approaches below can be used to increase knowledge and enhance cyber security practices; the Framework can make them more effective.

- **Cybersecurity and Infrastructure Security Agency**: CISA leads the national effort to protect and enhance the resilience of the Nation's physical and cyber infrastructure. Its Industry Engagement website[13] provides cyber security resources and best practices to assist businesses, government agencies, and other organizations in their efforts to use the Framework to manage their cyber risks as part of an all-hazards approach to enterprise risk management. Currently, there are many programs and resources available to critical infrastructure sectors and organizations that are looking to use the Framework and improve their cyber risk resilience. These resources are provided by CISA, other Federal and State agencies, and nonprofit organizations.
- **Nuclear Sector-Specific Plan:** The *Nuclear Reactors, Materials, and Waste Sector-Specific Plan*[14] (SSP) is designed to guide the sector's efforts to improve security and resilience, and describes how the Nuclear Sector manages risks and contributes to national critical infrastructure security and resilience, as set forth in Presidential Policy Directive 21 (PPD-21). The SSP reflects the overall strategic direction for the Nuclear Sector and represents the progress made in addressing the sector's evolving risk, operating, and policy environments. As an annex to the *National Infrastructure Protection Plan 2013: Partnering for Critical Infrastructure Security and Resilience* (*NIPP 2013*), the SSP tailors the NIPP's strategic guidance to the unique operating conditions and risk landscape of the Nuclear Sector.

7. Conclusion

U.S. nuclear power plants operate in both the Nuclear Reactors, Materials, and Waste and the Energy Sectors. U.S. reactors are regulated for safety and security by the NRC. The NRC issues requirements and develops or endorses guidance describing methods acceptable for meeting the requirements. Section 4 provides an overview of NRC requirements and guidance.

U.S. nuclear power plants already have advanced risk management practices, which are fully integrated into the design, operations, and oversight of the facility. Nuclear reactors in the United States have a strong track record of working together to develop and implement cyber security standards, tools, and processes that ensure safety, security, and reliability.

U.S. nuclear power reactors may implement the Framework for Improving Critical Infrastructure Cybersecurity through their existing practices and programs. Framework implementation at nuclear power reactors is, at present, repeatable, and will be adaptive once in-progress program enhancements are complete.

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[13] U.S. Department of Homeland Security, Cybersecurity and Infrastructure Security Agency (CISA), "CISA: Resources," https://www.us-cert.gov/resources.
[14] U.S. Department of Homeland Security, *Nuclear Reactors, Materials, and Waste Sector-Specific Plan: An Annex to the NIPP 2013*, 2015, http://www.dhs.gov/publication/nipp-ssp-nuclear-2015.

8. References

Abbreviated Reference	Citation
10 CFR 73.1	NRC Regulations, *Physical Protection of Plants and Materials, Purpose and Scope*, 10 CFR §73.1, http://www.nrc.gov/reading-rm/doc-collections/cfr/part073/part073-0001.html.
10 CFR 73.21	NRC Regulations, *Physical Protection of Plants and Materials, Protection of Safeguards Information: Performance Requirements*, 10 CFR §73.21, http://www.nrc.gov/reading-rm/doc-collections/cfr/part073/part073-0021.html.
10 CFR 73.22	NRC Regulations, *Physical Protection of Plants and Materials, Protection of Safeguards Information: Specific Requirements*, 10 CFR §73.22, http://www.nrc.gov/reading-rm/doc-collections/cfr/part073/part073-0022.html.
10 CFR 73.54	NRC Regulations, *Physical Protection of Plants and Materials, Protection of Digital Computer and Communication Systems and Networks*, 10 CFR §73.54, http://www.nrc.gov/reading-rm/doc-collections/cfr/part073/part073-0054.html.
10 CFR 73.55	NRC Regulations, *Physical Protection of Plants and Materials, Requirements for Physical Protection of Licensed Activities in Nuclear Power Reactors Against Radiological Sabotage*, 10 CFR §73.55, http://www.nrc.gov/reading-rm/doc-collections/cfr/part073/part073-0055.html.
10 CFR 73.56	NRC Regulations, *Physical Protection of Plants and Materials, Personnel access authorization requirements for nuclear power plants*, 10 CFR §73.56, http://www.nrc.gov/reading-rm/doc-collections/cfr/part073/part073-0056.html.
10 CFR 73.77	NRC Regulations, *Physical Protection of Plants and Materials, Cyber Security Event Notifications,* 10 CFR §73.77, http://pbadupws.nrc.gov/docs/ML1426/ML14269A388.pdf.
Implementation Schedule Template	Nuclear Energy Institute, *Template for the Cyber Security Plan Implementation Schedule*, https://adamswebsearch2.nrc.gov/webSearch2/main.jsp?AccessionNumber=ML110600218.
NEI 08-09	Nuclear Energy Institute, *Cyber Security Plan for Nuclear Power Plants,* http://pbadupws.nrc.gov/docs/ML1011/ML101180437.pdf.
NEI 10-04	Nuclear Energy Institute, *Identifying Systems and Assets Subject to the Cyber Security Rule*, Revision 2, 2012, https://adamswebsearch2.nrc.gov/webSearch2/main.jsp?AccessionNumber=ML12180A081.
NEI 10-08	Nuclear Energy Institute. *Cyber Security Control Assessments*, Revision 2, 2014, https://adamswebsearch2.nrc.gov/webSearch2/main.jsp?AccessionNumber=ML14351A288. Note: this document is under active revision, updated versions may be available.
NEI 10-09	NRC Regulatory Guide, *Cyber Security Programs for Nuclear Facilities,* Revision 0, January 2010, http://pbadupws.nrc.gov/docs/ML0903/ML090340159.pdf.

Abbreviated Reference	Citation
NEI 13-10	Nuclear Energy Institute, *Cyber Security Control Assessments,* Revision 2, 2014, https://adamswebsearch2.nrc.gov/webSearch2/main.jsp?AccessionNumber=ML14351A288. Note: This document is under active revision. Updated versions may be available.
NIST 2014	National Institute of Standards and Technology, *Framework for Improving Critical Infrastructure Security*, NIST, February 2014, http://www.nist.gov/cyberframework/index.cfm.
NIST SP 800-53	National Institute of Standards and Technology, Special Publication (SP) 800-53 (NIST SP 800-53), *Recommended Security Controls for Federal Information Systems*, Revision 2, http://csrc.nist.gov/publications/PubsSPs.html#SP 800. Note: At the time NEI 08-09 was developed, Revision 2 to NIST SP 800-53 was the currently approved standard.
NRC RG 5.71	NRC Regulatory Guide, *Cyber Security Programs for Nuclear Facilities*, Revision 0, January 2010, http://pbadupws.nrc.gov/docs/ML0903/ML090340159.pdf.

Appendix A: Mapping to the Framework

As discussed in Section 5 of this Implementation Guidance, cyber security programs at nuclear power plants can be mapped to the Framework Core and Implementation Tiers to demonstrate their implementation of the Framework.

U.S. nuclear power reactors established comprehensive and integrated operational and security risk management programs long before cyber security concerns warranted separate risk management attention. Accordingly, and to more fully inform the Framework mapping, Table A1 provides an overview of how various programs at power reactors support implementation of the Framework. These other programs include, for example, maintenance, work management, configuration management, and corrective-action programs that support safety and reliability. Power reactor physical protection programs existed before the NRC's new requirements for cyber security programs; they implement comprehensive physical security, personnel security, access controls, and information security practices. A stand-alone review of the Cyber Security Plan at U.S. nuclear power reactors would not provide an adequate representation of the comprehensive and integrated nature of established operational and security risk management programs. The cyber security programs do not necessarily establish or implement these other programs; however, the cyber security program may supplement or enhance them. Table A1 identifies these enhancements.

The overview is followed by a two-part mapping. These mappings provide detail for how plant practices meet the intent of the Framework. Table A2 maps the Framework Core and the nuclear reactor cyber security program practices. At the time of this writing, the Profile identified in Table A2 is currently achieved at all U.S. nuclear reactors for systems and equipment essential to safety and security. Progress toward the Profile is underway and is on schedule to be achieved between 2017 and 2019 based on each reactor's Implementation Schedule. The Profile column in Table A2 references applicable sections of the Plan and cyber security controls from NEI 08-09. The cyber security controls were tailored from the controls in NIST SP 800-53. The Plan sections and cyber security controls listed in Table A2 supplement and enhance existing programs described in Table A1. The cyber security controls listed in Table A2 are taken from Appendices A, D, and E from NEI 08-09. These controls have corollaries in Appendices A, B, and C of RG 5.71.

Table A3 maps practices at U.S. nuclear power plants to the Framework Implementation Tiers. The description of nuclear power plant implementation illustrates current practices in place at the time of the writing of this document and those future practices that will be in place once the enhancements to the cyber security program are fully implemented. The current practices are consistent with at least Implementation Tier 3, "Repeatable." The future practices that enhance those current practices are consistent with Implementation Tier 4, "Adaptive."

TABLE A1. U.S. Nuclear Power Reactor Implementation Notes Mapped to the Framework Core

Function	Category	U.S. Nuclear Power Reactor Implementation Notes
Identify (ID)	Asset Management (ID.AM)	Nuclear reactors maintain up-to-date inventories of the devices, systems software platforms, and applications within the plants. These inventories are updated as changes to the facilities occur in accordance with standard configuration management, work management, and software quality assurance programs. These inventories include details on the safety and reliability importance of the assets. Safety, reliability, and security systems within a reactor do not interface with external systems such as the plant business network. Plants use a variety of communications tools that ensure effective communications with personnel and management. These tools include pre-job briefings, shift-turnover reports, daily briefings, and regular updates to management on facility activities. These practices ensure that events that could affect the plant are managed effectively. Roles and responsibilities, including those related to cyber security, are documented in site-governing documents and are well understood.
Identify (ID)	Business Environment (ID.BE)	As significant contributors to the baseload generating capacity of the United States and significant consumers of electricity, nuclear power reactors are well-aware of the role they play in ensuring the reliability of the electrical system. The plants focus on safety and reliability to drive mission priorities, as well as risk and resilience management activities. The potential effects of cyber threats to safety, security, and reliability are well established and integrated into risk management activities.

Function	Category	U.S. Nuclear Power Reactor Implementation Notes
Identify (ID)	Governance (ID.GV)	Each U.S. reactor has a Cyber Security Plan that has been reviewed and approved by the NRC as meeting the NRC's cyber security requirements. The Plan includes a description of the roles, responsibilities, and authorities necessary to establish, implement, and maintain the cyber security program. The Plan describes how cyber security risk management is performed. The cyber security program is integrated into the overall nuclear power plant physical protection program and is subject to oversight by both the plant's independent oversight organization and by the NRC.
Identify (ID)	Risk Assessment (ID.RA)	The Cyber Security Plan describes the risk assessment steps. The Plan includes measures for receiving and dispositioning threat and vulnerability notices, assessing and responding to risks that affect critical systems, assessing changes to facility systems to ensure cyber risk is managed, and periodically reviewing cyber risk management activities.
Identify (ID)	Risk Management Strategy (ID.RM)	The Cyber Security Plan is implemented by site-governing documents and implementing procedures that establish and govern the risk management process. Risk tolerance is driven by the performance objective of preventing, detecting, and responding to cyberattacks before those attacks could adversely affect safety and security.
Identify (ID)	Supply Chain Risk Management (ID.SC)	Plants adhere to cyber supply chain requirements defined in their cyber security plans (licensing basis).
Protect (PR)	Identify Management and Access Control (PR.AC)	Power reactors have robust access control programs. These programs are designed to ensure that individuals granted access to the plant are trustworthy and reliable and do not constitute an unreasonable risk to the health and safety of the public. Access is granted to those individuals who have a need to access the facility to perform their job functions. The need for access is routinely reverified, and access is revoked when no longer needed. Assessing cyber security access controls to the plant's digital computer systems is included in the cyber security program.

Function	Category	U.S. Nuclear Power Reactor Implementation Notes
Protect (PR)	Awareness and Training (PR.AT)	Training is a key component of nuclear reactor operations. All personnel, including contractors and visitors, receive training that includes both basic awareness and job-function-specific training. The training programs, based on the individual's roles and responsibilities, include a variety of cyber security training, such as basic awareness, job-function-specific, and tiered training for personnel implanting the cyber security program.
Protect (PR)	Data Security (PR.DS)	Plants have specific data security programs established to protect certain information from unauthorized disclosure. Specific requirements regarding the protection of safeguarded information are codified in 10 CFR 73.21 and 10 CFR 73.22. Additionally, plants have programs in place to protect proprietary, non-safeguarded, security-related information. Plants evaluate security and integrity controls applicable to the digital systems and equipment within their cyber security program. The cyber security program includes measures governing management of assets throughout the lifecycle.
Protect (PR)	Information Protection Processes and Procedures (PR.IP)	Cyber security practices are integrated into digital asset lifecycles including configuration management, work management, software quality assurance, cyber security threat and vulnerability management, and incident response and recovery programs. The cyber security program complements site contingency and emergency response procedures. Periodic testing of these programs ensures they remain effective.
Protect (PR)	Maintenance (PR.MA)	Plants use an integration of corrective action, configuration management, and work management programs to ensure the maintenance and repair of assets are performed and logged in a timely, structured manner. Offsite access to critical systems and protected equipment relied on for safety, security, and reliability is prohibited—maintenance must be performed on site by personnel determined to be trustworthy and reliable or by individuals escorted by personnel determined to be trustworthy and reliable, trained to perform the escort function, and generally knowledgeable of the maintenance activities to be performed.

Function	Category	U.S. Nuclear Power Reactor Implementation Notes
Protect (PR)	Protective Technology (PR.PT)	Cyber security controls implement measures to protect digital systems and equipment against cyberattack. Plants have installed hardware-based network isolation devices to eliminate the potential for an external network-based attack. Comprehensive controls of portable media and equipment are implemented. Facility access controls are enhanced with computer system access controls. Audit logs are created, retained, and reviewed in accordance with the governing procedures.
Detect (DE)	Anomalies and Events (DE.AE)	Anomalous activity is detected by both cyber and non-cyber means. When anomalous system behavior is identified, documented procedures govern response, including a risk assessment and prioritization of response. Response may include an assessment of possible physical or cyber tampering. Intrusion detection systems are used.
Detect (DE)	Security Continuous Monitoring (DE.CM)	Physical access to the facility is continuously monitored in continuously manned central alarm stations. Cyber security controls are implemented to monitor systems and networks.
Detect (DE)	Detection Processes (DE.DP)	Detection process for physical security are well-established and regularly tested. Cyber security detection capabilities are implemented, reviewed, and tested.
Respond (RS)	Response Planning (RS.RP)	Response to security events, including cyber security events, is governed by a facility contingency response plan that is an integrated component of the facility physical protection program.
Respond (RS)	Communications (RS.CO)	Communications in response to events are governed by site procedures and include communications with facility operations and security, State and local officials as required, and the NRC as required. NRC Regulation 10 CFR 73.77 outlines requirements for conducting notifications and submitting follow-up reports to the NRC for cyber security events. Operating experience is shared voluntarily within the power-reactor community and with external stakeholders, as appropriate.

Function	Category	U.S. Nuclear Power Reactor Implementation Notes
Respond (RS)	Analysis (RS.AN)	Event response procedures govern the response to cyber and physical detection system notifications, performance of impact assessments, and determination of the need for forensic analysis.
Respond (RS)	Mitigation (RS.MI)	Event response procedures and the contingency response plan govern how events are contained. Newly identified vulnerabilities are addressed in accordance with the physical security plan or the cyber security plan, as appropriate.
Respond (RS)	Improvements (RS.IM)	Improvements based on lessons learned are handled through the facility corrective action program.
Recover (RC)	Recovery Planning (RC.RP)	Recovery plans are established for safety and security systems.
Recover (RC)	Improvements (RC.IM)	Improvements to recovery plans based on lessons learned are handled in the facility corrective action program.
Recover (RC)	Communications (RC.CO)	Communications are handled in accordance with site procedures. Reactors have an emergency plan that governs communications with external stakeholders.

TABLE A2. U.S. Nuclear Power Reactor Practices Mapped to the Framework Core

Function	Category	Subcategory	Profile
Identify (ID)	**Asset Management (ID.AM):** The data, personnel, devices, systems, and facilities that enable the organization to achieve business purposes are identified and managed consistent with their relative importance to business objectives and the organization's risk strategy.	**ID.AM-1:** Physical devices and systems within the organization are inventoried	A-3.1.3 D-5.4 E-10.3, E-10.9
		ID.AM-2: Software platforms and applications within the organization are inventoried	D-5.4 E-10.3, E-10.9
		ID.AM-3: Organizational communication and data flows are mapped	D-1.4, D-1.18 E.3.4
		ID.AM-4: External information systems are catalogued	A-3.1.3 D-1.22
		ID.AM-5: Resources (e.g., hardware, devices, data, and software) are prioritized based on their classification, criticality, and business value	A-3.1.3 D-3.5 E-8.1
		ID.AM-6: Cyber security roles and responsibilities for the entire workforce and third-party stakeholders (e.g., suppliers, customers, partners) are established	A-4.8, A-4.11 E-8.1
Identify (ID)	**Business Environment (ID.BE):** The organization's mission, objectives, stakeholders, and activities are understood and prioritized; this information is used to inform cyber	**ID.BE-1:** The organization's role in the supply chain is identified and communicated	The cyber security program does not include specific provisions to supplement the reactors' existing programs related to this activity.
		ID.BE-2: The organization's place in critical infrastructure and its industry sector is identified and communicated	The cyber security program does not include specific provisions to supplement the reactors' existing programs related to this activity.

Function	Category	Subcategory	Profile
	security roles, responsibilities, and risk management decisions.	**ID.BE-3:** Priorities for organizational mission, objectives, and activities are established and communicated	The cyber security program does not include specific provisions to supplement the reactors' existing programs related to this activity for the organization as a whole. Mission, objectives, and activities regarding cyber security are addressed in A-4.11.
		ID.BE-4: Dependencies and critical functions for delivery of critical services are established	E-11.2
		ID.BE-5: Resilience requirements to support delivery of critical services are established	A-4.6, A-4.7 E-8.1, E-8.6
Identify (ID)	**Governance (ID.GV):** The policies, procedures, and processes to manage and monitor the organization's regulatory, legal, risk, environmental, and operational requirements are understood and inform the management of cyber security risk.	**ID.GV-1:** Organizational information security policy is established	A
		ID.GV-2: Information security roles and responsibilities are coordinated and aligned with internal roles and external partners	A-4.11
		ID.GV-3: Legal and regulatory requirements regarding cyber security, including privacy and civil liberties obligations, are understood and managed	A-2.1, A-2.2
		ID.GV-4: Governance and risk management processes address cyber security risks	A-4.9
Identify (ID)	**Risk Assessment (ID.RA):** The organization understands the cyber security risk to organizational operations (including mission, functions, image, or reputation), organizational	**ID.RA-1:** Asset vulnerabilities are identified and documented	A-3.1.5, A-4.4.3.2 D-5.5 E-3.2, E-3.5, E-11.5, E-11.6, E-12
		ID.RA-2: Threat and vulnerability information is received from information-sharing forums and sources	A-4.9.1 E-3.5, E-9.8
		ID.RA-3: Threats, both internal and external, are identified and documented	A-2.1, A-4.9.1 E-3.5

Function	Category	Subcategory	Profile
	assets, and individuals.	**ID.RA-4:** Potential business impacts and likelihoods are identified	A-3.1.3
		ID.RA-5: Threats, vulnerabilities, likelihoods, and impacts are used to determine risk	A-4.9.1, A-4.9.4
		ID.RA-6: Risk responses are identified and prioritized	A-4.2, A-4.9.4
Identify (ID)	**Risk Management Strategy (ID.RM):** The organization's priorities, constraints, risk tolerances, and assumptions are established and used to support operational risk decisions.	**ID.RM-1:** Risk management processes are established, managed, and agreed to by organizational stakeholders	The cyber security program does not include specific provisions to supplement the reactors' existing programs related to this activity.
		ID.RM-2: Organizational risk tolerance is determined and clearly expressed	The cyber security program does not include specific provisions to supplement the reactors' existing programs related to this activity.
		ID.RM-3: The organization's determination of risk tolerance is informed by their role in critical infrastructure and sector-specific risk analysis	The cyber security program does not include specific provisions to supplement the reactors' existing programs related to this activity.
Identify (ID)	**Supply Chain Risk Management (ID.SC):** The organization's priorities, constraints, risk tolerances, and assumptions are established and used to support risk decisions associated with managing	**ID.SC-1:** Cyber supply chain risk management processes are identified, established, assessed, managed, and agreed to by organizational stakeholders	Plant Cyber Security Teams establish processes that address cyber supply chain risk management in their Cyber Security Plans.
		ID.SC-2: Suppliers and third-party partners of information systems, components, and services are identified, prioritized, and assessed using a cyber supply chain risk assessment process	Suppliers and partners are identified, vetted, and validated through the nuclear procurement process.

Function	Category	Subcategory	Profile
	supply chain risk. The organization has established and implemented the processes to identify, assess, and manage supply chain risks.	**ID.SC-3:** Contracts with suppliers and third-party partners are used to implement appropriate measures designed to meet the objectives of an organization's cyber security program and Cyber Supply Chain Risk Management Plan	Baseline cyber security requirements are integrated into the procurement process. Plants implement procedures to facilitate and maintain the procurement policies associated with vendor security and development life cycles. Plants ensure that alternative controls or countermeasures are implemented to mitigate vulnerabilities created by the lack of security functions provided by third-party products. For example, plants establish trusted distribution paths, validate vendors, and require tamper-proof products or tamper-evident seals on acquired products. Plants perform regular integrity, operation, and functional tests consistent with manufacturer or vendor recommendations.
		ID.SC-4: Suppliers and third-party partners are routinely assessed using audits, test results, or other forms of evaluations to confirm they are meeting their contractual obligations	The nuclear industry implements a graded approach based upon the component risk. Plant Cyber Security Teams collect and document the information security requirements necessary for vendors or developers to maintain the integrity of acquired systems. They also perform an analysis for product acquisitions to determine that the product provides the security requirements necessary to address the security controls.

Function	Category	Subcategory	Profile
		ID.SC-5: Response and recovery planning and testing are conducted with suppliers and third-party providers	To the extent practicable, plants also utilize third-party security alert notification services and vendor security alert lists. Plants also include vendor representatives in their Cyber Security Incident Response Teams as applicable and appropriate.
Protect (PR)	**Identify Management and Access Control (PR.AC):** Access to assets and associated facilities is limited to authorized users, processes, or devices and to authorized activities and transactions.	**PR.AC-1:** Identities and credentials are managed for authorized devices and users	D-1.2, D-1.11 D-4.2, D-4.3, D-4.5, D-4.6, D-4.7
		PR.AC-2: Physical access to assets is managed and protected	D-4.4 E-5.4, E-5.5
		PR.AC-3: Remote access is managed	A-4.3 D-1.1 E-6
		PR.AC-4: Access permissions are managed, incorporating the principles of least privilege and separation of duties	D-1.5, D-1.6, D-5.3
		PR.AC-5: Network integrity is protected, incorporating network segregation where appropriate	A-4.3, D-1.4 E-6
Protect (PR)	**Awareness and Training (PR.AT):** The organization's personnel and partners are provided cyber security awareness education and are adequately trained to perform their information security-related duties and responsibilities consistent with related policies, procedures, and agreements.	**PR.AT-1:** All users are informed and trained	A-4.8 E-9.1, E-9.2, E-9.3
		PR.AT-2: Privileged users understand roles and responsibilities	A-4.8, A-4.11 E-7.2, E-8.3, E-9.1, E-9.3
		PR.AT-3: Third-party stakeholders (e.g., suppliers, customers, partners) understand roles and responsibilities	A-4.8, A-4.11 E-11.1, E-11.2, E-11.3
		PR.AT-4: Senior executives understand roles and responsibilities	A-4.8, A-4.11 E-9.1, E-9.3
		PR.AT-5: Physical and information security personnel understand roles and responsibilities	A-4.8, A-4.11 E-9.1, E-9.3
Protect (PR)		**PR.DS-1:** Data-at-rest is protected	D-3.19

Function	Category	Subcategory	Profile
	Data Security (PR.DS): Information and records (data) are managed consistent with the organization's risk strategy to protect the confidentiality, integrity, and availability of information.	**PR.DS-2:** Data-in-transit is protected	D-3.6, D-3.7
		PR.DS-3: Assets are formally managed throughout removal, transfers, and disposition	E-1.6, E-10.9
		PR.DS-4: Adequate capacity to ensure availability is maintained	D-3.4
		PR.DS-5: Protections against data leaks are implemented	D-1.4, D-1.5, D-1.6, D-1.15, D-3.7, D-3.9, D-4.9, D-5.3 E-6
		PR.DS-6: Integrity checking mechanisms are used to verify software, firmware, and information integrity	E-3.7
		PR.DS-7: The development and testing environment(s) are separate from the production environment	D-5.4 E-10.3
Protect (PR)	**Information Protection Processes and Procedures (PR.IP):** Security policies (that address purpose, scope, roles, responsibilities, management commitment, and coordination among organizational entities), processes, and procedures are maintained and used to manage protection of information systems and assets.	**PR.IP-1:** A baseline configuration of information technology/industrial control systems is created and maintained	A-3.1.3, A-3.1.5, A-4.4.1, A-4.4.2, A-4.5 D-1.18, D-5.4 E-10.3, E-10.7
		PR.IP-2: A System Development Life Cycle to manage systems is implemented	A-4.5 E-11.3, E-11.4, E-11.5, E-11.6
		PR.IP-3: Configuration change control processes are in place	A-4.4.1 D-1.18, D-4.1, D-4.7, D-5.1, D-5.3 E-10.4, E-10.5, E-10.6, E-10.7, E-11.6
		PR.IP-4: Backups of information are conducted, maintained, and tested periodically	E-8.2, E-8.5
		PR.IP-5: Policy and regulations regarding the physical operating environment for organizational assets are met	A-4.12 E-5.1
		PR.IP-6: Data is destroyed according to policy	E-1.6
		PR.IP-7: Protection processes are continuously improved	A-4.12 E-9.8

Function	Category	Subcategory	Profile
		PR.IP-8: Effectiveness of protection technologies is shared with appropriate parties	A-4.12
		PR.IP-9: Response plans (Incident Response and Business Continuity) and recovery plans (Incident Recovery and Disaster Recovery) are in place and managed	A-4.6, A-4.7 E-7.1, E-7.6, E-8.1
		PR.IP-10: Response and recovery plans are tested	E-7.3, E-8.2
		PR.IP-11: Cyber security is included in human resources practices (e.g., deprovisioning, personnel screening)	E-2.1, E-2.2, E-5.2
		PR.IP-12: A vulnerability management plan is developed and implemented	A-4.9 D-5.5 E-3.2, E-11.6, E-12

Function	Category	Subcategory	Profile
Protect (PR)	**Maintenance (PR.MA):** Maintenance and repairs of industrial control and information system components is performed consistent with policies and procedures.	**PR.MA-1:** Maintenance and repair of organizational assets is performed and logged in a timely manner, with approved and controlled tools	E-4.2, E-4.3
		PR.MA-2: Remote maintenance of organizational assets is approved, logged, and performed in a manner that prevents unauthorized access	Remote maintenance to critical safety, security, and reliability systems is prohibited by the defensive architecture described in the cyber security plan. (A-4.3)
Protect (PR)	**Protective Technology (PR.PT):** Technical security solutions are managed to ensure the security and resilience of systems and assets consistent with related policies, procedures, and agreements.	**PR.PT-1:** Audit/log records are determined, documented, implemented, and reviewed in accordance with policy	D-2.1, D-2.2, D-2.3, D-2.6, D-2.7, D-2.12
		PR.PT-2: Removable media are protected, and their use restricted according to policy	D-1.2, D-1.19 E-1.4, E-1.5
		PR.PT-3: Access to systems and assets is controlled, incorporating the principle of least functionality	D-1.2, D-1.3, D-1.11, D-1.16, D-5.1, D-5.4 E-10.8
		PR.PT-4: Communications and control networks are protected	A-4.3 E-6
Detect (DE)	**Anomalies and Events (DE.AE):** Anomalous activity is detected in a timely manner and the potential impact of events is understood.	**DE.AE-1:** A baseline of network operations and expected data flows for users and systems is established and managed	D-2.6
		DE.AE-2: Detected events are analyzed to understand attack targets and methods	D-2.6 E-7.4
		DE.AE-3: Event data are aggregated and correlated from multiple sources and sensors	D-2.6 E-7.4, E-7.5
		DE.AE-4: Effect of events is determined	E-7.4
		DE.AE-5: Incident alert thresholds are established	D-5.2 E-3.4

Function	Category	Subcategory	Profile
Detect (DE)	**Security Continuous Monitoring (DE.CM):** The information system and assets are monitored at discrete intervals to identify cyber security events and verify the effectiveness of protective measures.	**DE.CM-1:** The network is monitored to detect potential cyber security events	D-5.2 E-3.4, E-6
		DE.CM-2: The physical environment is monitored to detect potential cyber security events	D-4.4 E-5.6, E-5.7, E-5.8
		DE.CM-3: Personnel activity is monitored to detect potential cyber security events	E-2.1
		DE.CM-4: Malicious code is detected	E-3.3
		DE.CM-5: Unauthorized mobile code is detected	D-3.13
		DE.CM-6: External service provider activity is monitored to detect potential cyber security events	D-5.2 E-3.4, E-5.2
		DE.CM-7: Monitoring for unauthorized personnel, connections, devices, and software is performed	D-1.2, D-1.17, D-1.19 D-4.4, D-5.2, D-5.3 E-3.4, E-5.6, E-5.7, E-5.8, E-6, E-10.5
		DE.CM-8: Vulnerability scans are performed	E-12
Detect (DE)	**Detection Processes (DE.DP):** Detection processes and procedures are maintained and tested to ensure timely and adequate awareness of anomalous events.	**DE.DP-1:** Roles and responsibilities for detection are well defined to ensure accountability	A-4.6 E-3.4
		DE.DP-2: Detection activities comply with all applicable requirements	A-4.6
		DE.DP-3: Detection processes are tested	D-5.2 E-3.4
		DE.DP-4: Event detection information is communicated to appropriate parties	A-4.6 D-2.6
		DE.DP-5: Detection processes are continuously improved	A-4.6, A-4.12 E-12

Function	Category	Subcategory	Profile
Respond (RS)	**Response Planning (RS.RP):** Response processes and procedures are executed and maintained to ensure timely response to detected cyber security events.	**RS.RP-1:** Response plan is executed during or after an event	A-4.6 E-8.1, E-8.6

Function	Category	Subcategory	Profile
Respond (RS)	**Communications (RS.CO):** Response activities are coordinated with internal and external stakeholders, as appropriate, to include external support from law enforcement agencies.	**RS.CO-1:** Personnel know their roles and order of operations when a response is needed	A-4.6, A-4.8 E-7.1, E-7.6, E-8.1
		RS.CO-2: Events are reported consistent with established criteria	A-4.6
		RS.CO-3: Information is shared consistent with response plans	A-4.6 E-8.1
		RS.CO-4: Coordination with stakeholders occurs consistent with response plans	A-4.6, E-8.1
		RS.CO-5: Voluntary information sharing occurs with external stakeholders to achieve broader cyber security situational awareness	A-4.6 E-3.5, E-9.8
Respond (RS)	**Analysis (RS.AN):** Analysis is conducted to ensure adequate response and support recovery activities.	**RS.AN-1:** Notifications from detection systems are investigated	D-2.6
		RS.AN-2: The effect of the incident is understood	E-7.4
		RS.AN-3: Forensics are performed	E-7.4
		RS.AN-4: Incidents are categorized consistent with response plans	E-8.1
Respond (RS)	**Mitigation (RS.MI):** Activities are performed to prevent expansion of an event, mitigate its effects, and eradicate the incident.	**RS.MI-1:** Incidents are contained	A-4.6 E-7.4
		RS.MI-2: Incidents are mitigated	A-4.7 E-7.4
		RS.MI-3: Newly identified vulnerabilities are mitigated or documented as accepted risks	A-4.9.1 E-12
Respond (RS)	**Improvements (RS.IM):** Organizational response activities are improved by incorporating lessons learned from current and previous detection/response activities.	**RS.IM-1:** Response plans incorporate lessons learned	A-4.9.3, A-4.9.4 E-3.11, E-8.1, E-7.4, E-12
		RS.IM-2: Response strategies are updated	A-4.9.4 E-7.1, E-7.4, E-7.6

Function	Category	Subcategory	Profile
Recover (RC)	**Recovery Planning (RC.RP):** Recovery processes and procedures are executed and maintained to ensure timely restoration of systems or assets affected by cyber security events.	**RC.RP-1:** Recovery plan is executed during or after an event	A-4.7 E-8.1
Recover (RC)	**Improvements (RC.IM):** Recovery planning and processes are improved by incorporating lessons learned into future activities.	**RC.IM-1:** Recovery plans incorporate lessons learned	A-4.7, A-4.9.3, A-4.9.4 E-3.11, E-7.4, E-8.1, E-12
		RC.IM-2: Recovery strategies are updated	A-4.9.4 E-7.1
Recover (RC)	**Communications (RC.CO):** Restoration activities are coordinated with internal and external parties, such as coordinating centers, Internet Service Providers, owners of attacking systems, victims, other Computer Security Incident Response Teams, and vendors.	**RC.CO-1:** Public relations are managed	The cyber security program does not include specific provisions to supplement the reactors' existing programs related to this activity.
		RC.CO-2: Reputation after an event is repaired	The cyber security program does not include specific provisions to supplement the reactors' existing programs related to this activity.
		RC.CO-3: Recovery activities are communicated to internal stakeholders and executive and management teams	A-4.7 E-8.1

TABLE A3. U.S. Nuclear Power Reactor Practices Mapped to the Framework Tiers

Tier Category	Characteristics: Tier 3, Repeatable	Characteristics: Tier 4, Adaptive	Nuclear Power Plant Implementation
Risk Management Process	The organization's risk management practices are formally approved and expressed as policy. Thus, organizational cyber security practices are regularly updated based on the application of risk management processes to changes in business/mission requirements and a changing threat and technology landscape.	The organization adapts its cyber security practices based on lessons learned and predictive indicators derived from previous and current cyber security activities. Through a process of continuous improvement incorporating advanced cyber security technologies and practices, the organization actively adapts to a changing cyber security landscape and responds to evolving and sophisticated threats in a timely manner.	**Current Practice:** Plants have an issued and approved Cyber Security Plan that is being implemented by an issued and approved Implementation Schedule, governing policies, and implementing procedures. The Plan establishes, implements, and maintains a cyber security program. Elements of the program were implemented by December 31, 2012 and are subject to oversight by the plant's independent oversight organization and to inspection by the NRC. The program is enhanced to address findings from oversight and inspection activities and industry lessons learned. **Future Practice:** Measures to manage evolving cyber risks to cyber systems and equipment and measures for timely detection and response to cyber security threats will be implemented. The fully implemented program will be inspected by the NRC and will be reviewed by the plant's independent oversight organization at a minimum of every 2 years to ensure the program remains effective. Plants will periodically review site and industry lessons learned to support program effectiveness.

Tier Category	Characteristics: Tier 3, Repeatable	Characteristics: Tier 4, Adaptive	Nuclear Power Plant Implementation
Integrated Risk Management Program	There is an organization-wide approach to manage cyber security risk. Risk-informed policies, processes, and procedures are defined, implemented as intended, and reviewed. Consistent methods are in place to respond effectively to changes in risk. Personnel possess the knowledge and skills to perform their appointed roles and responsibilities.	There is an organization-wide approach to managing cyber security risk that uses risk-informed policies, processes, and procedures to address potential cyber security events. Cyber security risk management is part of the organizational culture and evolves from an awareness of previous activities, information shared by other sources, and continuous awareness of activities on their systems and networks.	**Current Practice:** The Plan is issued and approved. Implementing procedures for interim milestones are developed and issued. Cyber awareness training is provided to all plant personnel and vendor personnel performing maintenance on plant equipment. Job-function-specific training is provided for individuals performing duties associated with the interim milestones. Plants evaluate and manage cyber security risks for existing and new digital equipment using established policies and procedures. Attack detection and incident response measures are implemented. **Future Practice:** Cyber security training for specialized job skills will be provided.

Tier Category	Characteristics: Tier 3, Repeatable	Characteristics: Tier 4, Adaptive	Nuclear Power Plant Implementation
External Participation	The organization understands its dependencies and partners and receives information from these partners that enables collaboration and risk-based management decisions within the organization in response to events.	The organization manages risk and actively shares information with partners to ensure that accurate, current information is being distributed and consumed to improve cyber security before a cyber security event occurs.	**Current Practice:** It is standard nuclear practice to share and receive lessons learned and operating experience from across the fleet of power plants. This sharing includes information on a range of topics that includes physical and cyber security. Certain cyber events are reported voluntarily to DHS, NERC, and the NRC in accordance with applicable requirements. DHS, NERC, and the NRC have the ability to disseminate information to plants and other stakeholders as necessary. Plants also voluntarily participate in a teleconference every other week that reviews relevant threat and vulnerability notices, monthly DHS-coordinated unclassified teleconferences, and quarterly classified threat briefings. **Future Practice:** Current practices will be enhanced with implementing procedures directing the regular review of threat and vulnerability notices from credible sources.

Appendix B: Summary of Framework Use Steps

TABLE B1. Summary of Framework Use Steps.

Step 1: Prioritize and Scope		
Inputs	Activities	Outputs
1. Risk management strategy 2. Organizational objectives and priorities 3. Threat information	1. Organization determines where it wants to apply the Framework to evaluate and potentially guide the improvement of the organization's cyber security capabilities	1. Framework usage scope
Step 2: Orient		
Inputs	Activities	Outputs
1. Framework usage scope 2. Risk management strategy	1. Organization identifies in-scope systems and assets (e.g., people, information, technology, and facilities) and the appropriate regulatory and Informative References (e.g., cyber security and risk management standards, tools, methods, and guidelines)	1. In-scope systems and assets 2. In-scope requirements (i.e., regulatory, company, organizational) 3. In-scope cyber security and risk management standards, tools, methods, and guidelines 4. Evaluation approach
Step 3: Create a Current Profile		
Inputs	Activities	Outputs
1. Evaluation approach 2. In-scope systems and assets 3. In-scope regulatory requirements 4. In-scope cyber security and risk management standards, tools, methods, and guidelines	1. Organization identifies its current cyber security and risk management state	1. Current Profile 2. Current Implementation Tier
Step 4: Conduct a Risk Assessment		
Inputs	Activities	Outputs

1. Framework usage scope 2. Risk management strategy 3. Organization-defined risk assessment approach 4. In-scope regulatory requirements 5. In-scope cyber security and risk management standards, tools, methods, and guidelines	1. Perform risk assessment for in-scope portion of the organization	1. Risk assessment reports
Step 5: Create a Target Profile		
Inputs	Activities	Outputs
1. Current Profile 2. Current Tier 3. Organizational objectives 4. Risk management strategy 5. Risk assessment reports	1. Identify goals that will mitigate risk commensurate with the risk to organizational and critical infrastructure objectives	1. Target Profile 2. Target Tier
Step 6: Determine, Analyze, and Prioritize Gaps		
Inputs	Activities	Outputs
1. Current Profile 2. Current Tier 3. Target Profile 4. Target Tier 5. Organizational objectives 6. Impact to critical infrastructure 7. Gaps and potential consequences 8. Organizational constraints 9. Risk management strategy 10. Risk assessment reports	1. Analyze gaps between current state and Target Profile in organization's context 2. Evaluate potential consequences from gaps 3. Determine which gaps need attention 4. Identify actions to address gaps 5. Perform cost-benefit analysis (CBA) on actions 6. Prioritize actions (CBA and consequences) 7. Plan to implement prioritized actions	1. Prioritized gaps and potential consequences 2. Prioritized implementation plan
Step 7: Implement Action Plan		
Inputs	Activities	Outputs
1. Prioritized implementation Plan	1. Implement actions by priority 2. Track progress against plan 3. Monitor and evaluate progress against key risks, metrics, and performance indicators 4. Report progress	1. Project tracking data 2. New security measures implemented

Appendix C: Glossary

Aside from the term "organization," the following glossary is excerpted verbatim from the Framework.

Term	Definition
Buyer	The people or organizations that consume a given product or service.
Category	The subdivision of a Function into groups of cyber security outcomes, closely tied to programmatic needs and particular activities. Examples of Categories include "Asset Management," "Access Control," and "Detection Processes."
Critical Infrastructure	Systems and assets, whether physical or virtual, so vital to the United States that the incapacity or destruction of such systems and assets would have a debilitating impact on cyber security, national economic security, national public health or safety, or any combination of those matters.
Cybersecurity	The process of protecting information by preventing, detecting, and responding to attacks.
Cybersecurity Event	A cyber security change that may have an impact on organizational operations (including mission, capabilities, or reputation).
Cybersecurity Incident	A cybersecurity event that has been determined to have an impact on the organization prompting the need for response and recovery.
Detect (Function)	Develop and implement the appropriate activities to identify the occurrence of a cyber security event.
Framework	A risk-based approach to reducing cyber security risk composed of three parts: the Framework Core, the Framework Profile, and the Framework Implementation Tiers. Also known as the "Cybersecurity Framework."
Framework Core	A set of cyber security activities and references that are common across critical infrastructure sectors and are organized around particular outcomes. The Framework Core comprises four types of elements: Functions, Categories, Subcategories, and Informative References.

Term	Definition
Framework Implementation Tier	A lens through which to view the characteristics of an organization's approach to risk—how an organization views cyber security risk and the processes in place to manage that risk.
Framework Profile	A representation of the outcomes that a particular system or organization has selected from the Framework Categories and Subcategories.
Function	One of the main components of the Framework. Functions provide the highest level of structure for organizing basic cyber security activities into Categories and Subcategories. The five functions are Identify, Protect, Detect, Respond, and Recover.
Identify (Function)	Develop the organizational understanding to manage cyber security risk to systems, assets, data, and capabilities.
Informative Reference	A specific section of standards, guidelines, and practices common among critical infrastructure sectors that illustrates a method to achieve the outcomes associated with each Subcategory.
Mobile Code	A program (e.g., script, macro, or other portable instruction) that can be shipped unchanged to a heterogeneous collection of platforms and executed with identical semantics.
Organization	An operational entity of any size that uses the same cyber security risk management program within its different components and may individually use the Framework.
Protect (Function)	Develop and implement the appropriate safeguards to ensure delivery of critical infrastructure services.
Privileged User	A user that is authorized (and, therefore, trusted) to perform security-relevant functions that ordinary users are not authorized to perform.
Recover (Function)	Develop and implement the appropriate activities to maintain plans for resilience and to restore any capabilities or services that were impaired due to a cyber security event.
Respond (Function)	Develop and implement the appropriate activities to take action regarding a detected cyber security event.
Risk	A measure of the extent to which an entity is threatened by a potential circumstance or event, and typically a function of: (i) the adverse impacts that would arise if the circumstance or event occurs; and (ii) the likelihood of occurrence.

Term	Definition
Risk Management	The process of identifying, assessing, and responding to risk.
Risk Management Plan (RMP)	The Risk Management Plan outlines the identified process of risk management.
Subcategory	The subdivision of a Category into specific outcomes of technical and/or management activities. Examples of Subcategories include “External information systems are catalogued,” “Data-at-rest is protected,” and “Notifications from detection systems are investigated.”
Supplier	Product and service providers used for an organization’s internal purposes (e.g., IT infrastructure) or integrated into the products of services provided to that organization’s Buyers.