

# **Artificial Intelligence Strategic Plan**

Fiscal Years 2023-2027

Draft Report for Comment

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# Artificial Intelligence Strategic Plan

Fiscal Years 2023-2027

Draft Report for Comment

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## ABSTRACT

2 The U.S. Nuclear Regulatory Commission (NRC) recognizes that interest in artificial intelligence  
3 (AI) is growing rapidly in both the public and private sectors and anticipates increased use of AI  
4 in NRC-regulated activities. For the purposes of this document, AI refers to a machine-based  
5 system that can go beyond defined results and scenarios and has the ability to emulate human-  
6 like perception, cognition, planning, learning, communication, or physical action. For a given set  
7 of human-defined objectives, AI can make predictions, recommendations, or decisions  
8 influencing real or virtual environments. The AI Strategic Plan focuses on a broad spectrum of  
9 sub-specialties (e.g., natural language processing, machine learning, deep learning, etc.) which  
10 could encompass various algorithms and application examples which the NRC has not  
11 previously reviewed and evaluated. Anticipating the industry's potential application of AI to  
12 NRC-regulated activities, the NRC has developed a strategic plan to ensure the agency's  
13 readiness to review such uses. The strategic plan includes five goals: (1) ensure NRC readiness  
14 for regulatory decisionmaking, (2) establish an organizational framework to review AI  
15 applications, (3) strengthen and expand AI partnerships, (4) cultivate an AI-proficient workforce,  
16 and (5) pursue use cases to build an AI foundation across the NRC. The overall goal of this  
17 strategic plan is to ensure continued staff readiness to review and evaluate AI applications  
18 effectively and efficiently.



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1

## EXECUTIVE SUMMARY

2 For the purposes of this document, artificial intelligence (AI) refers to a machine-based system  
3 that can go beyond defined results and scenarios and has the ability to emulate human-like  
4 perception, cognition, planning, learning, communication, or physical action. For a given set of  
5 human-defined objectives, AI can make predictions, recommendations, or decisions influencing  
6 real or virtual environments. AI is one of the fastest-growing technologies globally and has the  
7 potential to enhance decisionmaking processes for the nuclear industry by providing insights  
8 into vast amounts of data generated during the design and operation of nuclear facilities. As a  
9 result, the nuclear industry has expressed a growing interest in researching and using AI  
10 technologies to improve operational performance and mitigate operational risk. The AI Strategic  
11 Plan focuses on a broad spectrum of sub-specialties (e.g., natural language processing,  
12 machine learning, deep learning, etc.) which could encompass various algorithms and  
13 application examples which the U.S. Nuclear Regulatory Commission (NRC) has not previously  
14 reviewed and evaluated. The NRC is committed to continue to keep pace with technological  
15 innovations to ensure the safe and secure use of AI in NRC-regulated activities.

16

17 The NRC's AI Strategic Plan, covering fiscal years (FY) 2023–2027, establishes the vision and  
18 goals for the NRC to continue to improve its skills and capabilities to review and evaluate the  
19 application of AI to NRC-regulated activities, maintain awareness of technological innovations,  
20 and ensure the safe and secure use of AI in NRC-regulated activities. The AI Strategic Plan  
21 includes five goals: (1) ensure NRC readiness for regulatory decisionmaking, (2) establish an  
22 organizational framework to review AI applications, (3) strengthen and expand AI partnerships,  
23 (4) cultivate an AI-proficient workforce, and (5) pursue use cases to build an AI foundation  
24 across the NRC.

25

26 The AI Strategic Plan complements the NRC's mission, broadly aligns with the agency's  
27 Principles of Good Regulation, and is tied to multiple NRC FY 2022–2026 Strategic Plan safety,  
28 security, and openness strategies [1]. The NRC will consider the actions recommended for the  
29 short-term (<1 year), mid-term (1–3 years), and long-term (3–5 years) time horizons and will  
30 guide budgetary requirements and resource planning within the NRC's standard planning and  
31 budgeting processes to achieve the strategic goals in this document.

32

33 The overall goal of the AI Strategic Plan is to ensure the staff's readiness to effectively and  
34 efficiently review and evaluate the use of AI in NRC-regulated activities.



1

## **ABBREVIATIONS AND ACRONYMS**

2	AI	Artificial Intelligence
3	AICoP	Artificial Intelligence Community of Practice
4	AISC	Artificial Intelligence Steering Committee
5	FR	Federal Register
6	FY	Fiscal Year
7	NRC	U.S. Nuclear Regulatory Commission



# 1 INTRODUCTION

For the purposes of this document, artificial intelligence (AI) refers to a machine-based system that can go beyond defined results and scenarios and has the ability to emulate human-like perception, cognition, planning, learning, communication, or physical action. For a given set of human-defined objectives, AI can make predictions, recommendations, or decisions influencing real or virtual environments. These systems use machine- and human-based inputs to perceive real and virtual environments, abstract such perceptions into models through analysis in an automated manner, and use model inference to formulate options for information or action [2]. The AI Strategic Plan focuses on a broad spectrum of sub-specialties (e.g., natural language processing, machine learning, deep learning, etc.) which could encompass various algorithms and application examples which the U.S. Nuclear Regulatory Commission (NRC) has not previously reviewed and evaluated.

An AI algorithm is a computer program that has been trained on a set of data to recognize certain types of patterns. AI use various types of algorithms to reason over and learn from this data, with the overarching goal of providing solutions that mimic human-based decision and predictions for problems. Unlike developing and coding a traditional software program with specific instructions to complete a task, AI seeks to learn to recognize patterns and make predictions. This AI Strategic Plan considers an evolving landscape where computers use data and unseen behavior to construct the underlying algorithmic model, draw inferences, and define the rules to achieve a task. Advances in computing technologies have led to the expanded use of AI across multiple disciplines in the public and private sectors, both domestically and internationally. AI provides new opportunities for organizations to enhance safety and security, improve processes, leverage historical and current data, identify research needs, and even explore autonomous control and operation. As a result, the nuclear industry has expressed interest in deploying these technologies. The NRC is committed to enabling the safe and secure use of new technologies, especially those that can enhance the safety and security of nuclear facilities. The NRC is committed to keeping pace with technological innovations to effectively and efficiently carry out its safety and security mission.

The AI Strategic Plan complements the NRC’s mission<sup>1</sup>, broadly aligns with the agency’s Principles of Good Regulation,<sup>2</sup> and is tied to the following:

- NUREG-1614, Volume 8, “U.S. Nuclear Regulatory Commission Strategic Plan: Fiscal Years 2022–2026,” issued April 2022 [1]
- NRC, “International Strategy: 2021–2025,” issued August 2021 [3]
- NUREG-1908, Volume 4, “Information Technology Information Management Strategic Plan: Fiscal Years 2020–2024,” issued November 2019 [4]

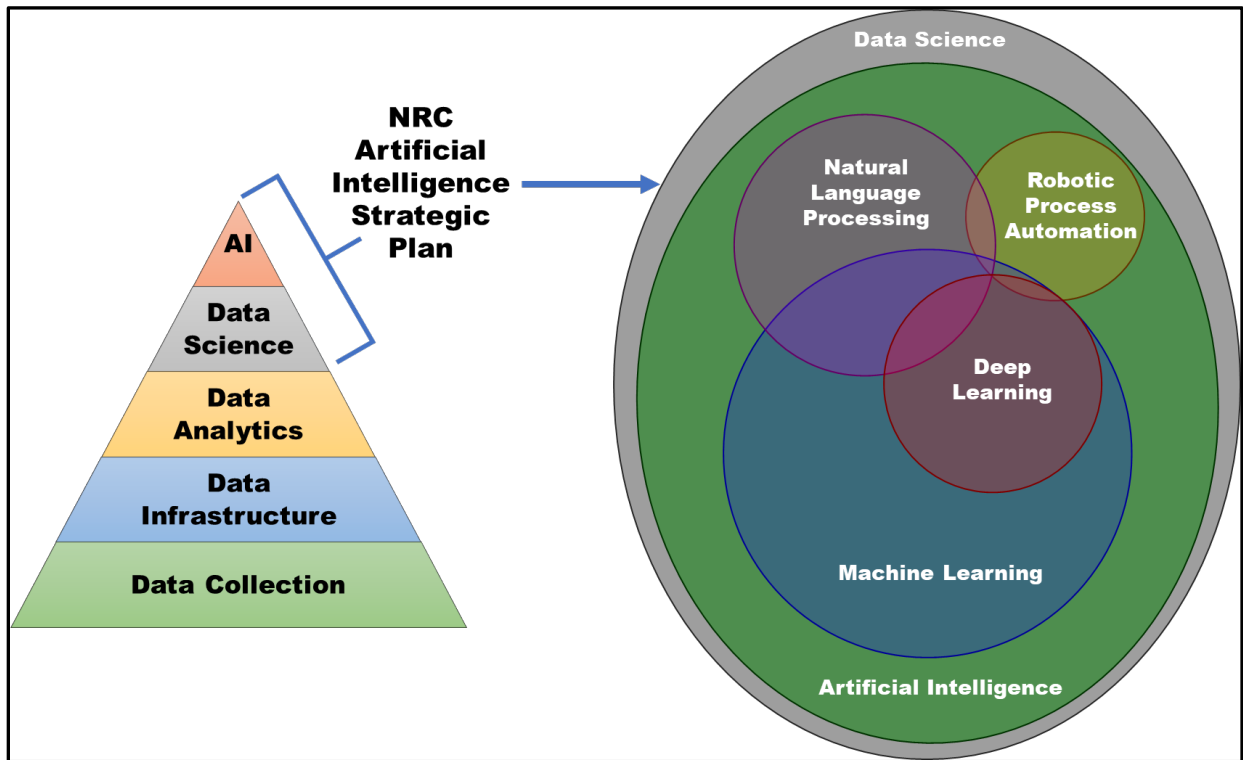
There are numerous fields of work that involve data and foundational concepts in AI (e.g., data analysis, statistics, computer programming, engineering), many of which the NRC already has experience with. However, given major advancements in AI, it is critical to establish how AI builds upon and relates to other data fields to understand the potential uses of AI in NRC-

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<sup>1</sup> The NRC’s mission can be found at <https://www.nrc.gov/about-nrc/values.html>.

<sup>2</sup> The NRC’s Principles of Good Regulation and other values can be found at <https://www.nrc.gov/about-nrc/values.html#principles>.

1 regulated activities. Figure 1 illustrates these relationships in two different ways. On the left is a  
 2 pyramid representing the increasing levels of complexity and maturity needed to implement AI  
 3 within an organization. The foundation of this pyramid is data collection, which establishes the  
 4 databases from which the AI is developed. Next is data infrastructure, which includes tools to  
 5 organize and transform the collected data, make it available, and govern its use. From this  
 6 point, the data may be used in data analytics, which provides plots and descriptive statistics that  
 7 can be used in decisionmaking. Once the organization is capable of data analytics, it can  
 8 pursue data science, which entails predictive modeling using data. Ultimately, at the apex is AI.  
 9 As shown Figure 1, this AI Strategic Plan primarily covers AI and data science applications.



10  
 11 **Figure 1 Artificial Intelligence Hierarchy and Relationship with the NRC AI Strategic Plan**  
 12 **(adapted from [5] and [6])**

13 The right side of Figure 1 illustrates an overview of major fields within the scope of the AI  
 14 Strategic Plan. As shown in the figure, this AI Strategic Plan considers machine learning, deep  
 15 learning, natural language processing, and robotic process automation to be subsets of AI.

16  
 17 AI technologies provide the underlying capability for autonomous systems. While AI enables  
 18 autonomy, not all uses of AI are autonomous. For example, many AI capabilities may be used to  
 19 augment human decisionmaking rather than replace it. Table 1 provides notional AI and  
 20 autonomy levels in potential commercial nuclear activities. Higher autonomy levels indicate less  
 21 reliance on human intervention or oversight and, therefore, may require greater regulatory  
 22 scrutiny of the AI system. AI Strategic Goal 1, discussed further in Section 4.1, will assess the  
 23 current regulatory framework and establish the appropriate regulatory requirements for varying  
 24 degrees of AI and autonomy. Lastly, the NRC recognizes that there are differences between



1 automation<sup>3</sup> and autonomy in potential uses of AI in NRC-regulated applications. As such, the  
 2 NRC will treat these differences with the appropriate level of regulatory scrutiny.

3 **Table 1 Notional AI and Autonomy Levels in Commercial Nuclear Activities**

Notional AI and Autonomy Levels	Potential Uses of AI and Autonomy in Commercial Nuclear Activities
<b>Level 1: Insight</b> (Human decisionmaking assisted by a machine)	AI integration in systems is used for optimization, operational guidance, or business process automation that would not affect plant safety/security and control
<b>Level 2: Collaboration</b> (Human decisionmaking augmented by a machine)	AI integration in systems where algorithms make recommendations that could affect plant safety/security and control are vetted and carried out by a human decisionmaker
<b>Level 3: Operation</b> (Machine decisionmaking supervised by a human)	AI and autonomy integration in systems where algorithms make decisions and conduct operations with human oversight that could affect plant safety/security and control
<b>Level 4: Fully Autonomous</b> (Machine decisionmaking with no human intervention)	Fully autonomous AI in systems where the algorithm is responsible for operation, control, and intelligent adaptation without reliance on human intervention or oversight that could affect plant safety/security and control

4  
 5 The NRC recognizes the output of this AI Strategic Plan may also support the agency use of AI  
 6 tools to enhance internal NRC activities. For example, the NRC will gain additional knowledge  
 7 and expertise in AI and data literacy to support expanding use for decisionmaking across the  
 8 agency. When assessing agency processes for improvement, the NRC will include in its  
 9 assessment potential ways AI tools could be incorporated. Further discussion related to  
 10 considerations on internal agency use of AI can be found in Appendix B.

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<sup>3</sup> Automation is considered to be a system that automatically takes action on a specific task according to pre-defined, prescriptive rules. For example, reactor protection systems are automatically actuated when process parameters exceed certain defined limits. In an autonomous system, both the point at which action is taken and the action that is taken are the result of training an algorithm on data collected about the system.



1

## **2 VISION**

- 2 The NRC's vision is to continue to keep pace with technological innovations to ensure the safe
- 3 and secure use of AI in NRC-regulated activities.



### 3 PURPOSE AND DRIVERS

The purpose of the AI Strategic Plan is to ensure the staff's readiness to review the use of AI in NRC-regulated activities as the nuclear industry has expressed interest in deploying AI applications. Based on feedback from the NRC's Data Science and AI Regulatory Applications Public Workshops<sup>4</sup>, the nuclear industry could start deploying AI technologies in the near future and has already begun investigating, developing, and assessing how such technologies can be used. Licensing applications that include the use of AI technologies may be submitted to the NRC for review and approval in the next five years.

In fiscal year (FY) 2021, the NRC began actively coordinating within the agency and across the nuclear industry to better understand activities and plans for AI by (1) conducting an internal scan to ascertain the scope of existing NRC projects that may fall within the technical area of AI, (2) issuing a *Federal Register* (FR) notice<sup>5</sup> to solicit feedback on the nuclear industry's AI readiness and applications, and (3) hosting a series of Data Science and AI Regulatory Applications Public Workshops to provide a forum for the NRC, nuclear industry, and relevant stakeholders to discuss the state of knowledge and research activities related to data science and AI and their application in the nuclear industry. In February 2022, the NRC issued NUREG/CR-7294, "Exploring Advanced Computational Tools and Techniques with Artificial Intelligence and Machine Learning in Operating Nuclear Plants" [7], documenting the current state of practice of AI tools in the nuclear industry. The staff used these insights in the development of this AI Strategic Plan. The NRC also reached out to the nuclear industry, U.S. Government agencies, nonprofit organizations, academia, international counterparts with mature or developing AI programs, and the public to gain valuable insights to inform the development of this AI Strategic Plan.

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<sup>4</sup> The NRC hosted a series of Data Science and AI Regulatory Applications Public Workshops in June, August, and November 2021 to provide a forum for the NRC, nuclear industry, and stakeholders to discuss the state of knowledge and research activities related to data science and AI and their application in the nuclear industry. At these workshops, the NRC worked with internal and external stakeholders to identify the benefits and risks associated with the use of AI in regulatory activities and discussed ongoing and planned projects in the nuclear industry. For more details, see the NRC public Web site at <https://www.nrc.gov/public-involve/conference-symposia/data-science-ai-reg-workshops.html>.

<sup>5</sup> See 86 FR 20744, "Role of Artificial Intelligence Tools in U.S. Commercial Nuclear Power Operations," at <https://www.federalregister.gov/documents/2021/04/21/2021-08177/role-of-artificial-intelligence-tools-in-us-commercial-nuclear-power-operations>.



## 4 STRATEGIC GOALS

The AI Strategic Plan sets out the five strategic goals shown in Figure 2 to ensure readiness for reviewing the use of AI in NRC-regulated activities.



**Figure 2 Overview of Strategic Goals**

As shown above, the first strategic goal is the ultimate outcome of the implementation of this strategic plan, which is to continue to keep pace with technological innovations to ensure the safe and secure use of AI in NRC-regulated activities through existing or new regulatory guidance, rules, inspection procedures, or oversight activities (AI Strategic Goal 1). AI Strategic Goals 2 through 5 directly support preparatory activities that culminate in successfully supporting technical readiness for regulatory decisionmaking activities desired in AI Strategic Goal 1. The establishment of the organizational framework (AI Strategic Goal 2) ensures all aspects of the NRC are represented in the preparations for reviewing AI in NRC-regulated activities. Strong partnerships are essential to ensuring the safe and secure use of AI in the nuclear industry. The NRC is committed to engaging the industry and relevant stakeholders to maintain awareness of industry efforts (AI Strategic Goal 3) and prepare for regulatory reviews. The NRC will also engage in workforce development and acquisition to ensure that the NRC staff and contractors have the critical skills required (AI Strategic Goal 4) to evaluate the use of AI in NRC-regulated activities. The NRC recognizes the establishment of a foundation in data science as a fundamental requirement for evaluating AI applications. Therefore, the NRC will build the necessary AI foundation to pursue use cases across the NRC (AI Strategic Goal 5), which will help build an organizational experience that supports future regulatory reviews and oversight activities.

The AI Strategic Goals are listed in order of priority and are expected to be initiated during different timeframes. All organizations within the NRC play a significant role in achieving the strategic goals. The NRC will also continue to monitor external factors that may influence the ability to achieve these strategic goals. The NRC will consider the actions needed for the short-

1 term (<1 year), mid-term (1–3 years), and long-term (3–5 years) time horizons and will guide  
2 budgetary requirements and resource planning within the NRC’s standard planning and  
3 budgeting processes to achieve the strategic goals in this document.  
4

5 The NRC developed an agency evidence-building plan [8], as required by the Foundations for  
6 Evidence-Based Policymaking Act of 2018, for identifying and addressing priority questions  
7 relevant to the agency’s programs, policies, and regulations. The NRC will leverage the  
8 resulting evidence gathered through the execution of the agency evidence-building plan to  
9 support the AI strategic goals. The AI Strategic Goals may inform the use of AI tools and  
10 enhance agency activities, as discussed in Appendix B of this AI Strategic Plan.  
11

#### 12 **4.1 Strategic Goal 1: Ensure NRC Readiness for Regulatory Decisionmaking**

13 The deployment of AI technologies by the nuclear industry is on the horizon. The NRC  
14 anticipates that within the next five years an existing licensee, new, or advanced nuclear  
15 technology applicant may employ AI in such a manner that it requires NRC regulatory  
16 consideration or oversight. The NRC needs to continue to be effective and efficient as it  
17 conducts its safety and security mission.  
18

19 This goal focuses on developing the regulatory guidance and tools to prepare the staff to assess  
20 AI as part of NRC regulatory activities. The NRC recognizes that the nuclear industry is likely to  
21 use AI in applications (e.g., notional AI and autonomy adoption levels in Table 1) that may  
22 require regulatory approval or oversight. Therefore, the NRC will assess whether any regulatory  
23 guidance (e.g., regulatory guides or standard review plan sections) or inspection procedures  
24 need to be updated or created to clarify the process and procedure for the licensing and  
25 oversight of the use of AI in NRC-regulated activities. The need for revision will be based on the  
26 information gathered through the execution of this AI Strategic Plan, engagement with external  
27 stakeholders (AI Strategic Goal 3), and experience obtained through pursuing internal use  
28 cases and their impact on the agency’s regulatory framework (AI Strategic Goal 5). For  
29 example, the NRC will leverage its experience reviewing relevant historical models as it  
30 determines the requirements for new, more detailed models. Lastly, additional options for long-  
31 range changes for AI regulatory reviews and oversight that would require rulemaking will also be  
32 considered.  
33

34 The NRC will undertake research to develop an AI framework to determine the approach to  
35 assess areas such as, but not limited to, explainability, trustworthiness, bias, robustness, ethics,  
36 security, risks, and technical readiness of AI. The NRC will also work with agency stakeholders  
37 and the international regulatory community to determine the currently available AI standards  
38 and identify the technical areas (e.g., explainability, trustworthiness, bias, robustness, ethics,  
39 security, risks) where gaps may exist. In addition, the NRC will participate with standards  
40 development organizations and work with Federal agencies and the international regulatory  
41 community (AI Strategic Goal 3) to offer critical expertise and perspectives to inform the drafting  
42 and revision of AI standards and guidance documents.  
43

44 The development of the AI framework will be communicated with agency stakeholders and the  
45 public to maintain transparency and clearly communicate regulatory guidance to the nuclear  
46 industry as early as possible in the process (AI Strategic Goal 3). For this goal, a successful  
47 outcome is providing, as needed, the regulatory guidance and tools to ensure readiness for  
48 reviewing the use of AI in NRC-regulated activities.  
49



## **4.2 Strategic Goal 2: Establish an Organizational Framework to Review AI Applications**

The successful implementation of the AI Strategic Plan requires effective coordination and collaboration across the NRC, at both the management and staff levels. The NRC will establish an Artificial Intelligence Steering Committee (AISC) to provide cross-office coordination and direction to ensure readiness for regulatory decisionmaking and develop AI governance. The AISC will need to include division or deputy division directors with management responsibility for AI technology across the agency. The AISC may engage external subject-matter experts with AI expertise to assist with specific issues, as needed. The AISC will also leverage existing information technology, data, and security communities and expertise. They will coordinate with the Information Technology and Information Management Portfolio Executive Council to ensure direct prioritization of the activities that will enable the achievement of the strategic goals outlined in this document.

To support staff engagement and collaboration, the NRC will need to establish an AI Community of Practice (AICoP) to provide a forum to (1) discuss best practices for reviewing requests that include the use of AI technologies, (2) provide agencywide awareness on active and potential use cases, and (3) facilitate the sharing of best practices and lessons learned. The AICoP will be comprised of NRC staff members from across the agency who are active in or interested in AI policy, technology, standards, and programs. In addition, AI working groups will support the AISC's efforts as needed to execute the AI Strategic Plan, such as prioritization of AI research, technical workshops, and specific subject-matter tasks as assigned. Membership for the AI working groups to support relevant subject matter expertise can be drawn from the AICoP.

A successful outcome of this goal is an organization that facilitates effective coordination and collaboration across the NRC to ensure readiness for reviewing the use of AI in NRC-regulated activities.

## **4.3 Strategic Goal 3: Strengthen and Expand AI Partnerships**

Strong partnerships across the Federal Government, with the nuclear industry, and with international counterparts are essential in order to gain valuable information to benchmark the agency's AI activities and serve as force multipliers to optimize resources and effort. Scientific and technological exchange keeps the NRC current in the rapidly evolving field of AI.

The NRC will continue to strengthen and expand strong AI working partnerships with domestic and international counterparts within the nuclear industry to stay abreast of industry interests, activities, and plans to deploy AI. For domestic AI activities, the NRC will continue to engage with stakeholders, including the public, nongovernmental organizations, and regulated entities through existing and new memoranda of understanding, public meetings, and workshops. For international AI activities, the NRC will continue to engage with international counterparts and multilateral organizations to collaborate in sharing information on the use of AI in NRC-regulated activities, conduct cooperative research, and influence the development of international standards and guidance.

The NRC is not the only Federal agency faced with the challenges of safely and securely deploying, overseeing, and evaluating AI technologies. Other Government agencies and industry sectors are facing similar challenges. In some cases, other Government agencies have more experience with assessment and implementation of AI. Their experience and lessons

1 learned provide the NRC with a unique opportunity to engage in intergovernmental information  
2 sharing, collaboration, and potential technology transfer from those agencies. The NRC will  
3 continue to build partnerships with other Government agencies to facilitate the exchange of  
4 ideas, practices, and procedures.

5  
6 Incorporating the information and knowledge gathered from external organizations, including  
7 regulatory research, industry, Federal partners, standards, and international bodies, into the  
8 NRC staff knowledge base will allow for informed regulatory decisionmaking. The NRC will  
9 coordinate external interactions, disseminate information from these interactions to the  
10 appropriate NRC staff, and support technical training and workshops to build AI awareness  
11 across the NRC offices. When achieved, this goal will provide established mechanisms to  
12 (1) maintain awareness of industry plans, (2) establish communication forums to discuss future  
13 plans and regulatory needs, and (3) effectively partner with other agencies on AI topics of  
14 mutual benefit.

#### 15 16 **4.4 Strategic Goal 4: Cultivate an AI-Proficient Workforce**

17 The NRC recognizes the value of acquiring, developing, and retaining a skilled workforce in the  
18 area of AI. The term AI is often used generically to encompass a wide range of applications,  
19 from data analysis to fully autonomous systems. The NRC will develop a common  
20 understanding of AI by providing the NRC staff with seminars, workshops, and training.

21  
22 This goal focuses on developing the technical information, knowledge, and tools to prepare the  
23 staff to review AI applications. The NRC must have the right number of people with the right  
24 skills at the right time to conduct effective and efficient regulatory reviews and oversight  
25 activities to accomplish its safety and security mission. Given the competitive marketplace for AI  
26 talent, the NRC will establish and stabilize a pipeline for AI talent by using the Strategic  
27 Workforce Planning and Competency Models to meet this strategic goal and support NRC  
28 needs. A primary mechanism for building this pipeline is leveraging existing hiring processes  
29 (e.g., NRC Integrated University Program, internships and cooperative education programs, the  
30 Nuclear Regulator Apprenticeship Network program, and the Information Technology Fellows or  
31 Graduate Fellows programs). In addition, the NRC will fully use Federal retention authorities to  
32 maintain a skilled AI workforce and allow talented experts to contribute to AI research and  
33 development activities.

34  
35 The NRC will cultivate the talent of its existing highly skilled workforce by investing in  
36 comprehensive training for NRC staff and managers working on use cases (AI Strategic  
37 Goal 5). The NRC AI training program will use a tiered approach, providing training ranging from  
38 basic to advanced concepts, applications, and AI tools tailored to the interest level and  
39 proficiency desired for staff as needed.

40  
41 The goal is to adopt the appropriate training programs and tools to develop the requisite skills in  
42 the NRC workforce. A successful outcome of this goal is to ensure appropriate qualifications,  
43 training, expertise, and access to tools exist for the workforce to review and evaluate AI usage  
44 in NRC-regulated activities effectively and efficiently.

#### 45 46 **4.5 Strategic Goal 5: Pursue Use Cases to Build an AI Foundation Across the** 47 **NRC**

48 AI technologies may pose novel challenges for the NRC regulatory framework. As the NRC  
49 prepares for regulatory decisionmaking, internal uses of AI tools that would also support

1 industry use for AI-based decisionmaking and control will increase staff knowledge of and  
2 experience with these tools for future regulatory reviews and oversight.

3

4 This goal focuses on developing and pursuing use cases, consistent with priority question 2 of  
5 the agency evidence-building plan (as discussed in Appendix B of this AI Strategic Plan), to  
6 build technical expertise for reviewing the use of AI in NRC-regulated activities. To build this  
7 expertise, the NRC needs to create an ecosystem that supports data science, assessment and  
8 integration of emerging AI tools, and hands-on talent development for reviewing the use of AI in  
9 NRC-regulated activities. To better understand how AI algorithms, models, and claims are  
10 validated and tested, the NRC needs to undertake research to develop use cases with data  
11 from various sources and in multiple forms. These use cases will help the staff gain AI expertise  
12 that could be used in performing regulatory reviews or assessments for a wide range of  
13 potential AI applications. In addition, the NRC will engage the nuclear industry to pursue  
14 potential pilot studies and proofs of concept to serve as a foundation for reviewing the use of AI  
15 in NRC-regulated activities. These pilots and proofs of concept will help in identifying challenges  
16 associated with getting the AI applications through the AI framework.

17

18 The NRC will provide staff with access to AI tools, which are often software based. The NRC will  
19 ensure it has access to training areas within applicable AI tools to allow the NRC staff to engage  
20 in training exercises that mimic regulatory reviews of potential AI in NRC-regulated activities.  
21 This will allow staff to identify and address potential gaps in future regulatory reviews.

22

23 For this goal, a successful outcome is one in which the NRC staff possesses an ecosystem that  
24 supports AI analysis, integration of emerging AI tools, and hands-on talent development for  
25 reviewing AI applications from the nuclear industry.



1

## 5 CONCLUSION

2 The NRC is committed to ensuring that the use of new technologies is safe and secure. New  
3 technologies, like AI, have the potential to enhance the safety and security of nuclear facilities.  
4 This AI Strategic Plan presents the vision and goals for the NRC to cultivate an AI-proficient  
5 workforce, keep pace with AI technological innovations, and ensure the safe and secure use of  
6 AI in NRC-regulated activities.



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## 6 REFERENCES

- [1] NRC, "U.S. Nuclear Regulatory Commission Strategic Plan: Fiscal Years 2022-2026," Washington, DC, NUREG-1614, Vol. 8, ML22067A170, 2022.
- [2] 116th U.S. Congress, "H.R.6395 - National Defense Authorization Act for Fiscal Year 2021: National Artificial Intelligence Initiative Act of 2020," 2021. [Online]. Available: <https://www.congress.gov/bill/116th-congress/house-bill/6395/text>.
- [3] NRC, "International Strategy: 2021-2025," Washington, DC, ML21236A120, <https://www.nrc.gov/docs/ML2123/ML21236A120.pdf>, 2021.
- [4] NRC, "Information Technology and Information Management Strategic Plan: Fiscal Years 2020-2024," U.S. Nuclear Regulatory Commission, Washington, DC, NUREG-1908, Vol. 4, ML19323D858, <https://www.nrc.gov/docs/ML1932/ML19323D858.pdf>, 2019.
- [5] O. Osagie, "medium.com," Medium, 21 February 2021. [Online]. Available: <https://medium.com/swlh/the-ai-hierarchy-of-needs-9b015d061f29>. [Accessed January 2022].
- [6] A. N. J. P. a. R. S. Andy Ho, "A Data Science Approach to Defining a Data Scientist," *SMU Data Science Review*, vol. 2, no. 3, 2019.
- [7] NRC, "Exploring Advanced Computational Tools and Techniques with Artificial Intelligence and Machine Learning in Operating Nuclear Plants," U.S. Nuclear Regulatory Commission, Washington, DC, NUREG/CR-7294, ML22042A662, <https://www.nrc.gov/docs/ML2204/ML22042A662.pdf>, 2022.
- [8] NRC, "Evidence Building Plan, Fiscal Year 2022," U.S. Nuclear Regulatory Commission, Rockville, MD, <https://www.nrc.gov/docs/ML2206/ML22066B056.pdf>, ML22066B056, 2022.

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## APPENDIX A GLOSSARY

- **ARTIFICIAL INTELLIGENCE (AI):** The term AI refers to a machine-based system that can go beyond defined results and scenarios and has the ability to emulate human-like perception, cognition, planning, learning, communication, or physical action. For a given set of human-defined objectives, AI can make predictions, recommendations, or decisions influencing real or virtual environments. AI systems use machine- and human-based inputs to perceive real and virtual environments, abstract such perceptions into models through analysis in an automated manner, and use model inference to formulate options for information or action (adapted from [1]).
- **AI APPLICATION:** An AI application represents a use case, project, plan, or other topic area that uses various AI technology and tools to conduct research and development or create a production product, service, or goal.
- **AI TECHNOLOGY:** AI technology represents the algorithms and methods that are used within the available machine learning and AI software tool sets.
- **AI TOOLS:** AI tools represent the computer software, code, information technology infrastructure, and service provider utilities (e.g., Azure Cognitive Service, IBM Watson Studio) that are used to facilitate AI applications.
- **DATA ARCHITECTURE:** Data architecture is defined by where the data resides; how it is collected, managed, secured, and accessed; and who has access to it. This architecture is constructed using purpose-built repositories, tools, and techniques, and it is controlled through the implementation of governance standards and policies.
- **DATA SCIENCE:** Data science is a multidisciplinary field that involves computer programming codes, such as Python and R; collaboration with other technical disciplines; and communication using charts, graphs, or dashboards and by transforming data into insights using techniques in statistics, analytics, and machine learning [2]. Data scientists use computer programming languages, such as Python, to develop algorithms that classify, predict, and suggest outcomes from data. In comparison, data analysts use historical data to create visualizations and predictions using dashboard development tools, such as Tableau and PowerBI.
- **DATA ANALYTICS:** The goal of data analytics is to derive and effectively communicate actionable insights from a vast quantity and variety of data. It covers a broad spectrum of activities, including data management and quality, mathematical and statistical methods for data modeling, and techniques for visualizing data in support of enterprise-wide decisionmaking [2]. Data analysts use historical data to create visualizations and predictions using dashboard development tools, such as Tableau and PowerBI. In comparison, data scientists use computer programming languages, such as Python, to develop algorithms that classify, predict, and suggest outcomes from data.
- **DEEP LEARNING:** Deep learning is a subset of machine learning in which multilayered neural networks, modeled to work like the human brain, “learn” from large amounts of data. Within each layer of the neural network, deep learning algorithms perform calculations and make predictions repeatedly, progressively “learning” and gradually improving the accuracy

1 of the outcome over time. Deep learning is differentiated in that it can ingest and process  
2 unstructured, unlabeled data [3].

3 • MACHINE LEARNING: Machine learning means an application of AI that is characterized by  
4 providing systems with the ability to automatically learn and improve on the basis of data or  
5 experience, without being explicitly programmed [1].

6 • NATURAL LANGUAGE PROCESSING: Natural language processing is the use of  
7 algorithms to determine properties of natural, human language so that computers can  
8 understand what humans have written or said. It includes teaching computer systems how  
9 to extract data from bodies of written text, translate from one language to another, and  
10 recognize printed or handwritten words [4].

11  
12 • ROBOTIC PROCESS AUTOMATION: Robotic process automation is used for software  
13 tools that partially or fully automate human activities that are manual, rule-based, and  
14 repetitive. It works by replicating the actions of an actual human interacting with one or more  
15 software applications to perform tasks such as entering data, processing standard  
16 transactions, or responding to simple customer service queries [5].

17  
18 • USE CASE: A use case is a specific situation in which a product or service could potentially  
19 be used.  
20

## 21 REFERENCES

22 1. 116th U.S. Congress, "H.R.6395 - National Defense Authorization Act for Fiscal Year 2021:  
23 National Artificial Intelligence Initiative Act of 2020," 2021. [Online]. Available:  
24 <https://www.congress.gov/bill/116th-congress/house-bill/6395/text>.

25 2. North Carolina State University, "Institute for Advanced Analytics," [Online]. Available:  
26 [https://analytics.ncsu.edu/?page\\_id=2](https://analytics.ncsu.edu/?page_id=2). [Accessed May 2022].

27 3. IBM, "What is Deep Learning?," [Online]. Available: [https://www.ibm.com/cloud/learn/deep-](https://www.ibm.com/cloud/learn/deep-learning)  
28 [learning](https://www.ibm.com/cloud/learn/deep-learning). [Accessed May 2022].

29 4. DeepAI, "Machine Learning Glossary and Terms," [Online]. Available:  
30 <https://deepai.org/machine-learning-glossary-and-terms/natural-language-processing>.  
31 [Accessed May 2022].

32 5. Association for Intelligent Information Management, "What is Robotic Process Automation?,"  
33 [Online]. Available: <https://www.aiim.org/what-is-robotic-process-automation>. [Accessed May  
34 2022].

## APPENDIX B USING ARTIFICIAL INTELLIGENCE TOOLS TO ENHANCE NRC ACTIVITIES

The U.S. Nuclear Regulatory Commission (NRC) will also pursue internal opportunities for the use of artificial intelligence (AI) tools for business process automation and knowledge mining. The NRC continues to build a flexible, agile, and innovative information technology and information management environment that is prepared for the rapid development of new technologies and changes in the nuclear industry. Technological advances continue to change the way the agency works and interacts with stakeholders. The increased use of data analytics, cloud computing, and AI may improve efficiency and provide support for the workforce. These activities increase dependency on a robust and resilient network and information technology infrastructure. While AI Strategic Goals 4 and 5 principally support agency preparation for external AI usage in NRC-regulated activities, Goals 4 and 5 may also benefit the agency in preparing for internal agency AI usage. In conjunction with AI Strategic Goals 4 and 5, the NRC will gain knowledge and expertise in a wide range of skills and capabilities such as artificial intelligence and data literacy, to support expanding the use of data for decisionmaking in the agency.

Several actions taken by Congress or executive branch agencies are prompting the NRC to further consider the best way to strategically integrate AI technology into agency internal processes and work products in addition to the regulatory oversight functions discussed in the AI Strategic Plan. The AI Strategic Plan aligns with and supports the provisions of the following:

- Administrative Conference of the United States, Statement #20, “Agency Use of Artificial Intelligence” [1]
- Foundations for Evidence-Based Policymaking Act of 2018 (Evidence Act) [2]
- National Artificial Intelligence Initiative Act of 2020 [3]
- Office of Management and Budget M-21-06, “Guidance for Regulation of Artificial Intelligence Applications,” [4]

AI tools may be used to enhance internal NRC activities, which could better allocate agency resources to higher value activities and emerging mission priorities. However, AI tools are highly dependent on the quantity and quality of the data that support them. In carrying out the agency’s mission, the NRC captures, creates, manages, and uses data from a variety of sources and in a variety of forms. These data inform the agency’s operational and regulatory decisionmaking and support all Federal reporting requirements. As part of the NRC’s Information Technology/Information Management Strategic Plan, the agency will provide future enhancements to identify and collate data more effectively and efficiently [5].

The NRC has also developed an agency evidence-building plan, as required by the Evidence Act, for identifying and addressing priority questions relevant to the agency’s programs, policies, and regulations [6]. As part of the evidence-building plan, the agency will identify what NRC decisionmaking processes could benefit from AI tools and prioritize the data collections that would have the most significant impact on agency decisionmaking, AI tool use, and stakeholder use. By improving how the NRC collects data and information, AI tools can be used more readily and potentially make decisionmaking more efficient. The evidence-building plan also discusses how processes and procedures are vital to ensure consistency, clear expectations,

1 performance measurement, and established roles and responsibilities consistent with  
2 established policy. As part of the evidence-building plan, the NRC will assess the agency's  
3 processes to determine what improvements can be implemented to continue as a more modern,  
4 risk informed regulator. When assessing processes for improvement, the NRC will include in its  
5 assessment, potential ways AI tools could be incorporated into processes, as well as for  
6 continuous process monitoring and optimization.  
7

## 8 **REFERENCES**

- 9 1. Administrative Conference of the United States, "Agency Use of Artificial Intelligence," 2021.  
10 [Online]. Available: <https://www.acus.gov/research-projects/agency-use-artificial-intelligence>.
- 11 2. 115th U.S. Congress, "H.R.4174 - Foundations for Evidence-Based Policymaking Act of  
12 2018," 2021. [Online]. Available: [https://www.congress.gov/bill/115th-congress/house-](https://www.congress.gov/bill/115th-congress/house-bill/4174/text)  
13 [bill/4174/text](https://www.congress.gov/bill/115th-congress/house-bill/4174/text).
- 14 3. 116th U.S. Congress, "H.R.6395 - National Defense Authorization Act for Fiscal Year 2021:  
15 National Artificial Intelligence Initiative Act of 2020," 2021. [Online]. Available:  
16 <https://www.congress.gov/bill/116th-congress/house-bill/6395/text>.
- 17 4. OMB, "Guidance for Regulation of Artificial Intelligence Applications," Office of Management  
18 and Budget, Washington, DC, [https://www.whitehouse.gov/wp-content/uploads/2020/11/M-](https://www.whitehouse.gov/wp-content/uploads/2020/11/M-21-06.pdf)  
19 [21-06.pdf](https://www.whitehouse.gov/wp-content/uploads/2020/11/M-21-06.pdf), 2020.
- 20 5. NRC, "Information Technology and Information Management Strategic Plan: Fiscal Years  
21 2020-2024," U.S. Nuclear Regulatory Commission, Washington, DC, NUREG-1908, Vol. 4,  
22 ML19323D858, <https://www.nrc.gov/docs/ML1932/ML19323D858.pdf>, 2019.
- 23 6. NRC, "Evidence Building Plan, Fiscal Year 2022," U.S. Nuclear Regulatory Commission,  
24 Rockville, MD, <https://www.nrc.gov/docs/ML2206/ML22066B056.pdf>, ML22066B056, 2022.

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The U.S. Nuclear Regulatory Commission (NRC) recognizes that interest in artificial intelligence (AI) is growing rapidly in both the public and private sectors and anticipates increased use of AI in NRC-regulated activities. AI generally refers to a machine-based system that can and has the ability to emulate human-like perception, cognition, planning, learning, communication, or physical action. For a given set of human-defined objectives, AI can make predictions, recommendations, or decisions influencing real or virtual environments. The AI Strategic Plan focuses on a broad spectrum of sub-specialties (e.g., natural language processing, machine learning, deep learning, etc.) which could encompass various algorithms and application examples which the NRC has not previously reviewed and evaluated. Anticipating the industry's potential application of AI to NRC-regulated activities, the NRC has developed an AI Strategic Plan to ensure the agency's readiness to review such uses. The AI Strategic Plan includes five goals: (1) ensure NRC readiness for regulatory decisionmaking, (2) establish an organizational framework to review AI applications, (3) strengthen and expand AI partnerships, (4) cultivate an AI proficient workforce, and (5) pursue use cases to build an AI foundation across the NRC. The overall goal of this AI Strategic Plan is to ensure continued staff readiness to review and evaluate AI applications effectively and efficiently.

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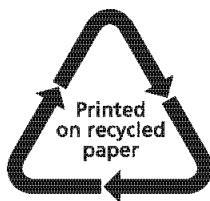
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