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Adaptation of the NWM Cloud Environment for an ISF Project

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ABSTRACT

The DOE-NE NWM Cloud was designed to be a generic set of tools and applications for any nuclear waste management program. As policymakers continue to consider approaches that emphasize consolidated interim storage and transportation of spent nuclear fuel, a gap analysis of the tools and applications provided for spent nuclear fuel and high-level radioactive waste disposal in comparison those needed for siting, licensing, and developing a consolidated interim storage facility and/or for a transportation campaign will help prepare DOE for implementing such potential policy direction. This report evaluates the points of alignment and potential gaps between the applications on the NWM Cloud that supported SNF disposal project, and the applications needed to address QA requirements and for other project support needs of an SNF storage project.

ACKNOWLEDGEMENTS

This report reflects the years of analysis and development work of the Sandia NWM Cloud Team of software developers, cloud system administrators, cybersecurity professionals, project managers, and expert former users and owners of the legacy applications, without whom the options analyzed in this paper could not be considered. Rick Maul, Bill Schrock, Tuan Dinh, Bob Walker, and others at the Office of Legacy Management who provided indispensable support and knowledge of the legacy applications.

The authors are also grateful to Tito Bonano and Don Beckman, whose input was instrumental in planning our approach to the topics outlined in the report, and to Jack Bailey and Jeremy Nichol for their comment and analysis. Their contributions have been substantial, but in the end any weakness in analysis is the sole responsibility of the authors.

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EXECUTIVE SUMMARY

The DOE Office of Nuclear Energy (DOE-NE) nuclear waste management cloud-enabled environment (the "NWM Cloud") provides direct access to historical spent nuclear fuel and high-level radioactive waste disposal project data and analyses and to programs and processes previously accepted by the U.S. Nuclear Regulatory Commission. The NWM Cloud was designed from the beginning to be a generic set of tools and applications for any potential nuclear waste management program, including nuclear waste transportation and storage projects.

The NWM Cloud delivers a network environment that provides a readily accessible IT framework for basic computing needs including email and messaging, network file storage, and videoconferencing for a project organization with participants at multiple distant sites. Its cybersecurity is certified and authorized under Federal Risk and Authorization Management Program (FedRAMP), which is required for any federal cloud deployment. Perhaps most importantly for the practical needs of a startup of a major federal program like a potential interim storage facility (ISF) project for nuclear waste management, the NWM Cloud provides a rapidly scalable infrastructure capable of expanding on demand for additional users, data traffic, and data storage.

Implementation approach for an ISF project—For implementation in support of an ISF, the existing DOE-NE NWM Cloud, which is already authorized for operation under FedRAMP, would add an additional domain specifically for ISF user accounts and applications. Existing custom applications in the NWM domain could be migrated to a new ISF domain without the existing data and used in support of ISF work. In specific cases—records management and the technical library—it is recommended that an application be a shared resource using existing content and adding to it. In one case—requirements management—it is recommended that, because requirements for an ISF are frequently identical to or close analogues with requirements currently in the repository project requirements management system, existing data might be retained as a useful starting point for a requirements management program that would be modified to be specific to an ISF project.

Applications available for ISF project use and potential gaps—The gap analysis concluded that the 28 NWM applications are all potentially useful for an ISF. Thirteen of them are suitable for addressing the QA processes that will be required for an ISF project under 10 CFR Part 72; twelve of them can support non-QA processes and information needs including applications related to DOE's Worker Health and Safety Program, its Operating Experience Program, and general licensing process requirements related to 10 CFR Part 2 and 10 CFR Part 72.

The gap analysis of applications identified a potential future gap related to applications that might be needed to support QA processes during construction and operations. The need for such applications would have to be assessed closer to that phase, and this is not a gap that would need to be addressed before licensing. The gap analysis also considered a system that might need to be completed in manner that would meet ISF needs, and it identified several potential opportunities for improvement, for example, in communications management tools that might better support public engagement in a consent-based siting process.

Costs and Schedule—Adaptation of the NWM Cloud environment for a ISF project is readily and rapidly achievable, and remarkably inexpensive in comparison to alternative approaches like developing an on-premises network or establishing a separate cloud environment.

The development and implementation of a fully operational ISF domain in the current cloud tenant would be relatively quick compared to the initial NWM Cloud development. The schedule estimate for just the O365/Azure environment for an ISF under the existing Authority to Operate (ATO), with no NWM applications or content would only be about 4 weeks (compared to about 2 years of planning, implementation, and testing to stand up the original NWM Cloud environment and obtain the ATO). Assuming 50 user accounts, the cost would only be about $40k. To set up that ISF cloud with all NWM applications for full functionality and access to that information would take 16 weeks and cost about $725k for 50 user accounts. These startup cost estimates are highly dependent on customer choices like number of user accounts and the COTS application to be deployed, so costs could be adjusted and prioritized within that range of $40k to $725k, depending on applications selected for initial deployment to the environment.

The annual costs for O&M of an ISF cloud environment, again assuming 50 user accounts, would be between $775k for the environment with no NWM applications or content and $1,665k for the environment with NWM applications fully installed. The difference reflects license costs of COTS software applications and additional labor related to support for applications. As with the startup costs, these cost estimates are dependent on customer choices like number of user accounts and the COTS application to be deployed, so costs could be adjusted and prioritized within that range of $775k to $1,665k annually, depending on applications needed for deployment to the environment at the time.

1. INTRODUCTION

In a multiyear effort conducted by a cross-disciplinary team of nuclear waste management program subject matter experts, software engineers and analysts, and cloud solution architects, the U.S. Department of Energy (DOE) Office of Nuclear Energy (DOE-NE) nuclear waste management (NWM) cloud-enabled environment (the "NWM Cloud") has been developed that the DOE can use as a framework for execution on any future nuclear waste management project. That environment includes the basic "desktop" services of Microsoft Office (Outlook, Word, Excel, SharePoint, Teams, etc.), and then adds a host of services for system administration, security, data storage and search, data backup and recovery, SQL database services, and custom application deployment on the Microsoft Azure Commercial Cloud.

To identify the custom applications needed for future DOE nuclear waste management programs, the team systematically reviewed the Yucca Mountain Project (YMP) applications currently maintained by the DOE Office of Legacy Management (LM), whose staff provided significant support in enabling the review of those legacy applications. The NWM Cloud Project goes much further than restoring and preserving information. It provides a set of tools containing implicit processes, workflows, and controls that provide the mechanics of procedure implementation and support the integrity of work process results. Many of these processes have already had extensive, rigorous review by the regulators and have been found functionally successful in meeting quality and non-quality requirements and expectations.

The NWM Cloud was designed to be a generic set of tools and applications for any DOE nuclear waste management program, including programs for consolidated interim storage and transportation of spent nuclear fuel as well as permanent repository programs. As policymakers continue to consider approaches that emphasize consolidated interim storage and transportation of spent nuclear fuel, a gap analysis of the tools and applications provided for NWM disposal in comparison those needed for siting, licensing, and developing a consolidated interim storage facility and/or for a transportation campaign will help prepare DOE for implementing such potential policy direction.

This NWM Cloud environment provides a readily accessible IT framework and basic computing needs for project organization with participants at multiple distant sites. It provides IT infrastructure such as data partitioning, scaling, Federal Risk and Authorization Management Program (FedRAMP)–certified security, and data backup. It provides an email server and other database services supporting a variety of applications. From a user perspective, it provides services including:

- User account management and authentication
- Virtual machines with desktop applications installed to include word processing, presentations, spreadsheets, email, calendar, and task management capabilities
- Videoconferencing and messaging
- Database services
- Email server, and
- Network file storage.

Most importantly, this infrastructure is rapidly scalable. User accounts and overall traffic, applications, and data storage can all be expanded on demand.

The NWM Cloud Project initiative provides direct access to programs and processes previously accepted by U.S. Nuclear Regulatory Commission (NRC) that implement principles of ASME NQA-1, *Quality Assurance Requirements for Nuclear Facility Applications*, and it can support the quality assurance processes of NRC regulations for transportation and storage as well as disposal of spent nuclear fuel and high-level radioactive waste. Adaptation of the NWM Cloud environment for spent nuclear fuel (SNF) storage and transportation projects, including Interim Storage Facility (ISF) projects, is believed to be readily achievable. This paper will:

- Outline the general advantages of the NWM Cloud environment (Section 3) and a design overview of it (Section 4)
- Describe an implementation approach to supporting a cloud environment for a potential ISF project (Section 5)
- Evaluate the points of alignment and potential gaps between ISF QA requirements and other ISF project information management needs, and the functions and solutions provided by applications available in the NWM Cloud (Section 6)
- Summarize approaches to adapt NWM applications for a potential ISF project, noting the use of COTS software (Section 7), considering the potential for alternatives (Section 8), and prioritizing application deployment across hypothetical project phases (Section 9).
- Estimate ROM costs for establishing and operating an ISF cloud domain including applications needed to support an ISF project (Section 10).

2. BACKGROUND: PURPOSE AND SCOPE OF THE NWM CLOUD PROJECT

The NWM Cloud Project's stated mission is to deliver a cloud-based information system consistent with NRC quality assurance (QA) requirements and prepared to support general project activities for a generic nuclear waste management project—that is, capable of supporting a repository project as well as storage and transportation projects. The processes implicit in the software systems are aligned with Quality Assurance procedures from the YMP, so that the procedures could be transferred as part of the project software release to establish an initial working infrastructure, to be modified as appropriate to suit an ISF project.

The NWM Cloud Project was initiated to address an urgent need for DOE: its existing information systems were being maintained on hardware that was aging and required periodic replacement, each time incurring a risk that an incompatibility with the software might finally make a system inoperable. Because of cybersecurity vulnerabilities, the systems were on an isolated network where access needed to support needs—such as fulfilling Freedom of Information Act (FOIA) requests or information requests from DOE Office of General Counsel (OGC), the U.S. Nuclear Waste Technical Review Board, or the U.S. Government Accountability Office—was severely limited with no access at all outside of DOE's Office of Legacy Management (LM). The software licensing was an additional vulnerability; at least two of the vendors of commercial off-the-shelf (COTS) systems maintained by LM no longer exist, which means those systems no longer are updated by the vendor to maintain compatibility or patch cybersecurity vulnerabilities. Two other key applications, operational when the NWM Cloud project began, are no longer accessible at LM because the license costs for the programming language that supported it were raised beyond what was reasonable for DOE to spend on those systems. (DOE was able to avoid these costs largely because the NWM Cloud project had already preserved the applications' data and was rebuilding them without that costly software, using instead tools available from the Microsoft (MS) Azure platform at no additional cost.)

Upon completion of the initial analysis of applications being housed by LM in April 2019, the scope for the project was expanded to better reflect the complexity of requirements:

- Establish an environment for program-wide collaboration with ability to communicate and share easily between multiple remote locations, multiple participating parties, and large number of participants (estimated at about 1,500 users)
- Meet all cyber requirements from DOE Office of the Chief Information Officer (OCIO)for the Cloud Environment
- Evaluate Cloud vendors with selection based on IT system infrastructure requirements, including FedRAMP certification
- Establish Cloud services and obtain an ATO (Authority to Operate) with DOE OCIO as signing official
- Include applications necessary for a NWM project to meet NRC and DOE quality assurance requirements
- Model functionality of the YMP applications that was proven with the NRC and use OCRWM procedures as roadmap
- Migrate copies of YMP data into the modernized applications for ease of use by DOE and LM

- Prioritize timing of the application development and content migration according to a schema maximizing availability should there be a restart of a disposal project
- Allow for this environment to be available for any future NWM project (including a potential ISF project).

3. GENERAL ADVANTAGES OF THE NWM CLOUD ENVIRONMENT

3.1. Standardized State-of-the-Art Cybersecurity

The Federal Risk and Authorization Management Program (FedRAMP) is a program of the federal government that provides a standardized approach to security assessment, authorization, and continuous monitoring for cloud products and services. The authorization process is illustrated in Figure 1.

It is mandatory for federal agency cloud deployments that would be adversely impacted by the loss of (1) confidentiality, (2) integrity of information, or (3) timely and reliable access to information. The NWM Cloud is currently authorized at a moderate impact level, where loss confidentiality, integrity, and availability would result in serious adverse effects to DOE, including significant operational damage to DOE assets, financial loss, or individual harm, but not loss of life or physical injury. The moderate impact level accounts for 80% of FedRAMP authorizations across the government (GSA 2017). In comparison, low impact systems have low risk to an agency's operations, assets or individuals and do not store personal identifiable information (PII) beyond usernames, password, and email addresses; high impact systems are generally limited to defense and national security, law enforcement, emergency services, financial, and health systems where security breaches or loss of access could have catastrophic impacts.

Figure 1. Agency Authorization Process for the FedRAMP Authority to Operate
(source: fedramp.gov)

Operating under a FedRAMP ATO ensures that cloud cybersecurity is state of the art and meets all requirements appropriate for the content managed in the environment. Without it, a cloud deployment is not an available option, and cybersecurity for a on-premises network must be applied, maintained and tested on a custom basis.

Establishing an ATO can be very difficult; some organizations struggle for years to earn it. Thus, the completed NWM Cloud ATO is a very valuable asset for DOE-NE. Since it is required for all federal cloud deployments, an ISF project can (1) rely on its own on-premises network hardware and implement its own custom cybersecurity program to protect it, which is itself costly and risky; (2) procure its own separate cloud and work through the FedRAMP authorization process to gain a separate ATO; or (3) utilize the NWM Cloud tenant and the existing ATO but under a separate ISF domain, as proposed in Section 5.2.

Security Technology—The NWM Cloud utilizes the latest secure cloud technologies and security procedures to build both the software and the infrastructure required to populate the environment. The table below highlights the key security advantages being utilized.

Technology	Advantage
Azure Virtual Private Cloud (VPC)	The Azure Virtual Private Cloud (VPC) allows us to carve out our own section of the Azure cloud for our own use, and is manage completely by us. It's private to us, Microsoft cannot access our resources. There are only two entrances to our VPC: Azure Virtual Desktop and Azure Front Door.
Azure Virtual Desktop (AVD)	The Azure Virtual Desktop (AVD) allows users to access a controlled Virtual environment from any device, anywhere. Data from the environment cannot leak to the user's device. Similarly, malware cannot travel from the user's device to the AVD. This is the only way to access some of the applications that were not updated to modern standards and that have known vulnerabilities.
Azure Front Door (AFD)	The Azure Front Door (AFD) is the only way to access many of the web applications available in the environment. It is an advanced web proxy that only allows traffic through secure HTTP and is protected by the Web Application Firewall.
Web Application Firewall (WAF)	The Web Application Firewall (WAF) is a next generation firewall which analyzes traffic in real time. If the traffic matches any signature we don't approve, it is automatically blocked. Some of those unwanted signatures are any connection that comes from a region outside of the US, anything that looks like an attack, etc.

3.2. YMP Application Functionality and Data in a Modern, Secure, and Scalable Environment

The NWM Cloud provides a turn-key environment for the restart of a disposal project saving years in time, labor, and funding for a new project. It also provides the basis for an ISF project's ability to quickly begin operations, including adding applications in a phased approach that meet NRC and NQA-1 requirements when needed.

The NWM Cloud provides a secure and scalable computing environment for a remotely located workforce. No hardware for the workforce is required—no servers need to be purchased and maintained; no laptops need to be issued for to contractors for project work; no cryptocards, Yubikeys, fobs, or badges are required for secure access to the environment, so new users can be added and outfitted with access to their general computing tools as rapidly as accounts can be created.

Legacy records currently maintained by LM are currently difficult to access. The NWM Cloud will provide DOE-NE, the OGC, LM, and the associated DOE laboratories convenient and secure online access to legacy nuclear waste project information that has been inaccessible except indirectly through request via DOE-LM. Cost reductions can be realized from reducing future hardware, software, and administration of the isolated DOE-LM network of systems.

By updating the LM-maintained applications and providing copies of any relevant information in a secure and easily accessed cloud environment, any future project has a set of necessary information systems and applications that are ready for any such use. NWM Cloud provides applications required by NRC regulations for projects engaged in geologic disposal (10 CFR Parts 60 and 63) as well as for transportation (10 CFR Part 71) and interim storage facility (10 CFR Part 72) and provides applications required by DOE's own regulations, including its Worker Safety and Health Program (10 CFR Part 851), Oversight Program (DOE O 226.1), and Operating Experience Program (DOE O 210.2), and more.

3.2.1. Flexibility in Levels of Operation & Maintenance (O&M): Cold to Hot

The individual domains of the NWM Cloud tenant can be operated at various levels of maintenance, and for this discussion we outline the options from Cold to Hot. The customer decision on the maintenance level during O&M impacts labor costs for maintaining the environment. Although currently maintained in a Lukewarm State of O&M, the NWM Cloud could quickly move into a Warm or Hot state of operations, adding new users and outfitting them with access to their general computing tools as rapidly as accounts can be added. The description below outlines the functions provided in each O&M state of operations.

COLD State (no active project)

1. No user access/use of environment
2. No updates to custom-built applications
3. Cost for cloud services (storage levels, virtual machine capacity, etc.) are minimized/reduced where possible
4. Contracts for Microsoft Cloud Services and COTS SW are maintained at lowest levels
5. Cloud services and Legacy applications are monitored, remain functional and security patched as needed
6. Cloud environment costs and performance are monitored
7. ATO maintained

LUKEWARM State (no active project)

1. Very small number of user (example: 5)
2. No application updates included for anything other than security issues; quotes would be provided for special requests
3. NO help desk function
4. Includes items 4-7 in COLD State
5. This option keeps the tenant available but to a very small group; support team is not on call; special requests will require a quote for service

WARM State (no active project)

1. Limited number of users with Read-Only access (example: 50)
2. Some high priority changes/enhancements to custom-built applications can be negotiated
3. Includes items 4-7 in COLD State
4. Help Desk function

HOT State (Environment most likely being used by an active project.)

1. Full user access to as many individuals as the project requires for operations
2. Changes/enhancement to custom-built applications are supported
3. Includes items 4-7 in COLD State
4. Full Help Desk function
5. Increased user licensing for COTS software as needed

3.3. General Technological Advantages of Cloud Operation

The DevSecOps paradigm was adopted for NWM, enabling developers and system administrators to accommodate the velocity required in modern IT organizations. Infrastructure can be created in a fashion which allows zero downtime deployments and updates. The software change management process required under DOE's nuclear waste management QA program, much of which was previously accomplished with complex administrative processes and controls, can now be largely automated: all changes go through rigorous automated testing and security vetting before being sent to distributed, asynchronous change review boards. This allows for fast, efficient, and thorough software configuration management at every level. All changes are version controlled and tracked so that if a problem does arise it can be quickly identified and rolled back to the last known good state.

The table below highlights the key technological advantages of the NWM Cloud infrastructure.

Technology	*Advantage*
Version Control	The solid base that the entire environment is built upon. All applications, along with the code that generates the environment they are run on, is stored in version control. This allows capture and documentation of all changes made to the environment, ensuring a stable and well-audited change process.
(Auto) scaling	Due to the nature of our cloud environment, resources may live for only a few seconds as they are tested then thrown away. The scaling of these resources can be automated and can utilize any of the Azure Cloud resources necessary to do their job, then discard them again once they are finished. This allows us to scale resources to only that which is necessary to perform their function at any given time.
Price	Rather than have a big powerful machine sitting idle at night, virtual machines can be scaled down to only the bare minimum, paying for the bare minimum when the resource is not in use.
Velocity	Changes occur in seconds. The cloud is always ready to deploy or destroy as system administrators require see fit. This allows developers to work without impediment, and analysts to immediately receive the resources they need.

4. DESIGN OVERVIEW OF THE NWM Cloud

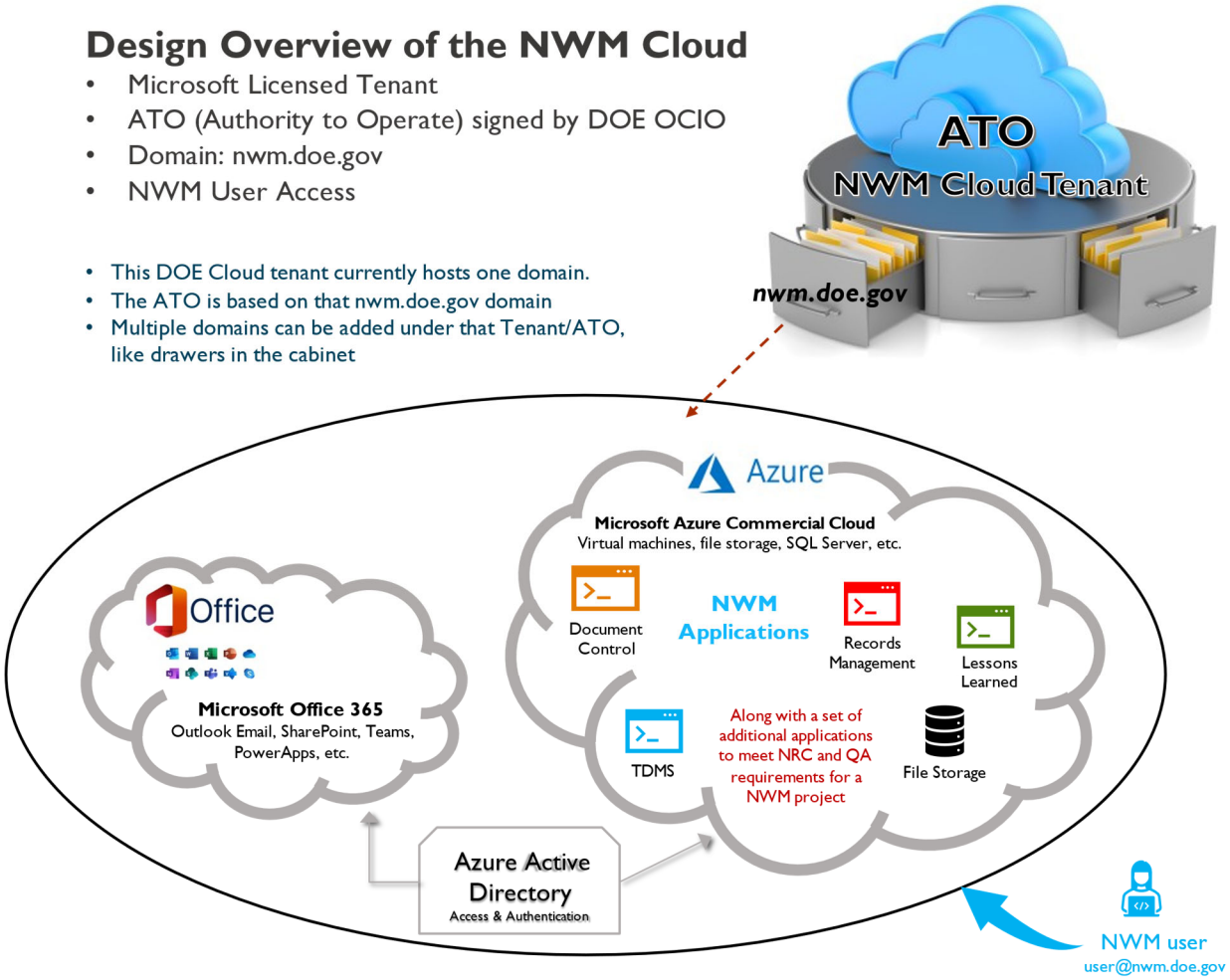


Figure 2. Conceptual Overview of the NWM Cloud

The primary components of a MS Cloud include the Tenant, the ATO, Azure Active Directory, the Domains, Office 365 with its applications and functionality, and the MS Azure Commercial Cloud which contains virtual machines, file storage, SQL Server, databases, and installed software applications.

An Azure Cloud tenant represents an organization, in this case DOE-NE. The tenant is a dedicated instance of Azure Active Directory that an organization receives at the beginning of its licensing relationship with Microsoft. For illustrative purposes, the tenant can be thought of as a file cabinet.

The file drawers in the cabinet represent the domains. The MS tenant can have hundreds of domains added as DOE-NE requires them. A domain under the tenant can be made up of a combination of users, workstations, devices, printers, computers, and database servers that share information using

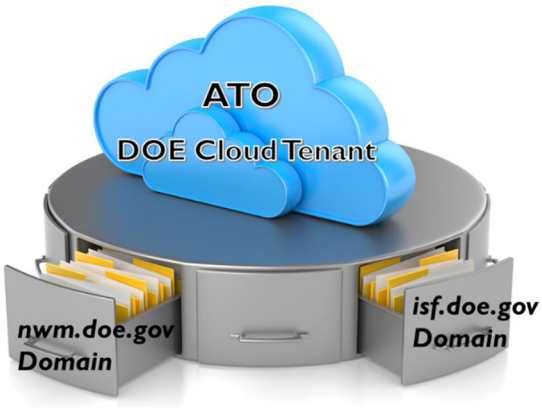
network resources. A domain uses controls to govern basic functions and manage network security and functions such as username/password, resource authentication, and access to the environment.

The Azure Commercial Cloud consists of virtual machines, servers, file storage, databases, networking, and software (SQL Server, Windows Server, Visual Studio, System Center, GitHub, etc.). In the NWM domain, it also holds copies of the custom applications updated or created from legacy YMP systems stored at LM.

The ATO, or Authority to Operate, is described in more detail in Section 3.1 of this document.

5. APPROACH FOR IMPLEMENTATION OF AN ISF DOMAIN IN THE NWM CLOUD

The NWM Cloud tenant can be readily extended to create multiple domains for multiple projects with the flexibility to share information across projects and domains or to limit access and control resources to a single group. An additional domain, for example an isf.doe.gov domain, could leverage the work that has already been completed to establish and maintain an ATO and a Cloud tenant with all the backbone functionality that entails. It should be noted that the current active ATO is dependent on the NWM domain. Planning for any additional domains requires either continued operation of the nwm.doe.gov domain or undertaking the development of a new ATO.



5.1. One MS Cloud Tenant over Two or More Domains

The NWM Cloud tenant currently has one active domain: nwm.doe.gov. It has the ability, however, to create additional domains as required by DOE to meet future needs.

Additional domains in the tenant could be partitioned and maintained separately:

- nwm.doe.gov could be maintained for the legacy YMP applications
  - Maintains nwm.doe.gov email and login accounts
- isf.doe.gov could be created for a new ISF project and its applications
  - New domain would have its own log-in access and email accounts

An ISF project could be maintained cleanly without comingling of accounts, operations, and information from other DOE projects.

But multiple domains can also be operated using trust relationships that allow for combined account authentication, with options such as one-way or two-way trust. In a two-way trust, Domain A trusts Domain B and Domain B trusts Domain A. This configuration means that authentication requests can be passed between the two domains in both directions. This kind of arrangement creates options for sharing applications, as we recommend as an approach in specific instances described in Section 5.3 and Appendix A.

5.2. One ATO to Cover the Entire Tenant

The process for gaining FedRAMP Authority to Operate is very detailed; it uses the National Institute of Standards and Technology's guidelines and procedures to provide standardized security requirements for cloud services. The key guidelines are NIST Special Publication 800-53A, *Assessing Security and Privacy Controls in Federal Information Systems and Organizations: Building Effective Assessment Plans* and NIST Special Publication 800-53B, *Control Baselines for Information Systems and Organizations*. The process they outline involves characterizing the information system and its data along with choosing a set of security controls. Those security controls require control assessments and risk assessments for each. FedRAMP for the moderate level under which the NWM Cloud operates includes 325 security controls. The System Security Plan for the NWM Cloud contains over 300

pages and is accompanied by 13 IT policy documents. Third party assessors review each security control using specific objectives to determine if the control has been met. A Cyber Security Assessment Report is issued after all controls are assessed to document the results. The NWM tenant's Security Assessment Report is over 130 pages in length. ATOs require continuous monitoring with reviews taking place annually for FedRAMP High, and every 18 months for FedRAMP Moderate.

Any changes to the applications installed in the cloud tenant or changes to the type of access allowed such as allowing nonverified users or public/guest access will require review of the ATO security plan to understand how those changes could impact the ATO. Early in the process of establishing any additional domains, discussions should be started with the tenant's Authorizing Official (AO) and the Information System Security Officer (ISSO) to review the new domain's requirements and plans to stay on the right track with the established ATO.

The roles and responsibilities involved in managing the NWM Cloud ATO are illustrated in Figure 3. It requires layers of responsibility and authority, starting with IT staff conducting development, implementation and review, DOE NE-8 as owner of the system, and DOE-CIO as the authorizing officer. The approach recommended for managing the ISF project as a domain within the tenant ensures that the ISF cloud resources are managed with the same team rather than doubling the responsibility and the work.

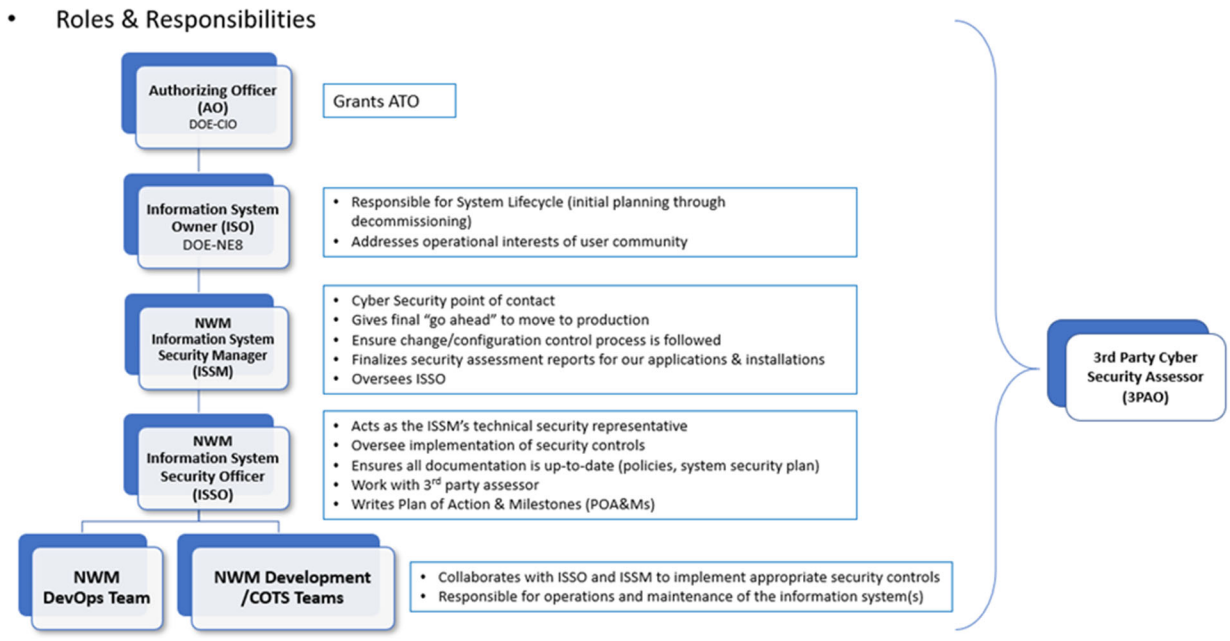


Figure 3. Roles and Responsibilities for Administration of the NWM Cloud ATO

5.3. Implementation of Applications

After completion of the analysis and development of the NWM cloud environment, there were 30 specific resources recovered from Legacy Management and re-implemented in the NWM cloud. Two of them—the "O:drive" (a copy of the past network drive fileshare, including the Intergraph PDS 3D and SmartPlant repository model files); and the Lotus Notes email warehouse—are not

applications per se, they are archive collections of information, nonrecord historical files. It is assumed that those two items are not needed for an ISF project.

The remaining 28 resources are applications that do fulfill requirements relevant to an ISF or have a potential use for an ISF project are as follows:

1. SCM (Software Configuration Management)
2. Records/Licensing Support Network (LSN) email categorization (email plug-in)
3. RDMS/RISweb (Records and Document Management System)
4. CDIS (Controlled Documents Information System)
5. TSERVE (Training Server)
6. CAP (Corrective Action system)
7. CSITS (Curatorial Sample Inventory & Tracking System)
8. TDMS (Technical Data Management System)
9. DIRS (Document Input Reference System)
10. Requirements Management System/DOORS
11. Correspondence Control and Correspondence Tracking Systems (multiple)
12. CIC (Consistency in Communications) Automated Review System
13. Communications Action Tracking
14. ES&H (Environment Safety & Health) Electronic Manual
15. Incident Log
16. TechLib/TIC (Technical Information Center)
17. Automated Forms System
18. DR/CAR
19. Qualified Supplier
20. Suspect/Counterfeit Items
21. Lessons Learned/Operating Experiences
22. Review Tracking
23. DARs (Document Action Requests) Database
24. USA RS Regulatory Analysis
25. LSN screening
26. LA (license application) Database
27. RAI (Request for Additional Information) Response System (RAIRS)
28. Contentions response system

These applications, their basis in requirements relevant to an ISF, and other factors important to their implementation for an ISF project, including alternative approaches are discussed in detail in Appendix A.

In general, when developing a new domain in the NWM Cloud tenant, the applications and data will remain partitioned and separate in the nwm.doe.gov domain. Only NWM account holders will have access to the YMP read-only data. Cloned applications with no data could be installed in the new ISF domain all at once or in a phased approach, such as the hypothetical project phases presented in Section 9.1.

There are two potential exceptions to this approach. As discussed in Appendix A, Section A.3, it is recommended that, rather than cloning the records management system for use only by an ISF project, the RDMS should be maintained as one continuous system. Any user with either an NWM or ISF account would be given access to the system in the NWM domain, with no additional cost implications from software or user licensing. Additional purposes and advantages for this approach are outlined in Section A.3. A similar approach is recommended for the TechLib/TIC library system, as discussed in Section A.16.

These concepts are illustrated in Figure 4, which includes the example of the records system being a shared resource.

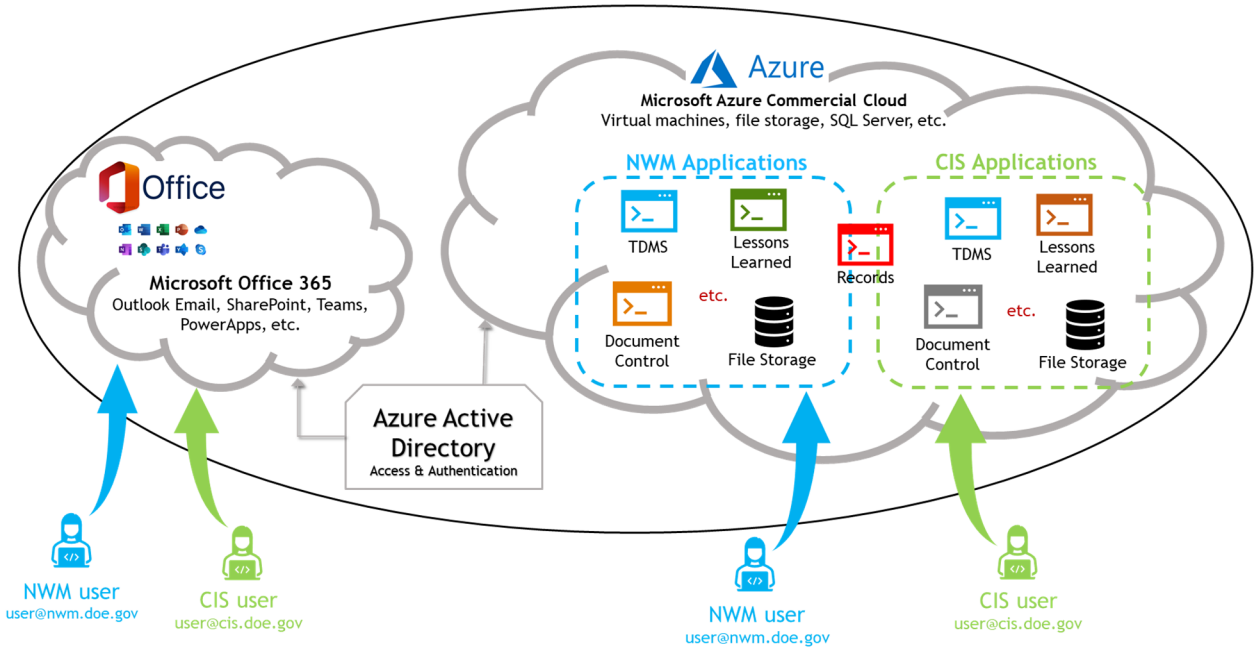


Figure 4. Schematic Illustration Showing Duplication and Sharing of Applications in the NWM and ESF Domains

6. ALIGNMENT OF INTERIM STORAGE FACILITY REQUIREMENTS AND SUPPORTING APPLICATIONS AND POTENTIAL GAPS

The requirements for a future ISF program can be conceptualized as three kinds:

1. Quality assurance requirements
2. Other regulatory requirements
3. General functional administrative needs.

This section will outline the alignment of NWM Cloud applications with requirements in each of these categories. This analysis is suitable only for planning purposes, not as a guarantee of compatibility with or fulfillment of all future requirements. Any future program will have to re-establish its requirements, policies, and procedures and ensure that applications are aligned with them.

6.1. Alignment and Potential Gaps in Quality Assurance Requirements and NWM Cloud Applications

The NWM Cloud applications represent modernized versions of validated, accepted software processes that the NRC had reviewed and found to be acceptable in meeting regulatory requirements and support DOE's QA requirements as documented in the *Quality Assurance Requirements and Description* (QARD) (DOE 2009). The NWM Cloud applications were tailored to the regulatory requirements in 10 CFR 63.142, the risk-informed NRC regulation for nuclear waste disposal at Yucca Mountain. These requirements are essentially repeated in 10 CFR Part 60, the generic NRC regulation for nuclear waste disposal; 10 CFR Part 71, the NRC regulation for packaging and transportation of radioactive waste; and 10 CFR Part 72, the NRC regulation for storage facilities for radioactive waste. Though the history of regulatory review, interpretation, and enforcement may show small differences that could be examined in greater detail, there is no substantial difference between the basic QA program requirements outlined in 10 CFR Parts 60,[1] 71, and 72 from the requirements of 10 CFR 63.142. For purposes of high-level planning, an application that successfully supported a key function of a QA program under 10 CFR 63.142 can be expected to be sufficient to support the equivalent function under 10 CFR Part 60, Part 71, or Part 72.

The QARD is based not only on NRC's QA criteria from 10 CFR 63.142 but also DOE's quality assurance directive, DOE O 414.1, *Quality Assurance* (at the time, DOE O 414.1C). The QARD also explicitly recognized its basis in the quality assurance requirements 10 CFR Part 71 Subpart H, for transportation, and 10 CFR 72 Subpart G, for storage facilities, and included them in the development and application of the QA program (DOE 2009, p. 12). The QARD also supplements the regulatory QA criteria by the addition of supplements derived in part from ASME NQA-1, *Quality Assurance Requirements for Nuclear Facility Applications*, and NRC guidance including NUREG-1298, *Qualification of Existing Data for High-Level Nuclear Waste Repositories* (NRC 1988) and NUREG-1636, *Regulatory Perspectives on Model Validation in High-Level Radioactive Waste Management Programs: A Joint NRC/SKI White Paper* (NRC 1999).

[1] 10 CFR Part 60, at 10 CFR 60.152, establishes the criteria for quality assurance by invoking Appendix B of 10 CFR Part 50, which is the NRC's quality assurance criteria for nuclear power plants.

As noted above, the QARD imposed additional requirements above that of 10 CFR 63.142. Future projects will review the QARD and updated the detailed QA requirements to best fit the nature of the proposed project (e.g., a storage facility as opposed to a repository) and adjust procedures and software as appropriate.

Processes and procedures are developed to meet NRC or DOE QA requirements may also address other critical requirements. Most obviously, the records system addresses NRC and DOE QA requirements including 10 CFR 72.174 and 63.142(r) and QARD Section 17 and also fulfills federal records requirements under the Federal Records Act and NARA regulations. Similarly, contractors establish procurement systems to meet contractual requirements, DOE orders, and corporate procurement rules, but they should also incorporate NRC regulations and applicable QA requirements. The procedures for each project area are developed to be consistent with and meet the associated quality assurance requirements. Software systems cannot ensure full compliance with requirements, but in many cases compliance cannot be demonstrated without them.

Table 1 shows the alignment between the NRC QA criteria for an ISF (10 CFR Part 72), the QARD and its supplements, and NWM Cloud applications that implement or support the relevant procedural processes and provide auditable confirmation that requirements have been met for at least a portion of the Quality Assurance requirements. The table lists all 18 QA program requirements of 10 CFR Part 72 as well as the parallel requirements of the QARD plus the QARD's five additional supplements. It should be noted that not all elements of a QA programs require a unique software system, and in no case does the provision of a software system fulfill all the related QA requirements.

The gap analysis in the last column is a simple one: it identifies the QARD requirements areas where software applications in the NWM Cloud successfully provided the necessary support for those processes and the requirements areas without such a supporting application. Where there was a software system in place during licensing under the 10 CFR Part 63 process and the years of preparation for it, it was subjected to internal QA audit and scrutiny and potentially NRC inspection, commensurate with its importance. These software systems were generally validated by their successful use in the past and can be assumed to be capable of fulfilling those same requirements for a future program. As part of the software development process, each system was tested against its past functions and requirements and shown to be operationally equivalent. Therefore, each application that fulfilled a role in meeting QARD requirements in the past can be judged likely to be capable of fulfilling a role for a future program.

In some cases, where there was no software application provided to support meeting a QARD requirement in the past, there is not a need for such a tool on a future program. For example, requirements for organization are implemented through the publication and distribution of procedures and other controlled documents. The documentation generated by the activities described by QARD requirements for procedures, instructions, and drawings or is captured in the general document control and records systems, not by additional specialized software tools.

Table 1. Crosswalk and Gap Analysis of Requirements from NRC Regulations for Storage and DOE QARD to Associated Applications

10 CFR Part 72	DOE QARD	NWM Cloud Applications	Gap Analysis
72.142 Quality assurance organization	1. Organization	No specialized applications provided.	No specialized applications needed—organization established via controlled documents and procedures system.
72.144 Quality assurance program	2. Quality Assurance Program (Section 2.2.11 Personnel Indoctrination, Training, Qualification, and Certification)	TSERVE (training) (Section A.5)	Software support in meeting the relevant requirement can be provided by the NWM Cloud application.
72.146 Design control	3. Design Control	DIRS (Document Input Reference System) (Section A.9)	Software support in meeting the relevant requirement can be provided by the NWM Cloud application.
72.148 Procurement document control	4. Procurement Document Control	No specialized applications provided.	Additional support in meeting these requirements in the operational phase may need to be considered. May be supported via existing document control system, but a separate system for specialized needs may be desired.
72.150 Instructions, procedures, and drawings	5. Procedures, Instructions, and Drawings	No specialized applications provided.	No specialized applications needed: documents and drawings produced using purchased desktop software and managed using existing document control software.
72.152 Document control	6. Document Control	CDIS (Controlled Document Information System) (Section A.4) —also, DARs database LN app (Section A.23)	Software support in meeting the relevant requirement can be provided by the NWM Cloud application.
72.154 Control of purchased material, equipment, and services	7. Control of Purchased Material, Equipment, and Services	DR/CAR database LN app (Section A.18) Qualified Supplier LN app (Section A.19) Suspect/Counterfeit Items LN app (Section A.20)	Software support in meeting the relevant requirement can be provided by the NWM Cloud application.
72.156 Identification and control of materials, parts, and components	8. Identification and Control of Materials, Parts, and Components	No specialized applications provided.	Support in meeting these operational requirements need to be considered. Likely future need—late licensing stage, prior to operations.
72.158 Control of special processes	9. Control of Special Processes	No specialized applications provided.	Additional support in meeting these requirements in the operational phase may need to be considered. May be implemented via training, procedures, and documentation, but augmented support with specialized application may be desired.

10 CFR Part 72	DOE QARD	NWM Cloud Applications	Gap Analysis
72.160 Licensee and certificate holder inspection	10. Inspection	No specialized applications provided.	Additional support in meeting these requirements in the operational phase may need to be considered. May be implemented via training, procedures, and documentation, but augmented support with specialized application may be desired.
72.162 Test control	11. Test Control	No specialized applications provided.	Support in meeting these operational requirements need to be considered. Likely future need—late licensing stage, prior to operations.
72.164 Control of measuring and test equipment	12. Control of Measuring and Test Equipment	No specialized applications provided.	Support in meeting these operational requirements need to be considered. Likely future need—late licensing stage, prior to operations.
72.166 Handling, storage, and shipping control	13. Handling, Storage, and Shipping	No specialized applications provided.	Support in meeting these operational requirements need to be considered. Likely future need—late licensing stage, prior to operations. Might also encompass “records traceable to the item as required, throughout fabrication, installation, and use of [items]” under 10 CFR 72.156.
72.168 Inspection, test, and operating status	14. Inspection, Test, and Operating Status	No specialized applications provided.	Support in meeting these operational requirements need to be considered. Likely future need—late licensing stage, prior to operations.
72.170 Nonconforming materials, parts, or components	15. Nonconforming Material, Parts, or Components	DR/CAR database LN app (Section A.18) Suspect/Counterfeit Items LN app (Section A.20)	Software support in meeting the relevant requirement can be provided by the NWM Cloud application.
72.172 Corrective action	16. Corrective Action	CAP (Corrective Action Program) (Section A.6) also, DR/CAR LN app (Section A.18)	Software support in meeting the relevant requirement can be provided by the NWM Cloud application.
72.174 Quality assurance records	17. Quality Assurance Records	RDMS (Records and Document Management System) (Section A.3) also, Outlook email system/Titus markings (Section A.2)	Software support in meeting the relevant requirement can be provided by the NWM Cloud application.
72.176 Audits	18. Audits	[*cross-cutting implications for applications that implement QA requirements, which must provide objective evidence that requirements elements are being implemented effectively*]	Software support in meeting the relevant requirement can be provided by the NWM Cloud application. All future software development and changes should similarly address auditability.
	Supplement I, Software	Software Configuration Management (SCM) (Section A.1)	Software support in meeting the relevant requirement can be provided by the NWM Cloud application.
	Supplement II, Sample Control	CSITS (Section A.7)	Software support in meeting the relevant requirement can be provided by the NWM Cloud application.

10 CFR Part 72	DOE QARD	NWM Cloud Applications	Gap Analysis
	Supplement III, Scientific Investigation	TDMS (Section A.8)	Software support in meeting the relevant requirement can be provided by the NWM Cloud application.
	Supplement IV, Field Surveying	No specialized applications provided.	No specialized applications needed—requirement sets standards to be implemented via procedures and documentation using purchased desktop software and managed using Document Control procedures and software.
	Supplement V, Control of the Electronic Management of Information	[*cross-cutting, platform-based requirements as well as basic standards for application functions*]	Software support in meeting the relevant requirement can be provided by the NWM Cloud application. All future software development and changes should similarly address these requirements.

In other cases, highlighted in the table in yellow, a requirement with no supporting software applications may indicate that the need for such a tool had not yet developed. For example, requirements related to inspection, test control, control of measuring and test equipment, and control of special processes were not yet relevant to YMP operations or those processes were conducted at a level that compliance could be demonstrated simply by establishment of standards, by training, procedures, and documentation such as paper forms and records, and by simple spreadsheets, not by specialized software applications. The documentation generated by the activities described by QARD requirements for procedures, instructions, and drawings or procurement document control is captured in the general document control and records systems (and in some cases under contractor oversight systems), not by additional specialized software tools.

Each of these requirements areas represent potential future software needs during an ISF construction and operations phase, therefore, they are highlighted as a potential future gap. However, none of them represent a gap that would need to be addressed before licensing. Some may be determined to be supportable with existing systems (e.g., a future analysis might determine that procurement document control requirements can be addressed using the main document control system and additional contractor oversight applications). But other requirements areas are highly likely to need a purpose-built (or procured) application not currently available in the suite of applications available in the NWM cloud be needed. For example, QA requirements for handling, storage, and shipping under 10 CFR 72.166, are will probably need support from a purpose-built (or procured) application. That requirement calls for "…measures to control, in accordance with work and inspection instructions, the handling, storage, shipping, cleaning, and preservation of materials and equipment to prevent damage or deterioration." Such a system might also encompass "records traceable to the item as required, throughout fabrication, installation, and use of [items]" under the requirement for management of materials, parts, and components 10 CFR 72.156, if those records and items are the same as or can be distinctly related to material and equipment controlled under 10 CFR 72.166. Such an application would probably need to be developed or procured near the end of construction, in anticipation of operations. Indeed, such an application would probably have been needed in support of YMP licensing and operations if that project had proceeded that far.

Other requirements areas identified as likely future needs are test control; control of measuring and test equipment; and inspection, test, and operating status. As noted above, none of these potential future needs represent a gap that would need to be addressed before licensing.

6.2. Other DOE and NRC Requirements Addressed by NWM Cloud Applications

This paper does not provide a complete analysis of all potential requirements for an ISF project beyond the framework of general nuclear QA requirements. However, in addition to QA requirements and processes analyzed above, there are applications preserved in the NWM Cloud with requirements sources that also apply to an ISF project. These applications are identified in Table 2, along with their functions and the relevant requirements they can help address.

These applications include:

- Systems to manage licensing documents and processes (i.e., the LA Database; the RAI Response System (RAIRS); the Contentions Response System; and the email categorization tool, which was also listed included in Table 1, above, because it addresses QA records requirements as well as the potential licensing purposes described here.
- Systems to support a DOE ES&H program, which were developed in the context of DOE's 10 CFR Part 851 worker health and safety program requirements.
- A system that combines Lessons Learned, which is a valuable tool in cultivating a nuclear safety culture, along with an operating experience program that was designed to work with DOE's Corporate Operating Experience Program as well as NRC's industry operating experience program, which may be especially valuable to storage operations.
- A standard requirements management tool, DOORS, which will be useful in establishing a complete requirements baseline for a federal ISF.
- The library management system that supports the technical library of copyrighted documents
- The review and approval tool used by DOE to review all presentations as part of the "Consistency in Communications" policy and procedures and to review all technical products for public release.
- The LSN screening system, which could be utilized to support records discovery and screening for an ISF, if desired.

There are no specific gaps to be definitively identified in addressing non-QA DOE and NRC requirements. Without a complete definition of project requirements for an ISF at a level of detail to outline all software needs, there is a possibility that a gap could be identified in the future. It is likely that potential future needs of this kind can be addressed with tools already provisioned by the NWM Cloud, like SharePoint or PowerApps.

The above observations having been made, the LSN screening system is a special case in this category. As noted in Table 2, it was developed to fulfill rigorous advance discovery requirements for the special hearing process for 10 CFR Part 63, and the approach to rebuilding it assumed very rigorous preservation of the prior software was necessary because the system was explicitly certified for its purpose. Its requirements to not apply to a 10 CFR Part 72 hearing. Nevertheless, a discovery support system that integrates legal review and Freedom of Information Act exemptions like this system would be valuable aid to DOE's hearing preparations, and, most likely, some kind of eDiscovery tool would be desired. But, because of uncertainties regarding future requirements and because of technical obstacles rebuilding some of the very components that might not be useful to the DOE except in a 10 CFR Part 63 proceeding, the LSN screening system was not completed. If an eDiscovery system was recognized as a needed system for an ISF, then the LSN screening system could be accounted for as a partial gap, since it is not complete and would require additional development. See Appendix A, Section A.25 for further discussion.

Table 2. Applications Available in the NWM Cloud that Address Other DOE and NRC Requirements Applicable to an ISF Project

Applications	Function	Requirements
Requirements Management/ DOORS (Section A.10) • also, USA RS Regulatory Analysis LN db (Section A.28)	Requirements management	DOE O 226.1A, Implementation of Department of Energy Oversight Policy Directives DOE O 251.1C, Departmental Directive Program [Potential future QA utilization: 10 CFR 72.146 Design Control]
CIC (Consistency in Communications) Automated Review System (Section A.12)	Document public release review Public presentations review Communications management	DOE G 241.1-1A, Guide to the Management of Scientific and Technical Information DOE O 241.1A, Scientific and Technical Information Management DOE O 1340.1B, Management of Public Communications Publications and Scientific, Technical, and Engineering Publications POL-RW-2003-003, Consistency in Communications Policy DM-PRO-003, Review and Approval for Release of Technical and Nontechnical Products to the Public
ES&H Electronic Manual (Section A.14)	ES&H	10 CFR Part 851, Energy: Worker Safety and Health Program
Incident Log (Section A.15)	ES&H	10 CFR Part 851, Energy: Worker Safety and Health Program
TechLib/TIC (Technical Library, external copyrighted documents) (Section A.16)	Technical library management	Necessitated largely by compliance with U.S. copyright law, NRC reference requirements under 10 CFR Part 2, and practical library management needs.
Lessons Learned/Operating Experiences (Section A.21)	Lessons learned and Operating Experience programs	DOE O 210.2A, DOE Corporate Operating Experience Program
Email categorization—Records/LSN categories (email plug in) (Section A.2)	Discovery, litigation support, NRC adjudicatory process	**Does not specifically apply:** 10 CFR 2 Subpart J, Procedures Applicable to Proceedings for the Issuance of Licenses for the Receipt of High-Level Radioactive Waste at a Geologic Repository, under direction from DOE OGC (Otis 2003) implementing exemptions defined roughly by FOIA exemptions derived from various sources. The Licensing Support Network (LSN) requirement under Subpart J *does not apply* to an ISF, but the general function of discovery and production of documents would be addressed with high efficiency by use of the tool in a similar way.
Licensing Support Network screening system (Section A.25)	Discovery, litigation support, NRC adjudicatory process	**Does not specifically apply:** 10 CFR 2 Subpart J. This LSN tool was developed to support the 10 CFR Part 63 discovery process, and therefore is not required under Part 72. However, the general function and the screening categories and exemptions the Freedom of Information Act are generic to the NRC hearing process, so the system could be used to support an ISF, if desired.
LA Database (Section A.26)	License application management, configuration control, NRC commitments management	10 CFR 72.11: completeness and accuracy of information 10 CFR 72.48: managing and communicating changes that impact the construction authorization or license
RAI Response System (RAIRS) (Section A.27)	Licensing process management	10 CFR Part 2, see especially 10 CFR Part 2.108 Denial of application for failure to supply information
Contentions response system (Section A.28)	Litigation support, NRC adjudicatory process	General support for effective participation in the 10 CFR Part 2 hearings process, though not specifically required

6.3. General Organizational and Process Needs Potentially of Value to an ISF Project Supported by NWM Cloud Applications

There are a handful other administrative systems with functions central to the past OCRWM organization and relied on frequently in administrative non-QA procedures that, because of their importance, were recovered and rebuilt by the NWM Cloud project. These applications include correspondence control and communications action tracking tools and the Automated Forms System. These applications are summarized in Table 3 and outlined in greater detail in Appendix A.

Table 3. Other General Administrative Systems of Potential Use to an ISF Program

Applications	Function	Need (past procedural basis)
Correspondence Control and Correspondence Tracking Systems (multiple) (Section A.11)	Incoming correspondence logging and distribution, outgoing correspondence review.	Various procedures, including those guiding interactions between OCRWM and the NRC and Nuclear Waste Technical Review Board, refer to use of these systems (separate ones for DOE, M&O, and satellite offices).
Communications Action Tracking (Section A.13)	Action tracking for capturing and responding comments and questions from stakeholders including elected members of government, press, advocacy groups, and individual members of the public	NP-DSK-1019, *Use and Maintenance of the Master Communications Database/Calendar*
Automated Forms System (Section A.17)	Database of procedural forms as well as organizational and employment related forms for staff use.	RM-DSK-2001-1001, *Forms Process*

Because there are no documented requirements in this area for an ISF to compare against, there are no specific gaps to be definitively identified in category of general organizational and process needs. Complete analysis of such gaps would require project requirements for an ISF at a level of detail and completeness not available at this time. A future ISF project is likely to identify practical, administrative needs and software tools not specifically anticipated by this analysis, but such unanticipated needs in this requirements category can almost universally be addressed with tools already provisioned by the NWM Cloud, like SharePoint or PowerApps.

The correspondence control and communications tracking functions are addressed with applications in the NWM Cloud and are therefore not identified as gaps. However, the area of communications management applications (including the Communications Action Tracking and Correspondence Control) is identified in the consideration of alternatives (Section 8) as opportunities for improvement because simplicity of existing could be a liability in a consent-based process oriented to public engagement, and modern software addressing the original functions while adding Customer Relationship Management–like features might be advantageous. Such an alternative approach for tools might also encompass the functions of the Consistency in Communications application included above in Section 6.2.

6.4. Conclusions and Potential Gaps Identified

The nuclear QA requirements for power plants and for nuclear waste transportation, storage, and disposal are highly parallel to each other. The NWM Cloud systems that supported QA processes

were based on the most recent iteration of those NRC requirements and, more directly, on DOE's QARD, which, while responsive directly to NRC's requirements under 10 CFR 63.142, explicitly recognized the quality assurance requirements 10 CFR Part 71 Subpart H, for transportation, and 10 CFR 72 Subpart G, for storage facilities, and included them in the development and application of the QA program. Therefore, for purposes of high-level planning and a preliminary gap analysis for an ISF program, an application that successfully supported a key function of a QA program under 10 CFR 63.142 can be expected to be sufficient to support the equivalent function under 10 CFR Part 60, Part 71, or Part 72.

A similar rationale is used to assess the ability of NWM Cloud applications for fulfill other requirements: NWM Cloud applications that successfully addressed a requirement that will also be applicable to an ISF program are considered capable of addressing the ISF need.

NWM Cloud Applications that can Support an ISF project—The NWM Cloud provides 13 applications that are suitable for addressing the 10 CFR Part 72 QA processes that will be required for an ISF project.

The NWM Cloud provides 12 applications that are suitable for other non-QA requirements. These requirements include DOE ES&H requirements of 10 CFR Part 851, Operating Experience Program requirements of DOE O 210.2A and others, as well as general licensing process requirements related to 10 CFR Part 2 and 10 CFR Part 72.

Finally, there are three NWM Cloud applications that, while they did not address any specific DOE requirement or other regulation, they support important programmatic needs for an ISF project.

Gaps and Other Observations—The key results are summarized below:

- **One potential future gap**—As discussed in Section 6.1, because the YMP did not begin construction or operations there are requirements areas of 10 CFR 63.142 and the QARD that weren't utilized in a significant way. Therefore, there are no applications supporting those processes, and there is a potential future is a potential gap in addressing those requirements relevant in the operations phase of an ISF: However, none of them represent a gap that would need to be addressed before licensing. Some may be determined to be supportable with existing systems (e.g., a future analysis might determine that procurement document control requirements can be addressed using the main document control system and additional contractor oversight applications), but other requirements areas, such as QA requirements for handling, storage, and shipping under 10 CFR 72.166, are highly likely to need a purpose-built (or procured) application not available in the suite of applications available in the NWM cloud be needed. However, this is not a gap that would need to be addressed before licensing.

- **One potential need for an incomplete system**—As discussed in Section 6.2, the LSN screening system is a case of note. Its rigorous advance discovery requirements do not apply to a 10 CFR Part 72 hearing, but a discovery support system that integrates legal review processes and Freedom of Information Act exemptions like this system would be valuable

aid to DOE's ISF hearing preparations, and, most likely, some kind of eDiscovery tool would be desired. But, because of uncertainties regarding future requirements and because of technical obstacles rebuilding some of the very components that might not be useful to the DOE except in a 10 CFR Part 63 proceeding, the application was deferred. If an eDiscovery system was recognized as a needed system for an ISF, the LSN screening system could fulfill that need but would have to be completed, probably by replacing rather than rebuilding the components that created the development obstacles for the NWM Cloud deployment. See Appendix A, Section A.25 for further discussion.

- **One potential opportunity for improvement**—As discussed in Section 6.3, while there are no explicit requirements to measure the need against, the area of communications management applications (including particularly Communications Action Tracking but also potentially Correspondence Control and the Consistency in Communications review system) is identified in the consideration of alternatives (Section 8) as an opportunity for improvement. The NWM Cloud systems, while they met the needs for the past program, a consent-based process oriented to public engagement and heavily dependent on external public communications might be greatly aided by modern software addressing the original functions while adding Customer Relationship Management–like features. See the discussion of the Correspondence Control, Consistency in Communications review system, and Communications Action Tracking in Appendix A, Sections A.11, A.12, and A.13 for further information.

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7. APPLICATION SOFTWARE DEVELOPMENT AND LICENSING

This section outlines the software licensing status of the NWM Cloud applications, particularly those that have ongoing costs. The suite of 28 NWM applications is implemented with:

- Eleven applications with no ongoing licensing fees, including:
    - Eight developed with recovered or reverse-engineered code from legacy applications
    - One using SharePoint, which is included in the Office 365 package provided by the MS Azure cloud.
    - The Software Configuration Management system, which is supported generally by the Azure DevOps services included in the cloud, and by a handful of tools with purchase costs, but no significant ongoing licensing fees
    - Titus email classification for records categorization (and LSN/discovery categorization), which is a one-time purchase
- PowerApps, with which nine small applications are supported under one license
- BPI System by Qualitech, which supports two systems, the Corrective Action Program system and the Lessons Learned/Operating Experience system, under one license
- OpenText Content Suite, which supports the RDMS records system
- OpenText Collections Server Library Management, which supports the Technical Information Center Library (TechLib) system
- Prosperity LMS, which support the TSERVE training system
- IBM Rational DOORS, which supports requirements management.

Table 4 is a matrix showing how each system was supported by licensed software, highlighting the twelve applications that are associated with QA requirements. Software development details are outlined for each specific application in Appendix A. The implications of the software licensing are discussed as a variable to the costs considered in Section 10.

Table 4. Software Licensing of NWM Cloud Apps

	SCM	Email categorization plug in	RDMS/RISweb	CDIS	TSERVE (Training)	CAP	CSITS	TDMS	DIRS	RMS (DOORS)	Correspondence Control	CIC Review System	Comms. Action Tracking	ES&H Electronic Manual	Incident Log	TechLib/TIC	Automated Forms System	DR/CAR	Qualified Supplier	Suspect/Counterfeit Items	LL/OE	TPIR impacts review	DAR Database	USA RS Regulatory Analysis	LSN screening	LA Database	RAIRS	Contentions
QA requirement	X	X	X	X	X	X	X	X	X									X	X	X			X					
N/A (developed software)				x			x	x	x																x	x	x	x
MS SharePoint (included)																	x											
Azure DevOps (incl.)	x																											
COTS: Titus email plug in		x																										
OpenText Content Suite			x																									
OpenText Collections Server Library Management																x												
Prosperity LMS					x																							
Qualitech BPI System						x															x							
Rational DOORS										x																		
MS PowerApps											x	x	x	x	x			x	x	x		x	x	x				

8. CONSIDERATION OF ALTERNATIVE APPLICATIONS FOR ISF IMPLEMENTATION

This section presents a summary assessment of the viability of potential alternatives for applications that were migrated to the NWM Cloud. The alternatives described reflect:

- Lessons learned, such as learning that a development platform used on an application developed later might have been a better platform that the only that had been used for an application completed early.
- Opportunities for streamlining or integration of data, processes, or systems, such as redeveloping document control in the same software as the records system, which could create opportunities for automation or streamlining in the process of submittal of records.
- Observations that some applications could be easily and readily converted to another software approach if advantages were recognized in the future; these generally reflect the applications developed in PowerApps, which are generally effective as is, but might be migrated readily into other systems if, for example, DOE or an M&O contractor brought a new, preferred suite of applications or tools for use on a project.

Table 5 summarizes the potential for an ISF to adopt an alternative application to meet the functional or content requirements met by the NWM Cloud application. These judgments represent the NWM Cloud team's advice regarding choices an ISF project will consider in the future. The table categorizes each application in four groups:

1. **Optimized:** the NWM Cloud team considers these applications, for the uses and configurations they are recommended for, to be optimized for use by an ISF project organization. These systems represent state-of-the-art software and/or comprehensive implementation of the nuclear QA and regulatory process requirements for content, process, and auditability. They are judged to be unlikely to be successfully replaced without an extensive effort of requirements analysis and software development and without incurring major risks and costs for an ISF project.

2. **Difficult to replace:** the NWM Cloud team considers these applications, for the uses and configurations they are recommended for, to be difficult to replace given the complicated requirements supported by the systems. They are systems that might be just as difficult and risky to replace as the "optimized" systems but are distinguished from optimized systems because they represent requirements that were particularly complicated under the QA program 10 CFR Part 63. Alternatives for these systems should only be considered if there is ample funding and more than a year available for the required effort.

3. **Alternatives optional:** the NWM Cloud team considers these applications, for the uses and configurations they are recommended for, to be potentially replaceable if there is some external requirement or opportunity that drives that choice, for example, if an operating contractor had a preferred system that met DOE's requirements for requirements management or if a simple tool could be integrated into another platform, such as a simple PowerApps tool being rebuild in OpenText Content Suite if integration advantages are identified. These options would generally have lower risk and costs to adopt in comparison to the first two groups or the fourth group.

Most of these applications are PowerApps tools that were migrated from old Lotus Notes databases.

4. **Possible opportunities for improvement:** The NWM Cloud team considers these applications, for the uses and configurations they are recommended for, to have potential opportunities for improvement. Some represent systems that were inherited from the old network that an ISF program might have more flexibility to reconsider. Some, like the DAR database, have specific integration opportunities identified; some depend on future ISF organization choices, such as whether an ISF would want to build a new, independent technical library (in which case a new system might be considered) or use the old library and its extensive collection of technical literature (in which case its more likely that the old software platform would be preferred). The risks involved in these choices also vary. For example, the document control application, CDIS, is included in this category because there might be significant advantages to implementing it in the OpenText system, but that approach would entail significant risk for a critical application and would only be reasonable to undertake if the entire process of document control were to be revised without modeling it on the successful past precedent. In contrast, the communications management applications (the Consistency in Communications review system, Correspondence Control, and Communications Action Tracking) are relatively simple non-QA applications with negligible regulatory risks incurred by changing processes or documentation requirements, and they are identified as opportunities for improvement because their simplicity could be a liability in a consent-based process oriented to public engagement, and modern software addressing the original functions adding while Customer Relationship Management–like features might be advantageous. These opportunities for improvement do not indicate "gaps" in known requirements or needs; in each case the NWM Cloud application fulfills the known requirements, but the NWM Cloud team recognizes that they might have considered an alternate approach if continuity of the specific system and the data it contains were not as important.

Table 5 also highlights the applications that support a QA process or requirement, which serves to emphasize both the increased risk of replacing a QA-related system, given the additional regulatory scrutiny that will be placed on it and the value in retaining it, given that those systems represent a model for operations that the NRC has evaluated and found acceptable.

The table here summarizes these judgments, but the details are outlined in relation to each specific application in Appendix A.

Table 5. Identification of Potential Options for Each NWM Application

	QA req.	N/A (optimized application)	Difficult to replace	Alternatives optional	Possible Opportunity for Improvement
SCM	X	x			
Email categorization plug in	X	x			
RDMS/RISweb	X	x			
CDIS	X				x
TSERVE (Training)	X	x			
CAP	X	x			
CSITS	X		x		
TDMS	X		x		
DIRS	X		x		
RMS (DOORS)				x	
Correspondence Control					x
CIC Review System					x
Communications Action Tracking					x
ES&H Electronic Manual				x	
Incident Log				x	
TechLib/TIC					x
Automated Forms System				x	
DR/CAR	X				x
Qualified Supplier	X				x
Suspect/Counterfeit Items	X			x	
LL/OE		x			
TPIR impacts review				x	
DAR Database	X				x
USA RS Regulatory Analysis				x	
LSN screening					x
LA Database		x			
RAIRS		x			
Contentions		x			

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9. ASSUMED ISF APPLICATION PRIORITIES

Prioritization of applications for an ISF cloud environment would be different than was implemented in the original NWM Cloud project, which assumed a "most difficult case" of restarting licensing processes and interactions with the NRC, which, in prioritizing the IT systems to restart first, put licensing information and support ahead of resuming new technical activities under a QA program. Starting up a new ISF project would have a different, more natural progression.

This section outlines a rough general assumption of how applications might support a phased startup of an ISF organization and the technical work involved in it. These phases and priorities are only for the purposes of illustration how information systems might be needed at different times over the lifetime of an ISF project. This might inform project planning and management of costs by considering delayed implementation of IT systems that might be expensive to license and operate far ahead of their need.

9.1. Hypothetical Project Phases for Purposes of IT Systems Planning

The ISF Program Priority represents our current assumption of priorities for establishing IT systems for an ISF project, which would have establishment of the organization and QA Program, site selection, and preliminary planning as its first objectives.

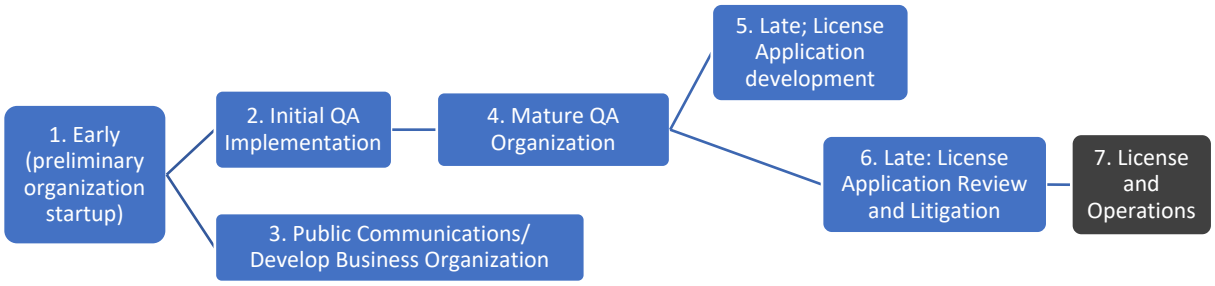

Figure 5. ISF Project Phases: A Conceptual Outline for Planning and Prioritizing IT Systems Needed of the Program

Under this hypothesis, there is little or no pre-existing program information, and—though the past requirements would be informative—the organizational and detailed QA requirements would need to be reevaluated for a new ISF organization to account for changes in comparison to past examples. But, broadly speaking, the general functions would be the same. As discussed in Section 6, records functions, a Corrective Action Program, document control functions, and so on, would still be required, but the detailed requirements for each would need to be validated and system roles reconfigured to reflect authorities of the new organization. The hypothetical stages of ISF cloud program implementation under this framework might be described as outlined here.

1. Early; Planning and Establishing Organization

- Stand up an organization and begin establishing authorities, roles and procedural framework, which requires:
    - Establishing computing resources
    - Document control for establishing QA and administrative processes.

    - Preliminary records capture meeting AP-17.1Q (and potentially LSN-like requirements).
- Plan for siting activities and communicate with stakeholders

2. Initial QA Implementation

- Preliminary site investigation activities, including sample collection
- Establish QA-compliant training framework
- Establish Corrective Action Program
- Develop data and controlled technical documents, including calculations and analyses for potentially "important to safety" topics that may support a future licensing proceeding
- Establish requirements management

3. Establish Public Communications and Develop Business Organization (overlapping or contemporaneous with Phases 2 and 4)

- Establish robust support for communications with stakeholders and the public, including, for example:
    - Formalized correspondence control
    - Tracking external communications and information requests from the public, units of state and local government, regulators, and other stakeholders
    - Review and approval of public information
- Develop robust business processes for efficient operations, including, for example:
    - Establish Environment Safety & Health programs
    - Establish technical library for copyrighted research materials, subscriptions, and references collection.
    - Forms management
    - Other employee resources and workplace facilities management

4. Mature QA Organization (overlapping or contemporaneous with Phase 3)

- Develop QA systems needed to manage a large organization, oversee subcontractor and supplier QA, and procurement compliance, establishing the last pieces of information infrastructure for a nuclear safety culture, including:
    - Lessons Learned
    - DOE Corporate Operating Experience Program
    - Procedure change management and tracking
    - Data review
    - Suspect/counterfeit items
    - Qualified supplier lists and contractor QA oversight
    - Requirements management

5. Late: License Application Development

- Develop, review, approve, and submit a license application based on technical data and analysis developed under the QA program
- Prepare for regulatory interactions (NRC staff review)

- Prepare for discovery processes of the regulatory proceedings

6. Late: License Application Review and Litigation (overlapping with later Phase 5)

- After LA submittal, respond to NRC Requests for Additional Information
- Participate in adjudicatory proceedings, responding to intervenor contentions, and providing expert testimony

7. Late: License and Operations

- Assuming licenses are granted, construction and operations begin
- Control handling, storage, shipping, cleaning, and preservation of materials and equipment
- Additional procurement, purchasing, parts and equipment management

Applications would be adapted for use according to these priorities. Note that the NWM Cloud applications would all be implemented in the first six phases. Because the repository program never advanced beyond the license application review and litigation phase, there were no applications developed in the later phases of construction and operations and no such applications included among those provided in the NWM Cloud. Thus, the potential gap the in the NWM Cloud applications identified in Section 6.1 is for applications supporting construction and operations activities such as handling, storage, shipping, cleaning, and preservation of materials and equipment.

9.2. Prioritizing Deployment of Applications in these Phases

In general, if there is significant expense from software licensing or maintenance, applications should not be implemented until they are needed to support project activities (with enough lead time to prepare for that support, of course). Most obviously, LA development and review roles and needs are best defined when that work is being planned and near its initiation, and litigation processes will be set by NRC's licensing board only after the LA submittal, so the adaptation of the contentions database should only be considered at that point. However, if an application can be installed and prepared for use with no licensing costs, managers can choose to put it in place with whatever limitations on access that they prefer, whenever they choose.

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10. COST OF ESTABLISHING AND OPERATING AN ISF CLOUD DOMAIN

Costs of development and implementation of any new domain are based on customer requirements and decisions: Will a phased approach be used for bringing applications online? Is there an active project imminent that would require a complete set of NWM applications to meet QA requirements? Will the cloud domain be used initially for basic collaboration, communication, and data storage without the custom NWM applications? These are all decisions DOE would make during the requirements planning process.

Cost estimates for any new domain would be based on negotiated customer requirements as discussed in Section 0 of this document, but would include the elements of:

- MS cloud services (Cloud hosting, Azure Commercial Cloud, and O365 applications such as Outlook, Word, Excel, SharePoint, Teams, etc.)
- Software licenses should applications using COTS software be installed
- Labor for support team
    - Initial development of the new domain
    - Ongoing O&M

The development and implementation of a fully operational ISF domain in the current cloud tenant would be relatively quick as compared to the initial cloud development. Current estimates to set up an ISF domain with all NWM applications and full functionality is 16 weeks. The schedule estimate for the basic O365/Azure environment with no custom applications would be greatly shortened to something closer to 4 weeks.

10.1. Variables Impacting Costs

Costs for cloud implementation and operation are variable and flexible, allowing the DOE to decide what is needed and when. This is one of the clear advantages of managing an organization or large project in a cloud environment.

The variables impacting costs include: (1) the number of accounts required for the domain; (2) the number of licenses required for the individual COTS applications, and (3) the level of O&M requested by DOE for the domain (Hot to Cold).

(1) Number of Accounts Required for the Domain

An important variable in determining costs is the number of accounts required by DOE for access to the cloud environment. Each account allows access to MS hosting and software license functionality, including:

- User access to O365 and any installed Azure applications
- Virtual machines
- Data storage
- Communications tools such as SharePoint and email accounts

(2) Number of Licenses Required for Individual COTS Applications

Another important variable in determining cost are the licenses needed for specific COTS applications. As outlined in Section 7, many of the key NWM applications are developed software with no licensing costs. The remaining six applications are implemented in COTS platforms for which licenses are required for access and use. Those six are:

- MS PowerApps, with which nine small applications are supported under one license. In an active project, all participants would need access to use these applications to access general project information like the ES&H Manual.
- BPI System by Qualitech, which supports the Corrective Action Program system and the Lessons Learned/Operating Experience system under one license. In an active project, all project participants are required to have access to use these applications to be able to identify issues in the CAP system.
- OpenText Content Suite, which supports the RDMS records system. In an active project, all project participants are assumed to need access to use this application to access records.
- OpenText Collections Server Library Management, which supports the Technical Information Center Library (TechLib) system. In an active project, all project participants are assumed to need access to use this application to access library information.
- Prosperity LMS, which support the TSERVE training system. In an active project, all project participants are required to have access to use this application to review training records and certifications, schedule classroom training, and take computer-based training.
- IBM Rational DOORS, which supports requirements management. It is assumed that, provided reports from the system can be made available to all staff, only the staff responsible for requirements management work in the DOORS system would need licenses to use this application.

For additional information on software licensing of the individual applications, see Appendix A. Some applications, for example the TechLib application that requires OpenText Collections Server Library Management (Section A.16), may have alternatives that might be considered for an ISF project that might reduce licenses needed, substitute one COTS program for another, or add a new COTS package by replacing developed software. All such considerations of alternatives must consider not only costs but also development risks and risks to requirements.

(3) Levels of Operation & Maintenance (O&M): Cold to Hot

As outlined in Section 3.2.1, the amount of labor required during O&M is dependent upon the level of maintenance the customer requires for an individual domain. Impacts to labor requirements include considerations of the number of custom applications to be maintained, the level of service required in the Help Desk operation, along with several other factors. (See Section 10.3 below)

Once the level of O&M maintenance is determined, this factor along with the number of domain accounts and the number of applications installed in the domain would be factored into a cost estimate.

10.2. Costs of Setting Up a New Domain

For cost estimating and future planning purposes, preliminary, rough order of magnitude (ROM) labor and schedule estimates are provided below to enable discussion. We will discuss two potential options of operation for a new domain ranging from (1) setting up the domain with all the NWM custom applications to (2) the basic O365 environment without any of the NWM applications. There are many different options available to DOE that could be explored along this spectrum. The NWM applications could be added one at a time or in groups as needed. These determinations could be introduced during the planning for an ISF organization. The estimates provided below are based on rates and conditions as of the date of this publication and would require updates before any new Cloud scope could be established.

Options 1 and 2 below represent both ends of the spectrum, from all NWM applications installed to none installed. Initial setup costs for an ISF domain depend a great deal on customer requirements, as will schedule estimates, based on number of applications being copied from the NWM Cloud domain and made operational in the ISF domain.

Option 1 — All NWM custom applications installed

- Hot state of operations
- 50 user licenses to the domain
- Full O365 and Azure functionality
- All NWM Applications copied from the NWM domain, emptied of content as appropriate, installed and made available for use by an ISF project

Option 2 — Basic environment, No NWM Applications for initial environment startup

- Hot state of operations
- 50 user licenses to the domain
- Full O365 and Azure functionality
- No NWM applications installed

Table 6. ROM Planning Cost Estimate Labor Costs and Schedule for Setting Up a new Domain

Labor Costs and Schedule for Setting Up a new Domain
Option 1 - 50 users, O365/Azure, ATO/Security, All NWM Applications
$725,000 estimate for development & implementation labor
16 weeks for implementation
Option 2 - 50 users, O365/Azure, ATO/Security, No NWM applications
$40,000 estimate for development & implementation labor
4 weeks for implementation

Note that the costs related to deployment of applications are a question of timing of the deployment, not options that affect total cost. Applications to support the required information and activities must be deployed eventually (along the lines suggested in Section 9), so the costs of deploying applications are not avoided over the long term of the project, only delayed to a later phase when they are needed.

10.3. Annual Costs for O&M of a New Domain

For cost estimating and future planning purposes, the two potential options of operation used in the previous section will be used. These are just two of many different options available to DOE that should be explored during requirements development of any new domain.

Annual MS service and software costs are based on the number of domain and application users; as the number of users increase or decrease with access to the environment and licenses to individual COTS applications, the software costs change accordingly.

Table 7. Annual O&M of an ISF Domain - ROM Planning Cost Estimate

Annual O&M of an ISF Domain - ROM Planning Cost Estimate		
Option 1 - 50 users, O365/Azure, ATO/Security, All NWM Applications		
Annual MS Hosting, Azure, O365	$	400,000
COTS Costs*	$	340,000
Annual Labor Costs	$	925,000
	$	1,665,000
Option 2 - 50 users, O365/Azure, ATO/Security, No NWM applications		
Annual MS Hosting, Azure, O365	$	400,000
Annual Labor Costs	$	375,000
	$	775,000
**based on use of all current NWM custom applications*		

As noted above in Section 10.2 regarding startup, the annual costs related to deployment of applications are a question of timing of the deployment, not options that affect total cost or eventual annual costs. Applications to support the required information and activities must be deployed eventually (see Section 9), so the annual costs of maintaining applications are not totally avoided over the long term of the project, only delayed to a later phase when they are needed.

10.3.1. O&M Labor – FTEs by Category and Functions included

O&M includes the following functions at varying degrees based on level of operation (Cold to Hot):

- Help Desk presence
- End-user account/access/security management
- Application or service improvements
- Cloud and COTS Software contracts kept current/active/renewed with increased user-based licensing procured if/when needed
- Cloud services and NWM applications are monitored, remain functional and security patched as needed
- Cloud environment costs and performance are monitored
- End-user orientation and guidance on the use and interpretation of information in the system is available.
- Support for external information requests

Roles and functions included in O&M Labor estimates include ATO Support, Software Developers, Cloud Administrators, Functional Subject Matter Experts for applications, and Project Manager. Table 8 below illustrates the total number of full-time equivalents (FTEs) as the staffing requirement for each option.

Table 8. O&M Roles and Functions Included in ROM Costs for O&M

	FTEs	
	Option 1	Option 1
Project Manager	0.15	0.06
Functional SMEs	0.44	0.18
Cloud Admins	0.36	0.22
Software Developers	1.47	0.33
ATO Support	0.32	0.24
	2.74	**1.02**

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11. SUMMARY AND CONCLUSIONS

The NWM Cloud initiative provides direct access to SNF project data and analyses and to programs and processes previously accepted by NRC. The NWM Cloud was designed from the beginning to be a generic set of tools and applications for any potential nuclear waste management program, including nuclear waste transportation and storage projects.

The NWM Cloud provides a network environment that provides readily accessible IT framework for and basic computing needs including email and messaging, network file storage, and videoconferencing for a project organization with participants at multiple distant sites. Its cyber security is certified and authorized under Federal Risk and Authorization Management Program (FedRAMP), which is required for any federal cloud deployment and therefore should be recognized as a valuable asset for DOE-NE to leverage as appropriate in the future. Perhaps most importantly for the practical needs of startup of a major federal program like a potential ISF project, cloud environment provides a rapidly scalable infrastructure capable of expanding on demand for additional users, data traffic, and data storage.

Implementation approach for an ISF project—For implementation in support of an ISF (as described in Section 5), the existing NWM Cloud tenant, which is already authorized for operation under FedRAMP, would add an additional domain specifically for ISF user accounts and applications. Existing NWM applications could be migrated to that domain without the existing data and used in support of ISF work. In specific cases—records management and the technical library—it is recommended that an application be a shared resource using existing content and adding to it. In one case—requirements management using DOORS—it is recommended that, because requirements for an ISF are frequently identical to or close analogues with requirements currently in the repository requirements system, existing data might be retained as a useful starting point for a requirements management program that would be modified to be specific to an ISF project.

Applications available for ISF project use and potential gaps—The gap analysis in Section showed that the 28 NWM applications are all potentially useful for an ISF. Those include:

- 13 applications that are suitable for addressing the QA processes that will be required for an ISF project under 10 CFR Part 72 and the QARD.
- 12 applications that are suitable for other non-QA requirements such as DOE ES&H requirements of 10 CFR Part 851, Operating Experience Program requirements of DOE O 210.2A and others, as well as general non-QA licensing process requirements related to 10 CFR Part 2 and 10 CFR Part 72.
- Three applications that, while they do not address any specific DOE requirement or other regulation, they support important programmatic needs for an ISF project.

The gap analysis of applications provided in Section 6 identified one potential future gap, one system currently incomplete that might be useful, and one potential opportunity for improvement:

- Because the YMP did not begin construction and operations, there are no applications on the NWM Cloud that would support needs that will arise in that later phase of ISF development. Therefore, as discussed in Section 6.1, there is a potential future gap in

addressing QA processes that become active in the operations phase of an ISF. The need for such applications would have to be assessed closer to that phase, and this is not a gap that would need to be addressed before licensing.

- As discussed in Section 6.2, completion of the LSN screening system was deferred because of uncertainties regarding future requirements and because of technical obstacles rebuilding some of the specific components that would only be useful to the DOE in a 10 CFR Part 63 proceeding. An eDiscovery system might be determined to useful for ISF, the LSN screening system could fulfill that need but it would have to be completed, probably by replacing rather than rebuilding the components that created the development obstacles for the NWM Cloud deployment.
- As discussed in Section 6.3, communications management applications are identified as an opportunity for improvement. A consent-based process oriented to public engagement and heavily dependent on external public communications might be greatly aided by modern software addressing the original functions while adding Customer Relationship Management–like features.

Section 7 summarizes some additional analysis reflecting the NWM Cloud team's judgments, observations, and lessons learned on alternatives that might be considered by an ISF project in adapting NWM Cloud applications to their needs. Most of the systems supporting QA processes are considered optimized or difficult to replace in terms of their functional support of the related process and their technology. In other areas, the team observed cases where processes and requirements are flexible enough to be addressed by alternative approaches to accommodate, for example, alignment with contractor software preferences or links to existing information systems. In still other areas, the team notes cases where and ISF project requirements may allow opportunities for improvement that the NWM Cloud could not explore, due to its requirements for strict fidelity to existing procedures.

Costs and Schedule—Adaptation of the NWM Cloud environment for a ISF project is readily and rapidly achievable. As outlined in Section 10, cost estimates for any new domain would be based on negotiated customer requirements.

The development and implementation of a fully operational ISF domain in the current cloud tenant would be relatively quick compared to the initial NWM Cloud development. The schedule estimate for just the O365/Azure environment for an ISF under the existing ATO, with no NWM applications or content would only about 4 weeks (compared to about 2 years of planning, implementation, and testing to stand up the original NWM Cloud environment and obtain the ATO). Assuming 50 user accounts, that would cost only about $40k. To set up that ISF cloud with all NWM applications for full functionality and providing access to that information would take 16 weeks and cost about $725k for 50 user accounts. These cost estimates are highly dependent on customer choices like number of user accounts and the COTS application to be deployed, so costs could be adjusted and prioritized within that range of $40k to $725k, depending on applications selected for deployment to the environment. Of course, the costs of deploying applications are not avoided over the long term of the project, only delayed to a later phase when they are needed.

The annual costs for O&M of an ISF cloud environment, again assuming 50 user accounts, would be between $775k for the environment with no NWM applications or content and $1,665k for the

environment with NWM applications or content fully installed. The difference reflects license costs of COTS software applications and additional labor related to support for NWM applications. As with the startup costs, these cost estimates are dependent on customer choices like number of user accounts and the COTS application to be deployed, so annual costs could be adjusted and prioritized within that range of $$775k to $1,665k, depending on applications selected for deployment to the environment at the time.

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ACRONYMS AND DEFINITIONS

Abbreviation	Definition
ATO	Authority to Operate
COTS	commercial off-the-shelf
CDIS	Controlled Documents Information System
CIC	Consistency in Communications
CSITS	Curatorial Sample Inventory & Tracking System
DAR	Document Action Request
DIRS	Document Input Reference System
DOE	U.S. Department of Energy
DOE-NE	DOE Office of Nuclear Energy
ES&H	Environment Safety & Health
FedRAMP	Federal Risk and Authorization Management Program
FOIA	Freedom of Information Act
ISF	Interim Storage Facility
LA	license application
LM	DOE Office of Legacy Management
LSN	Licensing Support Network
MS	Microsoft
NWM	nuclear waste management
OCIO	DOE Office of the Chief Information Officer
OGC	DOE Office of General Counsel
PII	personal identifiable information
QA	quality assurance
QARD	Quality Assurance Requirements and Description
RAI	Request for Additional Information
RDMS	Records and Document Management System
SCM	Software Configuration Management
SNF	spent nuclear fuel
TDMS	Technical Data Management System
TIC	Technical Information Center
TSERVE	Training Server
YMP	Yucca Mountain Project

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APPENDIX A. SPECIFIC APPLICATIONS AND ISF IMPLEMENTATION

This Appendix discusses each NWM Cloud application, its specific requirements basis, its software licensing requirements, its readiness for implementation for an ISF, and an assessment of potential alternatives that an ISF project might consider in addressing its requirements and objectives.

A.1. SCM (Software Configuration Management)

Requirements sources: This is a suite of tools that manage both quality affecting and non-quality affecting software under configuration management. It provides a graded approach to identifying, developing, and updating software for both general business purposes and for technical work under the QARD (DOE 2009). The requirements sources that make this set of applications necessary include:

- DOE QARD—Supplement I, Software
    - IT-PRO-0011, Software Management
    - IT-PRO-0022, Software Configuration Management

ISF Program Priority: 1. Early (preliminary organization startup)—General functions are prerequisite to installation of ISF-specific software systems.

Data content: Specific to each new domain only; would be populated as part of startup and as applications are installed and validated in the new domain.

Readiness for use: Ready immediately when established in the new domain during cloud domain setup.

Software licensing: The necessary tools are largely supplied natively by the Azure cloud environment (Azure DevOps), but software management is also supported with open-source tools (no fees) and Ansible, which has an enterprise-level license accounted in cloud hosting costs.

Comments: The Software Configuration Management suite of tools would be established at initiation of the ISF cloud environment as an enabling function of the rollout and maintenance of all system software. Access to the system tools is provided only to cloud system administrators. All information available to the general user and the organization at large and records required by software management procedures is generated by reports from the system and then posted for general information and submitted to the records system.

Alternatives: Many of the primary functions of SCM are provided natively by Azure Cloud tools, and using alternatives for those functions would be unfeasible or disadvantageous. Other tools could be implemented to do the same work. Obviously, in the case of the free open-source tools being implemented, no cost advantages can be obtained by choosing an alternative software. Where COTS tools like Ansible are being implemented, there is no great cost advantage or disadvantage to adopting an alternative, but the analytical effort and development time required to select such alternatives and then implement and validate them as meeting the requirements is likely to outweigh any advantage gained.

These tools represent fully modern technology. The NWM Cloud team believes that the key features of SCM system are optimized for this use in this environment. However, user management and reporting tools copied from the old system as is (e.g., the historical Access databases that delivered procedurally required reports) could be improved or automated, but such automations and reports would rely in part on a definition of an organization and roles that don't currently exist, and these improvements went beyond the scope of the NWM Cloud charter.

The NWM Cloud team believes that the key features of SCM system are optimized for this use in this environment. However, user management and reporting tools copied from the old system as is (e.g., the historical Access databases that delivered procedurally required reports) could be improved or automated, but the effort to do that went beyond the scope of the NWM Cloud charter.

A.2. Email categorization (Records/LSN email plug-in)

Requirements sources: This is an email (MS Outlook) plug-in that is derived from two independent requirements sources. Primarily, it implements federal records requirements and quality assurance records requirements by serving as a tool that categorizes and dispositions email in a way that allows the email system to serve as official repository of federal records. Secondarily, it categorizes email for future litigation support and discovery during NRC's adjudicatory hearings. In its current configuration it implements DOE OGC's direction (Otis 2003) for implementation of Licensing Support Network (LSN) categorization requirements under 10 CFR Part 2 Subpart J, and could readily be adjusted to anticipate the less-defined requirements of 10 CFR Part 2 Subpart G. The requirements sources that make this application necessary include:

- **10 CFR Part 72.174, Quality Assurance Records.** The licensee, applicant for a license, certificate holder, and applicant for a CoC shall maintain sufficient records to furnish evidence of activities affecting quality. The records must include the following: design records, records of use, and the results of reviews, inspections, tests, audits, monitoring of work performance, and materials analyses. The records must include closely related data such as qualifications of personnel, procedures, and equipment. Inspection and test records must, at a minimum, identify the inspector or data recorder, the type of observation, the results, the acceptability, and the action taken in connection with any noted deficiencies. Records must be identifiable and retrievable. Records pertaining to the design, fabrication, erection, testing, maintenance, and use of structures, systems, and components important to safety must be maintained by or under the control of the licensee or certificate holder until the NRC terminates the license or CoC.
- DOE QARD, Section 17, Quality Assurance Records.
    - AP-17.3Q, Managing Electronic Mail Records
- **10 CFR Part 2 discovery requirements**, derived specifically from 10 CFR 2 Subpart J, Procedures Applicable to Proceedings for the Issuance of Licenses for the Receipt of High-Level Radioactive Waste at a Geologic Repository (with exemptions defined generally by FOIA exemptions derived from various statutory sources)

ISF Program Priority: 1. Early (preliminary organization startup)—This system is important to establish as early as feasible during startup to capture all required records, which includes email correspondence prior to establishment of the QA program.

Data content: None: only categories implemented by the system; categorization data is added to the email system itself (MS Outlook)

Readiness for use: Ready for use shortly after email system is configured in the new domain. Can be reconfigured with new categories for future relevance to NRC proceedings and withholding definitions, if desired.

Software licensing: Single one-time purchase for enterprise license of Titus.

Comments and analysis: This system is an email plug-in that, on sending email from the system or opening incoming email from outside the system, requires users to categorize the emails for QA status, for federal records status, and for potential relevance for future NRC licensing proceedings. If not implemented promptly, a potentially major project for categorization and screening would later have to be undertaken on the accumulated collection of uncategorized records.

Alternatives: The Titus tool represents fully modern technology. Alternatives are unlikely to provide cost or functional advantage, and the NWM Team identified no opportunities for improvement. For those reasons, the NWM Cloud Team considers this application to be optimized for its intended use.

A.3. RDMS/RISweb (Records and Document Management System)

Requirements sources: The Records Document Management System (RDMS) supports records management from submittal to disposition or transfer. The RDMS enables the capture, electronic processing, indexing, review, maintenance, search, and retrieval of both electronic and physical project records. The requirements sources that make this application necessary include:

- **10 CFR Part 72.174, Quality Assurance Records**. The licensee, applicant for a license, certificate holder, and applicant for a CoC shall maintain sufficient records to furnish evidence of activities affecting quality. The records must include the following: design records, records of use, and the results of reviews, inspections, tests, audits, monitoring of work performance, and materials analyses. The records must include closely related data such as qualifications of personnel, procedures, and equipment. Inspection and test records must, at a minimum, identify the inspector or data recorder, the type of observation, the results, the acceptability, and the action taken in connection with any noted deficiencies. Records must be identifiable and retrievable. Records pertaining to the design, fabrication, erection, testing, maintenance, and use of structures, systems, and components important to safety must be maintained by or under the control of the licensee or certificate holder until the NRC terminates the license or CoC.
- DOE QARD, Section 17, Records Management
    - AP-17.1Q, Records Management
    - RM-PRO-1002, Processing Records

ISF Program Priority: ***1. Early (preliminary organization startup)***—This system is important to establish as early as feasible during startup to capture all required records, which includes program documentation and correspondence prior to establishment of the QA program.

Data content: Existing data retained, as explained in the comments below.

Readiness for use: Under the assumptions outlined below, the RDMS system would be ready for use immediately, requiring only assignment of administrative roles and granting user access. This would be established as part of ISF team startup and available for implementation even before the first ISF-specific applications. Ready upon completion of NWM implementation, and available to any user.

Software licensing: Based on OpenText Content Suite, with additional OpenText add-on components (e.g., Brava) that provide records processing and automation functions. Enterprise licensing begins at 2,000 seats, but the price structure makes that enterprise license the least cost option at approximately 65 seats. As described in the comments below, this software would only be needed in one instance, with access provided to all NWM domain and ISF domain users.

Comments and analysis: Based on the assumption that the existing records in the NWM system are DOE nuclear waste management records (OCRWM or its successor organization) and that the purpose of the records system is, first, to fulfill ongoing federal obligations under the Federal Records Act and NARA requirements and, second, to meet OCRWM quality assurance requirements under the NRC regulations and the QARD, the NWM Cloud team recommends maintaining the RDMS as one continuous system, managed by whatever program is active (or however else DOE might choose to assign it or contract it). In addition to fulfilling DOE's federal records obligations under the law in the most straightforward way, this approach has administrative efficiencies and cost advantages:

- It allows DOE's federal records responsibilities for nuclear waste management to be consolidated—presumably under one contractor—rather than distributed to potentially multiple contractors.
- It provides all records from multiple programs to be available to program's participants in one location, available with one search.
- It reduces costs by having only one system to purchase, maintain, and operate rather than one for each potential project.

Alternatives: The NWM Cloud team selected the OpenText Content Suite via a competitive procurement. The OpenText Content Suite system was chosen partially because it is the modern version of the software used to build the original YMP RDMS system, which helped to streamline the migration of data from the old system to the new one, suggesting effort and risks involved in migration of the legacy data to the new system could be minimized, the team recognized OpenText Content Suite as competitive with others, and likely would have been the preferred choice even if old data did not need to be migrated to the new system.

The Content Suite platform represents fully modern technology, used widely in government and industry. Alternatives are unlikely to provide cost or functional advantage.

Building a records system from scratch would represent a major analytical effort to confidently establish a system with workflows, controls, and audit features that were demonstrated to meet requirements. In fact, the easiest path to determine that requirements were met would be to compare it against the NWM Cloud system.

For those reasons, the NWM Cloud Team considers this application to be optimized for its intended use.

The alternative approach of implementing the OpenText Content Suite application for ISF records only using the required configurations, as implemented in the NWM RDMS, is feasible. It would involve copying the application components, including workflow modules, add-ons, and databases, and removing all NWM Cloud data. In addition to the costs involved in establishing that empty ISF records system, it would require purchasing and maintaining additional licenses (potentially twice as many, doubling the licensing costs), and increase DOE records management and IT system administration costs.

Since the records management processes already separate records by "location" or source, records for an ISF project would be uniquely identified within the NWM RDMS, and could be readily searched, retrieved, managed, and dispositioned as a separate collection, so in that respect there is not an advantage to be gained from an ISF-only RDMS.

A.4. CDIS (Controlled Documents Information System)

Requirements sources: Controlled Document Information System (CDIS) is a database management system that implements QA requirements for document control. It identifies the current revision and change level and status of documents. The system manages the controlled distribution process. The system ensures that all document revisions and changes are traceable. Each controlled document is assigned a Document Status which is a designation indicating its use or limits of use (e.g., Active, Draft, Superseded, Cancelled, Historical). The requirements sources that make this application necessary include:

- **10 CFR Part 72.152, Document control.** The licensee, applicant for a license, certificate holder, and applicant for a CoC shall establish measures to control the issuance of documents such as instructions, procedures, and drawings, including changes, which prescribe all activities affecting quality. These measures must assure that documents, including changes, are reviewed for adequacy, approved for release by authorized personnel, and distributed and used at the location where the prescribed activity is performed. These measures must ensure that changes to documents are reviewed and approved.
- DOE QARD, Section 6, Document Control
    - RWDC-PRO-006, *Document Control* (DOE)
    - RM-PRO-2001, *Document Control* (M&O, administration of system)

ISF Program Priority: 1. Early (preliminary organization startup)—Establishing Document Control is an initiating condition for establishing a QA program, documenting an organization, and publishing QA policies, directives, and procedures. It is therefore a prerequisite for performing any quality-affecting technical work.

Data content: Specific to each new domain only. Legacy data would need to be cleared out to provide an empty database for new content.

Readiness for use: Ready once the system is provisioned and configured, data is cleansed, and a readiness check has been passed.

Software licensing: None. The application reuses the original code, modernized and implemented with the SQL server platform provided by the Azure Cloud.

Comments and analysis: The NWM Cloud team considered this system as among the applications most in need of rework and potentially the least flexible for future change. However, those issues arise because this application is very closely aligned with an unusually complex set of requirements for document control (e.g., many document types and a multitude of revision types and change processes to manage). It is likely that any system implementing these complex requirements with this level of rigor would be challenging to implement and maintain, so the NWM Cloud team cautions against lightly abandoning the CDIS application in favor of alternatives. If details of the requirements change (e.g., streamlining the procedures by increasing common rules and increasing rigidity in the process to result in fewer exceptions and complications), it might be easier to consider an alternative approach.

Alternatives: Recognizing the caveats noted in the comments above, the NWM Cloud team recognizes a potential opportunity to implement an ISF document control application in the OpenText Content Suite, which supports RDMS records. The OpenText Content Suite might plausibly be configured to support document control, given enough time and money for development. This could potentially automate processes between document control and records submittal. Such a decision would require careful research before beginning.

Another alternative would be to procure and configure another COTS document control tool. However, the cost of alternative COTS software and the cost of the analytical and configuration work to ensure that it met requirements would probably outweigh any benefit provided by an alternative system, especially if it provided no additional integration advantages.

A.5. TSERVE (Training Server)

Requirements sources: TSERVE is a Learning Management System that supports the Training Program with functions including: (1) tracking training assignments; (2) validating current status of individuals' qualifications and certifications (both internal and external certifications); (3) validating reporting training requirements and certification status by individual, job function, or organization; (4) validating recording training completion data; (5) maintaining metadata on lesson plans, courses, students, training histories, and schedules; and (6) hosting or linking to computer-based-training courses and registering completion. The requirements sources that make this application necessary include:

- **10 CFR Part 72.144(d),** [**Quality Assurance Program**] The licensee, applicant for a license, certificate holder, and applicant for a CoC shall provide for indoctrination and training of personnel performing activities affecting quality as necessary to ensure that suitable proficiency is achieved and maintained.

- DOE QARD, Section 2. Quality Assurance Program: Section 2.2.11 Personnel Indoctrination, Training, Qualification, and Certification
    - TQ-PRO-1005, *Training Development*
    - TQ-PRO-1006, *Training Implementation*
    - TQ-PRO-1008, *Training Program Descriptions*

ISF Program Priority: 2. Initial QA Implementation—Establishing a training program is an initiating condition for establishing a QA program, and planning for and documenting the attainment of required proficiencies for performing quality affecting work. In addition, training is a key requirement for generic organizational requirements, communicating and confirming understanding of federal and contractor policies, as well as cybersecurity. The training program, facilitated with the TSERVE application, is therefore needed to support establishing a nuclear waste management organization as well as a prerequisite for performing any quality-affecting technical work.

Data content: Specific to each new domain only. As noted above, the legacy training data was retained in a database archive and training records preserved in the records system.

Readiness for use: Ready once system is installed and system is validated for use. (There is no existing data in the NWM version to remove.)

Software licensing: TSERVE is implemented in a COTS Learning Management System, Prosperity LMS, licensed by Ziiva, Inc. Licensing is on a per user basis with a minimum number of 500 seats.

Comments and analysis: Learning Management Systems like the version licensed from Ziiva are somewhat standardized technology in terms of the functionality provided by the software. The systems generally support the development and publication of training modules, organizational and job-specific training plans, scheduling of classroom training, support for online computer-based-training modules, and capturing employee training records. All of them represent an advancement over the Legacy software. The discriminating factors tend to be network compatibility, price, and perhaps differences in licensing models.

Alternatives: Given the commonality of features in Learning Management Systems, there are certainly many feasible alternatives to the Prosperity LMS platform. Because there is no Legacy data to maintain, constraints derived from the need to maintain existing data aren't an issue. A project contractor may have a system that could support the training program just as effectively, and such a system might be preferred on the basis of its familiarity to their training program administrators.

However, even though such alternatives are feasible, the Prosperity LMS application represents fully modern technology and can readily support a nuclear QA Training Program. Alternatives are unlikely to provide significant cost or functional advantage, and the NWM Team identified no opportunities for improvement. For those reasons, the NWM Cloud Team considers this application to be optimized for its intended use even though it is recognized that future factors, such as a pre-existing familiarity of use with another application, could reasonably lead to selection of another tool.

A.6. CAP (Corrective Action Program System)

Requirements sources: The Corrective Action Program (CAP) system is an application that allows issues to be raised by any project participant, have them screened for significance, planned for resolution, and tracked until they are corrected and confirmed to be complete. It includes automated notifications to the relevant organizational authorities for review and actions, as appropriate. The system facilitates identification of trends in similar issues and similar causes. The requirements sources that make this application necessary include:

- **10 CFR Part 72.172, Corrective Action.** The licensee, applicant for a license, certificate holder, and applicant for a CoC shall establish measures to ensure that conditions adverse to quality, such as failures, malfunctions, deficiencies, deviations, defective material and equipment, and nonconformances, are promptly identified and corrected. In the case of a significant condition identified as adverse to quality, the measures must ensure that the cause of the condition is determined and corrective action is taken to preclude repetition. The identification of the significant condition adverse to quality, the cause of the condition, and the corrective action taken must be documented and reported to appropriate levels of management.
- DOE QARD, Section 16. Corrective Action
    - AP-16.1Q, *Condition Reporting and Resolution*
    - AP-16.7Q, *OCRWM Trend Program*

ISF Program Priority: 2. Initial QA Implementation—A Corrective Action Program is a key component of QA program, serving as a means to identify and document issues, track the issue resolution, and identify trends and recurring issues for additional scrutiny. It also serves as a key component of a nuclear safety culture and a Safety Conscious Work Environment.

Data content: Specific to each new domain only. Legacy data would need to be cleared out to provide an empty database for new content.

Readiness for use: Ready once the system is provisioned and configured, data is cleansed, and a readiness check has been passed.

Software licensing: This system is developed in the Business Performance Improvement (BPI) System software licensed by Qualitech. Licensing is on a per user basis, providing access to both the CAP application and the Lessons Learned/Operating Experience application.

Comments and analysis: The CAP system supports a very complex workflow that (1) enables conditions to be identified by anyone on the project; (2) screening for significance in relation to safety and quality; (3) cause analysis and planning for corrective actions; (4) implementation and documentation of corrective actions; (5) review and closure; (6) auditable documentation of all checks and approvals; and (7) trend identification and analysis of recurring and related issues. The software is used to support both the CAP application as well as the Lessons Learned/Operating Experience application outlined in Section A.21 and to help integrate them together, as was envisioned in the prior processes but not accomplished in the Legacy software.

Alternatives: The CAP application represents fully modern technology and fully supports a nuclear Corrective Action Program. Alternatives are unlikely to provide cost or functional advantage, and the NWM Team identified no opportunities for improvement. For those reasons, the NWM Cloud Team considers this application to be optimized for its intended use.

A.7. CSITS (Curatorial Sample Inventory & Tracking System)

Requirements sources: The requirements sources that make this application necessary include:

- DOE QARD Supplement II, Sample Control
  - TST-PRO-008, *Sample Control*
  - TST-PRO-011, *Sample Examination, Allocation, and Archival at the Sample Management Facility*

ISF Program Priority: 2. Initial QA Implementation—The Curatorial Sample Inventory & Tracking System must be in place to when samples are collected for formal site characterization under a QA program.

Data content: Specific to each new domain only; Legacy data would need to be cleared out to provide an empty database for new content.

Readiness for use: Ready once the system is provisioned and configured, data is cleansed, and a readiness check has been passed.

Software licensing: None. The application reuses the original code, modernized and implemented with the SQL server platform provided by the Azure Cloud.

Comments and analysis: The Curatorial Sample Inventory and Tracking System (CSITS) database contains inventory and usage data for scientific samples, documenting and tracking sample possession from sample collection and identification through handling, preservation, shipment, transfer, analysis, storage, and final use. It ensures that samples are always traceable from their collection through final use. It supported operations at the Sample Management Facility at the site.

Alternatives: The NWM Cloud Team considers replacement of this system with cost-effective alternative for the ISF project to be difficult. The NWM Cloud Team investigated a number of COTS Laboratory Information Management Systems and concluded that most of them would not readily support site geologic samples unless they were products oriented to oil and gas exploration and development, and those systems included many additional unneeded features and complications, and their costs were exorbitant. While the functions of the modernized CSITS application can probably be provided with alternative applications, it is unlikely that they would be as cost effective as CSITS.

A.8. TDMS (Technical Data Management System)

Requirements sources: The TDMS is a technical data library containing developed and acquired data, along with the information about the technical data including qualification status and limitations or constraints on use of the data. The requirements sources that are reflected in this system:

- DOE QARD Supplement III, Scientific Analysis
  - AP-SIII.3Q, *Submittal of Data to the Technical Data Management System*
  - TST-PRO-001, *Submittal and Incorporation of Data to the Technical Data Management System*
- NUREG-1298, *Qualification of Existing Data for High-Level Nuclear Waste Repositories*
- NUREG-1636, *Regulatory Perspectives on Model Validation in High-Level Radioactive Waste Management Programs: A Joint NRC/SKI White Paper*, particularly Section 3, "Model Validation Approach from a Regulatory Perspective."

ISF Program Priority: 2. Initial QA Implementation—The Technical Data Management System supports collection and management of data and supports model development and use, ensuring data traceability to its associated documentation and qualification status. When an ISF project begins collecting data, this system should be in place.

Data content: Specific to each new domain only. Legacy data would need to be cleared out to provide an empty database for new content.

Readiness for use: Ready once the system is provisioned and configured, data is cleansed, and a readiness check has been passed.

Software licensing: None. The application reuses the original code, modernized and implemented with the SQL server platform provided by the Azure Cloud.

Comments and analysis: The TDMS is a complex application, managing data stored directly in database tables as well as in native data files stored in a file server. It includes GIS mapping data, modeling data including input and output files, engineering data, and testing and monitoring data of many types and sources.

Alternatives: The NWM Cloud Team considers replacement of this system with an alternative for the ISF project to be difficult. The system is very complicated, which makes replacing it with a COTS system with all its features and categories unlikely. Simplifying the data management processes and requirements to enable its replacement with a less complicated COTS system would be a challenging requirements analysis effort, with significant regulatory uncertainty and risk, and it may not be successful. The cost of alternative COTS software and the cost of the analytical and configuration work to ensure that it met requirements would probably outweigh any benefit provided by an alternative system.

A.9. DIRS (Document Input Reference System)

Requirements sources: The Document Input Reference System (DIRS) provided access, automation, and tracking of document references (technical product inputs) information. Key functions of the system included: (1) recording and tracking inputs referenced in detail (i.e., individual citations and their purposes) within technical documents being prepared for publication; (2) maintaining input status values of potential inputs, reflecting potential limitations or constraints (e.g., TBD/TBVs) on further use; (3) compiling and generating a bibliography for a technical document based on entering cited references into the database; (4) generating "Impact Reports" of

references used by other documents to discover document linkages and statuses and identify changes and impacts that might require notifications to the regulator. The requirements sources that make this application necessary include:

- **10 CFR 72.146 Design control**. (a) The licensee, applicant for a license, certificate holder, and applicant for a CoC shall establish measures to ensure that applicable regulatory requirements and the design basis, as specified in the license or CoC application for those structures, systems, and components to which this section applies, are correctly translated into specifications, drawings, procedures, and instructions. These measures must include provisions to ensure that appropriate quality standards are specified and included in design documents and that deviations from standards are controlled. Measures must be established for the selection and review for suitability of application of materials, parts, equipment, and processes that are essential to the functions of the structures, systems, and components which are important to safety. (b) The licensee, applicant for a license, certificate holder, and applicant for a CoC shall establish measures for the identification and control of design interfaces and for coordination among participating design organizations. These measures must include the establishment of written procedures among participating design organizations for the review, approval, release, distribution, and revision of documents involving design interfaces. The design control measures must provide for verifying or checking the adequacy of design by methods such as design reviews, alternate or simplified calculational methods, or by a suitable testing program….
- **10 CFR 72.11, Completeness and accuracy of information**
- **10 CFR 72.48, Changes, tests, and experiments**
- **10 CFR 72.70, Safety analysis report updating**
- QARD Section 3. Design Control
    - SCI-PRO-004, *Managing Technical Product Inputs*

ISF Program Priority: 2. Initial QA Implementation—The Document Input Reference System (DIRS) must be in place to establish configuration management for design and performance assessment.

Data content: Specific to each new domain only. Legacy data would need to be cleared out to provide an empty database for new content.

Readiness for use: Ready once the system is provisioned and configured, data is cleansed, and a readiness check has been passed.

Software licensing: None. The application reuses the original code, modernized and implemented with the SQL server platform provided by the Azure Cloud.

Comments and analysis: The DIRS application fulfills a very complex set of requirements for configuration management and impact analysis (e.g., it includes unique categories for qualification status of developed and acquired data and complex relationships derived from document control). In addition, it includes a custom catalog of bibliographic reference types and formats and a

verification process that is not likely to be included in COTS engineering configuration management software.

Alternatives: The NWM Cloud Team considers replacement of this system with an alternative for the ISF project to be difficult. The system is very complicated, which makes replacing it with a COTS system with all its features and categories unlikely. Simplifying the reference requirements to enable its replacement with a less complicated COTS system would be a challenging requirements analysis effort, with significant regulatory uncertainty and risk, and it may not be successful. The cost of alternative COTS software and the cost of the analytical and configuration work to ensure that it met requirements would probably outweigh any benefit provided by an alternative system.

If the CDIS document control system were to be implemented in the OpenText Content Suite platform (an alternative approach raised in Section A.4), there might also be an opportunity for alignment or integration between CDIS and DIRS. It might be worth investigating, but it is doubtful that all the functions and features of DIRS would be easily implemented in OpenText.

A.10. Requirements Management System/DOORS

Requirements sources: The requirements sources that made this application necessary include:

- **DOE O 226.1A, Implementation of Department of Energy Oversight Policy Directives**
- **DOE O 250.1, Civilian Radioactive Waste Management Facilities-Exemption from Departmental Management Requirements**
- **DOE O 251.1C, Departmental Directive Program**
- **DOE O 252.1, Technical Standards Program**
- **DOE P 450.2A, Identifying, Implementing and Complying with Environment, Safety and Health Requirements**
    - RWRQ-PRG-001, *Requirements Management Program Description*
    - RWRQ-PRO-001, *OCRWM Requirements Management*
    - LP-REG-002-OCRWM, *Identification and Maintenance of Monitored Geologic Repository Systems Requirements*
- **10 CFR 72.146, Design Control** (not implemented as part of design control previously, but could be utilized that that purpose for potential later-phase construction and operation of an ISF)

ISF Program Priority: 2. Initial QA Implementation—The Requirements Management System, as implemented in IBM's Rational Dynamic Object-Oriented Requirements System (Rational DOORS, formerly Telelogic DOORS), must be in place to confirm accurate and complete disposition of all program requirements. As implemented previously, DOORS requirements management might be viewed as the last confirmatory step of initial QA implementation, demonstrating that initial QA requirements are being fully implemented and identifying what remains to be completed to attain a mature QA organization and satisfy regulatory and DOE policy requirements.

It is worth noting that other nuclear QA programs use DOORS as part of a detailed QA design control program, instead of using a requirements documents and other interface control documents. Use of this system in that capacity should be considered when planning QA implementation for operations.

Data content: Specific to each new domain only. Legacy data may be useful as a starting point, due to some common requirements, so it might be best to maintain existing information and establish requirements baseline by deletion first and then addition as part of the initial review and implementation.

Readiness for use: Ready once the system is provisioned and configured and a readiness check has been passed. If legacy data is to be removed prior to use, it should be removed before validation.

Software licensing: The per-user licensing model is appropriate for a small user group only, not general access. This is consistent with prior use, where the requirements management group maintained the DOORS system, while making information available for external review through reports output from the system.

Comments and analysis: The DOORS software is unmodified and requires no customizations for use in supporting any DOE projects. The system data (i.e., the requirements and their allocations to the project implementing procedures and documents) can be reused and updated for specific needs if desired. For example, QA requirements can be updated from the 10 CFR Part 63 source to the equivalent 10 CFR Part 72 source and then associated with the new implementing mechanisms appropriate for QA activities on a storage project. In that way, the prior requirements intelligence can be repurposed and updated for a new project rather than reassembled from square one.

The implementation of DOORS for requirements management was never fully completed for the YM repository project. As noted above, it might find further utility in addressing the design control requirements of 10 CFR 72.146 at during the construction or operations of an ISF.

Alternatives: Because the data may be useful to but is not directly required by an ISF project, and because the software itself has no unique features that must be preserved for an ISF project, alternatives to Rational DOORS could be selected based on the preferences of future users. However, the software is widely used in similar nuclear engineering requirements management applications, and NWM Cloud Team cannot identify any equivalent options that might be preferred.

A.11. Correspondence Control and Correspondence Tracking Systems

Requirements sources: These tools do not directly fulfill any QA or regulatory requirements, they implement processes outlined by a variety of administrative procedures, including those guiding interactions between OCRWM and the NRC and Nuclear Waste Technical Review Board, which refer to use of these systems, and they help to formalize contractually obligated communications.

ISF Program Priority: 3. Public Communications/Develop Business Organization—These correspondence control systems are enabling tools for public communications as well as internal communications and inter-agency communications. It is a fundamental function required when

public engagement begins and when DOE begins interacting with regulators and other external oversight.

Data content: Specific to each new domain only; Legacy data would need to be cleared out to provide an empty database for new content.

Readiness for use: Ready once the system is provisioned and configured, data is cleansed, and a readiness check has been passed.

Software licensing: This system is developed in MS Power Apps, which is licensed on a per-user basis that allows each user to run all applications developed in Power Apps.

Comments and analysis: Originally implemented in Lotus Notes databases, these correspondence control systems route correspondence for awareness, review, or approval from the appropriate parties before it is sent and/or capture incoming correspondence in a centralized library and route items to the appropriate recipients. In concert with Consistency in Communications protocols and the Communications Action Tracking system, they help ensure that information shared with state and local governments as well as interested members of the public are accurate and managed in a timely, consistent, and effective manner. This application is a simple review and approval application. It captures the review options and approval authorities in the original system. It was not especially difficult to rebuild and would not be difficult to replace or reconfigure if different review and approval processes were to be implemented or if such tools were to be implemented in a different platform.

Alternatives: As noted above, the specific functions of this custom application are not unique or difficult to reproduce. If there were opportunities or needs for integration with other introduced systems, such as a Customer Relationship Management system for stakeholder engagement, this system could relatively easily be developed using a different approach to integrate with those systems, or its functions could be implemented inside those applications. The cost to purchase, develop, or integrate those alternatives may be significant.

A different alternative approach could be to pursue integration opportunities that might be found be replacing the MS Power Apps system with workflows in the OpenText Collection Server platform, which readily supports document development, review, and approval workflows. These workflows would not be part of the RDMS records system, but the shared platform could streamline records submittal of relevant correspondence. That approach would require no additional software purchases, but it would require the time and effort to rebuild the correspondence control workflows.

A.12. Consistency in Communications (CIC) Automated Review System

Requirements sources: The Consistency in Communications (CIC) Automated Review System does not directly fulfill any QA or regulatory requirements; it implements DOE information management policies and requirements, and it implements processes outlined by a variety of administrative procedures, including:

- DOE G 241.1-1A, Guide to the Management of Scientific and Technical Information
- DOE Order 24l.1A, Scientific and Technical Information Management

- DOE Order 1340.1B, Management of Public Communications Publications and Scientific, Technical, and Engineering Publications
    - POL-RW-2003-003, *Consistency in Communications Policy*
    - DM-PRO-003, *Review and Approval for Release of Technical and Nontechnical Products to the Public*

ISF Program Priority: 3. Public Communications/Develop Business Organization—The CIC Automated Review System is an enabling tool for public communications, part of a suite of information management and information security functions that are needed when public engagement begins.

Data content: Specific to each new domain only; NWM data would need to be cleared out to provide an empty database for new content.

Readiness for use: Ready once the system is provisioned and configured, data is cleansed, and a readiness check has been passed.

Software licensing: This system is developed in MS Power Apps, which is licensed on a per-user basis that allows each user to run all applications developed in Power Apps.

Comments and analysis: Originally implemented in a Lotus Notes database, the Consistency in Communications (CIC) Automated Review System is a tool that reviewed and authorized public release all materials for a public audience (e.g., presentation slides, posters, and articles as well as technical reports to be released to the public), in a process much like the Sandia "R&A" review and approval process. It is a simple review and approval application. It captures the review categories and options and approval authorities from the original process and the supporting system. It was not especially difficult to rebuild; it would be very easy to reconfigure if different review and approval processes were to be implemented; it would not be difficult to replace if such tools were to be implemented in a different platform.

Alternatives: As noted above, the specific functions of this custom application are not unique or difficult to reproduce or replace. The cost to purchase, develop, or integrate those alternatives may be significant. However, integration opportunities might be found by replacing the MS Power Apps application with workflows in the OpenText Collection Server platform, which readily supports document development, review, and approval workflows. These workflows would not be part of the RDMS records system, but the shared platform might streamline records submittal of relevant documents. That approach would require no additional software purchases, but it would require the time and effort to rebuild the correspondence control workflows.

Some of these functions of might also be incorporated into a Customer Relationship Management–like system for stakeholder engagement, which could probably include features that could replace this system; if a CRM were purchased for other purposes, the management of public release review for communications could be implemented in that framework, rather than in this stand-alone tool.

A.13. Communications Action Tracking

Requirements sources: The Communications Action Tracking system does not directly fulfill any QA or regulatory requirements; it implements DOE information management policies and requirements, and it implements processes outlined by a variety of administrative procedures, including:

- NP-DSK-1019, *Use and Maintenance of the Master Communications Database/Calendar*

ISF Program Priority: 3. Public Communications/Develop Business Organization —The Communications Action Tracking system is an enabling tool for public communications, part of a suite of functions that are needed when public engagement begins. This tool ensures that public requests for information are provided a timely response with input from the correct resources.

Data content: Specific to each new domain only; NWM data would need to be cleared out to provide an empty database for new content.

Readiness for use: Ready once the system is provisioned and configured, data is cleansed, and a readiness check has been passed.

Software licensing: This system is developed in MS Power Apps, which is licensed on a per-user basis that allows each user to run all applications developed in Power Apps.

Comments and analysis: Originally implemented in a Lotus Notes database, the Communications Action Tracking system is a simple action tracking tool that documents comments and questions from stakeholders including elected members of government, press inquiries, advocacy groups, and individual members of the public received via mail, email, telephone, or walk-in visits to public information centers. It routes them for review and response in a process managed by communications staff. It was not especially difficult to rebuild and would not be difficult to replace or reconfigure if different review and approval processes were to be implemented or if such tools were to be implemented in a different platform.

Alternatives: As noted above, the specific functions of this custom application are not unique or difficult to reproduce. A Customer Relationship Management system for stakeholder engagement, would probably include features that could replace this system; if a CRM were purchased for other purposes, the communications action tracking functions should probably be implemented in that framework, rather than in this stand-alone tool.

Integration opportunities might also be found be replacing the MS Power Apps system with workflows in the OpenText Collection Server platform, which readily supports document development, review, and approval workflows. These workflows would not be part of the RDMS records system, but the shared platform might streamline records submittal of relevant correspondence. That approach would require no additional software purchases, but it would require the time and effort to rebuild the correspondence control workflows.

A.14. ES&H Electronic Manual

Requirements sources: The Environmental, Safety, and Health (ES&H) Electronic Manual is a virtual compilation of all ES&H program elements, procedures and other ES&H related documents and program information that implement the ES&H requirements of Federal and state laws, regulations, standards, and U.S. Department of Energy (DOE) directives applicable to DOE OCRWM. The ES&H Electronic Manual does not directly fulfill any QA or NRC regulatory requirements. It implements DOE ES&H policies and requirements and fulfills information requirements and supports processes outlined by a variety of administrative policies and procedures, including:

- **10 CFR Part 851, Energy: Worker Safety and Health Program**
- MIS-CRW-ES-000001*, Safety and Health Manual*
    - SA-PRO-1008, *Hazards Analysis System*
    - EV-PRO-4001, *Environmental Permitting*

ISF Program Priority: 3. Public Communications/Develop Business Organization —The ES&H Electronic Manual Tracking system serves as a foundation for the organization's required ES&H program, part of the environmental and worker safety functions that are required to manage workplace facilities. This tool directs workers to information resources required by DOE and other safety requirements.

Data content: Specific to each new domain only; NWM data would need to be cleared out or updated to provide an empty database for new content.

Readiness for use: Ready once the system is provisioned and configured, data is cleansed, and a readiness check has been passed.

Software licensing: This system is developed in MS Power Apps, which is licensed on a per-user basis that allows each user to run all applications developed in Power Apps.

Comments and analysis: Originally implemented in a Lotus Notes database, the ES&H Electronic Manual is a simple tool to publish ES&H information through a single portal. The software itself has no unique or complex functions that must be preserved for an ISF project; the value of the system is its content (even though that too would need to be revised to be reused). The critical requirements are (1) simple and direct maintainability of that content by ES&H adminstrators and (2) simple and direct access by all project participants. Even though the content is outdated and would have to be updated for an ISF project, it provides a roadmap of what content is necessary in support of a robust safety program, which is key component of a nuclear safety culture.

Alternatives: As noted above, the software itself has no unique or complex features that must be preserved for an ISF project. As a result, the application could be supported by a number of alternative approaches, depending on a future owner's preferences. SharePoint, for example, or any other system allowing content to be maintained by its owner can successfully maintain this content. The key advantage of PowerApps is that it is designed for mobile access, which makes this tool

available anywhere on any device. (SharePoint, for example, can create navigation issues on mobile devices.)

A.15. Incident Log

Requirements sources: During emergency operations, the Incident Log provides a shared electronic log-keeping and communications capability between emergency facilities located, for example, at field sites and various office locations. It also allows the log to be displayed in an Emergency Operations Center and shared in other locations. The requirements sources that make this application necessary and describe its use include:

- **10 CFR Part 851, Energy: Worker Safety and Health Program**
  - AP-EP-001, *Yucca Mountain Project Emergency Operations Center*
  - EM-DSK-4000-2000, *Incident Log Operations*

ISF Program Priority: 3. Public Communications/Develop Business Organization—The Incident Log application supports emergency response operations, both during drills and in actual incident response. It is one of the ES&H functions required to manage workplace facilities.

Data content: Specific to each new domain only; NWM data would need to be cleared out to provide an empty database for new content.

Readiness for use: Ready once the system is provisioned and configured, data is cleansed, and a readiness check has been passed.

Software licensing: This system is developed in MS Power Apps, which is licensed on a per-user basis that allows each user to run all applications developed in Power Apps.

Comments and analysis: Originally implemented in a Lotus Notes database, the Incident Log application was a well-designed system, tailored to the specific purposes of an Emergency Management team on a DOE project with multiple locations. Its workflows and functions have been replicated on the PowerApps platform.

Alternatives: The Incident Log application is not large or particularly complex, so could be rebuilt on a different platform, depending on a future owner's preferences. There are COTS tools for Operations Management, but their cost would not be justifiable, especially considering that they would probably require as much work in configuring to DOE's specific needs as it would take to redevelop the application independently. The PowerApps platform is also particularly advantageous for this Emergency Operations purpose, in that it is designed for mobile access, providing availability anywhere on any device. The NWM Cloud Team sees this tool, therefore, as relatively easy and potentially inexpensive to replace if desired, but recommends the PowerApps implementation in the NWM Cloud as optimized for its use.

A.16. TechLib/TIC (Technical Information Center library)

Requirements sources: This system is necessitated largely by compliance with U.S. copyright law, NRC reference requirements under 10 CFR Part 2 and in support of technical document checking

requirements, and practical library management needs, and it implements processes outlined by administrative procedures including:

- RM-PRO-5001, *Technical Information Center*
- RM-PRO-5002, *Use of Copyright-Protected Materials*

ISF Program Priority: 3. Public Communications/Develop Business Organization—This library management system supports cataloging, ordering, circulation, and subscriptions of copyrighted documents including codes and standards, journal articles, textbooks, and industry publications.

Data content: Existing data retained, under the assumptions explained in the comments below.

Readiness for use: Under the assumptions outlined below, the TechLib/TIC system would be ready for use immediately, requiring only assignment of administrative roles and granting user access. This would be established as part of ISF team startup and available for implementation even before the first ISF-specific applications. Under those assumptions, it would be ready upon completion of NWM implementation and available to any user in the NWM or ISF domains.

Software licensing: Implemented in OpenText Collections Server and Library Management. Currently priced on per-user basis; enterprise licensing may be available, likely on a similar basis to RDMS.

Comments and analysis: The NWM Cloud team views the Techlib database and TIC library collection as a general resource for all DOE's potential nuclear waste management projects. Separating that collection into "archive," "repository," "transportation," and "storage" collections offers no benefit to DOE and the library's potential user community; on the contrary, it would multiply the costs to administer the library collection and maintain multiple IT systems. Because the TIC collection provides indirect support to the technical work, there is no QA requirement direct enough that supporting more than one project organization would be untenable. As with the RDMS system, NWM Cloud team recommends maintaining the Techlib/TIC as one continuous system, managed by whatever program is active (or however else DOE might choose to assign it or contract it). In addition to fulfilling DOE's federal records obligations under the law in the most straightforward way, this approach has administrative efficiencies and cost advantages:

- It allows DOE's technical library needs for nuclear waste management to be consolidated—presumably under one contractor—rather than distributed to potentially multiple contractors.
- It provides a library for all projects in one location, administered with one system.
- It reduces costs by having only one collection, rather than building multiple potentially redundant collections, with just one IT system to purchase, maintain, and operate rather than one for each potential project.

Alternatives: If an ISF project were to build its own separate technical library, the NWM Cloud recognizes a potential opportunity in investigating the possibility of managing it a different COTS library management platform as an option instead of building a new instance of Collections Server

and Library Management. The requirements, schedule, and scope of the NWM Cloud project (i.e., supporting the existing TIC library collection) made OpenText Collections Server and Library Management the appropriate choice, but if an ISF project were to build a technical library of its own, starting with no existing library, the NWM Cloud Team would recommend exploration of implementing the library in a COTS integrated library system, for example a system like SirsiDynix's EOS.web or perhaps an open source solution like Koha (neither of which have been evaluated, but are mentioned here as examples only).

A.17. Automated Forms System

Requirements sources: This system was necessitated largely by practical needs, making a variety of forms—including forms procedurally required by or otherwise specific to the project as well as general DOE forms—available to the workforce. Its use is outlined by administrative procedures including:

- RM-DSK-2001-1001, *Forms Process*

ISF Program Priority: 3. Public Communications/Develop Business Organization —This forms management system serves a mature organization and a variety of procedural documentation, human resources, and employee information needs.

Data content: Specific to each new domain only. Legacy data may be useful as a starting point, providing information value on past content, so it might be best to maintain existing information and establish content by deletion first and then addition as part of the initial review and implementation.

Readiness for use: Ready once the SharePoint application can be installed.

Software licensing: No additional licenses. This system is implemented in SharePoint, which is licensed under the MS Azure and Office 365 licenses.

Comments and analysis: This is the simplest of all the applications retained in the NWM Cloud Project. It is essentially a library of documents maintained by an administrator group for use as needed by project participants. It formerly implemented a forms system based on the eForms Designer (.far) system, but that fell out of use. The system now contains both .far files and forms in MS Word and PDF.

Alternatives: This system is readily replaceable if desired, but there will probably be little advantage to doing so unless its content and function as a library is integrated into another system with broader purposes (e.g., as a non-Q adjunct to document control or another library of workforce information resources).

A.18. DR/CAR

Requirements sources: The DR/CAR database is an application that enables oversight of external contractors who do not participate directly in the Corrective Action Program. This system captures deficiencies and tracks corrective actions through implementation and acceptance. In addition to the regulatory requirements for the Corrective Action Program outlined for the CAP system in

Section A.6 above (i.e., 10 CFR 71.133 and 72.172), the requirements sources that make this application necessary along with the next two outlined below (the Qualified Supplier database and the Suspect/Counterfeit Items database) include:

- **10 CFR 72.154, Control of purchased material, equipment, and services.**
  (a) The licensee, applicant for a license, certificate holder, and applicant for a CoC shall establish measures to ensure that purchased material, equipment, and services, whether purchased directly or through contractors and subcontractors, conform to the procurement documents. These measures must include provisions, as appropriate, for source evaluation and selection, objective evidence of quality furnished by the contractor or subcontractor, inspection at the contractor or subcontractor source, and examination of products upon delivery.
  (b) The licensee, applicant for a license, certificate holder, and applicant for a CoC shall have available documentary evidence that material and equipment conform to the procurement specifications prior to installation or use of the material and equipment. The licensee and certificate holder shall retain or have available this documentary evidence for the life of the ISFSI, MRS, or spent fuel storage cask. The licensee and certificate holder shall ensure that the evidence is sufficient to identify the specific requirements met by the purchased material and equipment.
  (c) The licensee, applicant for a license, certificate holder, and applicant for a CoC, or a designee of either, shall assess the effectiveness of the control of quality by contractors and subcontractors at intervals consistent with the importance, complexity, and quantity of the product or services.
- DOE QARD, Section 7, Control of Purchased Material, Equipment and Services
- DOE QARD, Section 16, Corrective Action
  - LP-16.2Q-OCRWM, *Management of Conditions Adverse to Quality for External Organizations*
  - QA-PRO-1043, *Managing Supplier Condition Reports.*

ISF Program Priority: 4. Mature QA Organization—This is one of the three critical tools that serve as part of a program to manage external suppliers and their compliance with QA standards, and is needed once external suppliers (i.e., contractors beyond the M&O contractor and those subject to direct oversight of the DOE QA program). This need for oversight of purchased material, equipment, and external services is a representative aspect of a mature QA organization. It needs to be in place when an ISF project adds vendors and external contractors doing quality affecting work.

Data content: Specific to each new domain only; NWM data would need to be cleared out to provide an empty database for new content.

Readiness for use: Ready once the system is provisioned and configured, data is cleansed, and a readiness check has been passed.

Software licensing: This system is developed in MS Power Apps, which is licensed on a per-user basis that allows each user to run all applications developed in Power Apps.

Comments and analysis: This application was the most complicated system originally implemented in Lotus Notes and rebuilt by the NMW Cloud project in the PowerApps platform. It represents most of the functions of the CAP system, including identification, screening, planning, review, and closure, but is operated as oversight of external participants.

Alternatives: The DR/CAR application effectively replicates the legacy system and will be a cost-effective way to meet requirements for oversight of vendor and supplier quality assurance. However, the PowerApps platform may create some limitations and constraints on future changes and improvements that might be desired. The NWM Cloud team recognizes a potential opportunity to implement the DR/CAR functions and processes in the Qualitech BPI system as a separate module not implemented in CAP, but within the BPI platform, like LL/OE. The BPI system is designed to support the functions and processes of quality management, and there may be benefits from alignment or integration between DR/CAR oversight and CAP. The existing license being used for CAP and LL/OE could be utilized for DR/CAR with no additional software cost, only IT development costs for configuring the BPI system for the DR/CAR requirements.

A.19. Qualified Supplier List

Requirements sources: The Qualified Supplier List is a Database of authorized suppliers of quality affecting materials and products. In addition to the NRC's regulations for a QA program including control of purchased material, equipment, and services that are outlined for the DR/CAR application Section A.18 above (i.e., 10 CFR 71.115 and 72.154), the process requirements that make this application necessary include:

- DOE QARD, Section 7, Control of Purchased Material, Equipment and Services
- DOE QARD, Section 16, Corrective Action
    - RWQA-PRO-001, *Supplier Evaluation and Maintenance of the Qualified Suppliers List*
    - QA-PRO-1042*, Supplier Evaluation and Qualified Supplier List (QSL) Maintenance*

ISF Program Priority: 4. Mature QA Organization—The Qualified Supplier List is one of the three critical tools that serve as part of a program to manage external suppliers and their compliance with QA standards. This need for oversight of purchased material, equipment, and external services is a representative aspect of a mature QA organization.

Data content: Specific to each new domain only; NWM data would need to be cleared out to provide an empty database for new content.

Readiness for use: Ready once the system is provisioned and configured, data is cleansed, and a readiness check has been passed.

Software licensing: This system is developed in MS Power Apps, which is licensed on a per-user basis that allows each user to run all applications developed in Power Apps.

Comments and analysis: Originally implemented in a Lotus Notes database, the Qualified Supplier List is a relatively simple database, managed by administrators and accessed by users generally for information.

Alternatives: As noted above, the software itself has no unique or complex features and could be supported by a variety of alternative approaches, depending on a future owner's preferences. The key advantage of PowerApps is that it is designed for mobile access, which makes this resource available anywhere on any device. If the DR/CAR system were to be implemented in the BPI system (an alternative approach raised in Section A.18), there might also be an opportunity alignment or integration opportunities between DR/CAR application and other contractor oversight applications if all of them were supported by the BPI system, but it is too soon to determine any clear advantages in doing so.

A.20. Suspect/Counterfeit Items

Requirements sources: In addition to the NRC's regulations for a QA program including control of purchased material, equipment, and services that are outlined for the DR/CAR application Section A.18 above (i.e., 10 CFR 71.115 and 72.154), the requirements sources and procedural processes that make this application necessary include:

- DOE O 414.1C, Attachment 3, Suspect/Counterfeit Items Prevention
- DOE QARD, Section 7, Control of Purchased Material, Equipment and Services
- DOE QARD, Section 16, Corrective Action
    - RWQA-PRO-001, *Supplier Evaluation and Maintenance of the Qualified Suppliers List*
    - QA-PRO-1072, *Suspect/Counterfeit Item Reporting*

ISF Program Priority: 4. Mature QA Organization—The Suspect/Counterfeit Items database is one of the three critical tools that serve as part of a program to manage purchased material and equipment and external suppliers and their compliance with QA standards. This need for oversight of purchased material, equipment, and external services is a representative aspect of a mature QA organization.

Data content: Specific to each new domain only; NWM data would need to be cleared out to provide an empty database for new content.

Readiness for use: Ready once the system is provisioned and configured, data is cleansed, and a readiness check has been passed.

Software licensing: This system is developed in MS Power Apps, which is licensed on a per-user basis that allows each user to run all applications developed in Power Apps.

Comments and analysis: Originally implemented in a Lotus Notes database, the Suspect/Counterfeit Items application is a relatively simple database, managed by administrators and accessed by users generally for information.

Alternatives: As noted above, the software itself has no unique or complex features and could be supported by a variety of alternative approaches, depending on a future owner's preferences. The

key advantage of PowerApps is that it is designed for mobile access, which makes this resource available anywhere on any device. If the DR/CAR system were to be implemented in the BPI system (an alternative approach raised in Section A.18), there might also be an alignment or integration opportunity between DR/CAR application and other contractor oversight applications if all of them were supported by the BPI system, but there are no clear advantages in doing so.

A.21. Lessons Learned/Operating Experiences

Requirements sources: The Lessons Learned/Operating Experience program is a non-QA program. It includes both internally generated Lessons Learned as well as externally facing Operating Experience data. The requirements sources and procedural processes that are the basis for this application necessary include:

- DOE O 210.2A, DOE Corporate Operating Experience Program
    - LP-REG-010-OCRWM, *Managing Operating Experience/Lessons Learned*
    - GM-PRO-3001, *Operating Experience/Lessons Learned Initiation and Coordination*
    - PI-PRO-003, *Operating Experience/Lessons Learned.*

ISF Program Priority: 4. Mature QA Organization—The Lessons Learned/Operating Experience program supports a mature learning organization and is an important component of a nuclear safety culture and a Safety Conscious Work Environment. Though it is a non-QA program, it helps strengthen the Corrective Action Program by reviewing projects and processes and potentially revealing otherwise unidentified conditions.

Data content: Specific to each new domain only; Legacy data would need to be cleared out to provide an empty database for new content.

Readiness for use: Ready once the system is provisioned and configured, data is cleansed, and a readiness check has been passed.

Software licensing: This system is developed in the BPI System software licensed by Qualitech. Licensing is on a per user basis. The software is used to support both the Lessons Learned/Operating Experience tool as well as the CAP Corrective Action Program tool outlined in Section A.6. There is only one license required for both tools.

Comments and analysis: The software is used to support both the Lessons Learned/Operating Experience tool as well as the CAP Corrective Action Program tool outlined in Section A.6. This enables integration not previously enabled in the legacy systems. Specifically, when a Lessons Learned review or Operating Experience information identifies a condition and, as a result, a Condition Report is created they can easily be linked within the system.

Alternatives: The Lessons Learned/Operating Experience application represents fully modern technology and fully supports a robust internal Lessons Learned program and an Operating Experience program that draws data from the nuclear industry and the DOE Complex. Alternatives are unlikely to provide cost or functional advantage, and the NWM Team identified no opportunities for improvement.

For those reasons, and because of the advantageous integration it provides with the CAP program, the NWM Cloud Team considers this application to be optimized for its intended use.

A.22. Technical Products Impact Review Tracking (TPIR)

Requirements sources: This is a nonessential work aid that assists in tracking progress of Impact Review Action Notices associated with technical data. The requirements sources that describe the use of this application include:

- **QARD Supplement III, Scientific Investigation** (indirect support of the process; direct QA requirements are fulfilled by the TDMS system itself)
    - TST-PRO-001, *Submittal and Incorporation of Data to The Technical Data Management System*
    - SCI-PRO-003, *Document Review*

ISF Program Priority: 4. Mature QA Organization—This application is a work control tool that supports the Impact Review Action Notice (IRAN) processes that identify and respond to impacts to and from data in the Technical Data Management System (Section A.8). It is prioritized as a later phase, as part of a mature QA organization, because during the initial period when the volume of data being submitted to the TDMS is small, this task tracking tool is not necessary. When the volume of data submittals is greater, when interrelationships between data inputs and outputs have been well developed, and when a larger technical staff requires a greater effort of coordination with the data management staff, this tool becomes more important in managing and tracking that work.

Data content: Specific to each new domain only; NWM data would need to be cleared out to provide an empty database for new content.

Readiness for use: Ready once the system is provisioned and configured, data is cleansed, and a readiness check has been passed.

Software licensing: This system is developed in MS Power Apps, which is licensed on a per-user basis that allows each user to run all applications developed in Power Apps.

Comments and analysis: Originally implemented in a Lotus Notes database, this is a relatively simple review tracking application, administered by data management staff who gather input from and notify document and data owners and users in identifying and responding to impacts related to the TDMS.

Alternatives: As noted above, the software itself has no unique or complex features that must be preserved for an ISF project. As a result, the application could be supported by a number of alternative approaches, depending on a future owner's preferences. However, if PowerApps is licensed to support other applications, that license covers this application as well, and there are no cost or functional advantages to replacing or rebuilding support for the IRAN process in another software.

A.23. Document Action Request (DAR) Database

Requirements sources: The DAR database allowed procedure users to request updates or changes to procedures. The requirements sources that make this application necessary include:

- QARD Section 6. Document Control
    - AP-5.1Q, *Procedure Preparation, Review, and Approval*

ISF Program Priority: 4. Mature QA Organization—This application supports procedural processes that allow any person to propose changes to project procedures, and then manages review and approval of the request and prioritizes those changes by immediacy of need. The DARs Database application is prioritized as a later phase, as part of a mature QA organization, because during the initial period when the volume of procedure change requests is low and responsibilities for procedure maintenance are more directly owned by a smaller staff, process can be managed without this tool. When the volume of Document Action Requests is greater, when interrelationships between requirements and the performance document procedures system grows more complex, and when a larger technical staff requires a greater effort of coordination with the procedure owners, this tool becomes more important in managing and tracking that work.

Data content: Specific to each new domain only; NWM data would need to be cleared out to provide an empty database for new content.

Readiness for use: Ready once the system is provisioned and configured, data is cleansed, and a readiness check has been passed.

Software licensing: This system is developed in MS Power Apps, which is licensed on a per-user basis that allows each user to run all applications developed in Power Apps.

Comments and analysis: Originally implemented in a Lotus Notes database, the DAR database is a relatively simple system that allows general users to access and create requests. System owners then review the request and, if approved, assign a schedule for incorporation into the procedure. For example, depending on the cause, a change may be pushed forward as scheduled immediately or it may wait to be incorporated in a future update.

Alternatives: As noted above, the software itself has fairly simple and has commonplace functions for review, approval, and action scheduling. As a result, the application could be supported by a number of alternative approaches, depending on a future owner's preferences. However, if PowerApps is licensed to support other applications, that license covers this application as well, and there are no great cost or functional advantages to replacing or rebuilding support for the DAR process in another software.

However, if CDIS (Section A.4) is implemented using an alternative approach, the DAR functions should be considered for inclusion and integration in that effort.

A.24. USA RS Regulatory Analysis

Requirements sources: This system was used to identify new requirements or changes to requirements that may have impacted their contractual requirements and then communicate those

requirements impacts to DOE's Requirements Management System (Section A.10). The requirements sources that make this application necessary include:

- RQ-PRO-1000, *Managing Requirements*
- RQ-DSK-1002, *Requirements Management System Administrator's Guide*

ISF Program Priority: 4. Mature QA Organization—This application helps in the implementation of requirements management program by identification and review of potential external changes to requirements, such as new regulatory guidance, changes in the law, or changes to contractual agreements.

Data content: Specific to each new domain only; NWM data would need to be cleared out to provide an empty database for new content.

Readiness for use: Ready once the system is provisioned and configured, data is cleansed, and a readiness check has been passed.

Software licensing: This system is developed in MS Power Apps, which is licensed on a per-user basis that allows each user to run all applications developed in Power Apps.

Comments and analysis: The DOE requirements management program was in a state of flux when the program was shut down. Funding for the effort was cut and some DOE requirements management procedures (e.g., RWRQ-PRO-001) were marked as suspended as a result. The existing documentation described the Requirements Management System in DOORS as the "single" system used by all project participants in some documentation while, in fact, only DOE had access and use of the DOORS system at shutdown. The USA RS Regulatory Analysis application was developed originally in a Lotus Notes database and used by the M&O contractor as an internal workflow tool to facilitate identification and review of potential impacts from external changes to requirements. It is a relatively simple review tracking application, administered by staff who identified reviewers and requirements area owners to document, review, and approve the disposition of the potential impacts. It supported the internal review and helped to facilitate baseline change proposals and updates to the contract, but actual updates to the requirements system were officially captured in the Requirements Management System in DOORS, not here.

Alternatives: As noted above, the software itself has fairly simple and has commonplace functions for review, approval, and action scheduling. As a result, the application could be supported by a number of alternative approaches, depending on a future owner's preferences. If PowerApps is licensed to support other applications, that license covers this application as well, and there are no great cost or functional advantages to replacing or rebuilding support for this requirements impact review process in another software.

A.25. Licensing Support Network (LSN) Screening

Requirements sources: This was the screening system that was operated by DOE's LSN support counsel and CACI in support of submittals to the NRC's Licensing Support Network (LSN). The requirements sources that make this application necessary include:

- **10 CFR Part 2,** see especially 10 CFR 2.336 General discovery
- System is responsive specifically to 10 CFR Part 2 Subpart J, which is applicable specifically to 10 CFR Part 63 proceedings; those requirements go far beyond the generic requirements at 10 CFR 2.336.
- Categorization and marking was done under the direction of a variety memoranda from OCRWM management and DOE Office of General Counsel that provided an interpretation of records requirements and FOIA and LSN exemption rules.

ISF Program Priority: 5. Late; License Application development—This is the screening system that was operated by DOE's LSN support counsel and CACI in to review and screen submittals to the NRC's Licensing Support Network (LSN). It received all records identified by DOE as LSN-relevant. This application provided secondary screening of potentially relevant materials for discovery at litigation. It facilitated legal review for withholding documents from discovery. Screening reviews were defined roughly by FOIA exemptions derived from various laws for information security and privacy.

Data content: Specific to each new domain only.

Readiness for use: This system has been deferred and is not ready for implementation, as discussed in comments below.

Software licensing: None. The application reuses the original code, modernized and implemented with the SQL server platform provided by the Azure Cloud.

Comments and analysis: Completion of this system was deferred by the NWM Cloud project because LSN development challenges increased schedule and cost forecasts and because the needs analysis changed to make screening functions less immediately important. Further development was canceled until the requirements and priorities for the full LSN screening and review system can be clarified. All system components have been preserved in the NWM Cloud, so development work could be resumed if DOE directed it. Unless licensing proceedings under 10 CFR Part 63 were continued, a different approach to development of these tools might be preferred, including in the case of ISF licensing. All system components have been preserved in the NWM Cloud, so development work could be resumed if DOE directed it.

Alternatives: Much of the workflow components of the screening and review software is still viable, and development could be completed and the system made operable if a custom, no-licensing-cost screening and review approach for discovery was desired. The homeland security and personal identifiable information modules, HSC and PAC respectively, which were the components that presented the biggest development challenge, could be replaced by considerably more advanced technology available now, allowing the rest of the system to be reused quite effectively. In fact, there are potential integration opportunities with MS Office 365 and AI tools in the Azure platform for PII discovery that could be utilized for these categorization and screening automations that might be utilized as adjuncts to the existing LSN screening system.

The review functions and workflows represented by the system are now commonly available in COTS "eDiscovery" litigation support software tools, though they can be expensive, and most would require significant reconfiguration to reflect DOE's requirements and processes.

Finally, the OpenText Content Suite platform that the RDMS is built on has add-on systems for eDiscovery as well, which could leverage the existing records architecture and capitalize on an opportunity for integration and streamlining of records and litigation processes.

A.26. LA Database

Requirements sources: The License Application Database supported development and review of the license application. It defined the development, review, and approval responsibilities for each LA section, managed a library of supporting references with additional metadata relevant for licensing, managed licensing action items and regulatory commitments. The requirements sources that make this application necessary include:

- **10 CFR 72.11 Completeness and accuracy of information**
- **10 CFR 72.70 Safety analysis report updating**
    - PLN-MGR-RL-000004, *Yucca Mountain Repository License Application Support Plan*
    - AP-REG-022, *License Application Configuration Management*
    - LP-REG-004-OCRWM, *Managing Commitments to the U.S. Nuclear Regulatory Commission*
    - LP-REG-020-OCRWM, *Activity Screening for License Application Impact*
    - LS-PRO-2001, *License Application Update and Maintenance*
    - LS-PRO-2002, *License Application Change Identification and Control*

ISF Program Priority: 5. Late: License Application development—The LA database set contains licensing document sections, supporting references, and management information related to licensing standards and activities. The relational database tools support document development and review for the License Application, configuration control, impact review, change management of supporting documents. An action tracking system categorizes and tracks various types of licensing-related action items, including the project Commitment Management System, which manages the formal commitments made to the NRC.

Data content: Specific to each new domain only; NWM data would need to be cleared out to provide an empty database for new content.

Readiness for use: Ready once the system is provisioned and configured, data is cleansed, and a readiness check has been passed.

Software licensing: None; custom developed software owned by DOE reusing the original code, modernized and implemented with the SQL server platform provided by the Azure Cloud. Involves a one-time purchase of ColdFusion, under a license that covers both RAIRS and the LA database.

Comments and analysis: The LA Database supported the DOE, M&O, and Lead Lab organizations in developing, reviewing, and finalizing the license application and then updating it after submittal. It facilitated configuration control of supporting references and impact reviews for potential changes. In addition, it contained a database of regulatory correspondence, an action item

management system, a matrix of regulatory requirements and NRC review criteria, and it supported the program's Commitment Management System for DOE's official commitments to the NRC. It had multiple complex modules like these, all of which were built around an association with related sections of the LA.

Alternatives: Some of functions of the individual modules could be replaced, but the integration of all the tools could only be delivered by a custom system. For that reason, the NWM Cloud Team considers this application to be optimized for its intended use.

A.27. RAI Response System (RAIRS)

Requirements sources: The RAI Response System supported screening, assignment, planning, development, review, and approval of responses to NRC's requests for additional information, which are questions supporting NRC staff's technical review of the safety analysis report. The requirements sources that make this application necessary include:

- **10 CFR Part 2,** see especially 10 CFR Part 2.108 Denial of application for failure to supply information
- **10 CFR 72.11 Completeness and accuracy of information**
    - PLN-MGR-RL-000004, *Yucca Mountain Repository License Application Support Plan*
    - AP-REG-019, *Request for Additional Information Response Development, Review, and Approval*
    - LP-REG-004-OCRWM, *Managing Commitments to the U.S. Nuclear Regulatory Commission*

ISF Program Priority: 6. Late: License Application Review and Litigation—The RAI Response System (RAIRS) implements the procedural steps of the RAI response procedure, supporting scheduling and development of responses to NRC requests for additional information, including review, routing, validation, concurrence, and approval steps. RAIRS generates appropriate notifications, sent via the project email system an automated set of recipients.

Data content: Specific to each new domain only; NWM data would need to be cleared out to provide an empty database for new content.

Readiness for use: Ready once the system is provisioned and configured, data is cleansed, and a readiness check has been passed.

Software licensing: None; custom developed software owned by DOE reusing the original code, modernized and implemented with the SQL server platform provided by the Azure Cloud. Involves a one-time purchase of ColdFusion, under a license that covers both RAIRS and the LA database.

Comments and analysis: RAIRS supported the DOE, M&O, and Lead Lab organizations in screening, assignment, planning, and development of responses to NRC's requests for additional information, which are questions supporting NRC staff's technical review of the safety analysis report and which are required to be answered within 90 days. It automated at least two cycles of review and approval including dynamically assigning review authorities based on relevant technical groups and associations with LA sections and generating automated notifications of responsible

individuals at each step. It reported status of response development in real time and highlighted current actions required for each RAI response.

Alternatives: RAIRS is a highly custom system with very detailed process automations, notifications, and reporting features. There are not alternatives available that don't involve custom programming to provide all its tailored features. The NWM Cloud Team considers this application to be optimized for its intended use.

A.28. Contentions Response System

Requirements sources: The Contentions Response System is a tool that supports the NRC Atomic Safety and Licensing Board (ALSB) hearing process. It was developed under the guidance of DOE OGC and its external counsel. The requirements sources that make this application necessary include:

- **10 CFR Part 2**, see especially 10 CFR Subpart C proceedings processes

ISF Program Priority: 6. Late: License Application Review and Litigation—The Contentions Response System is a tool that supports the ALSB hearing process. It was developed under the guidance of DOE OGC and its external counsel. It collects all submitted contentions, categorizes and groups the contentions, and manages assignments, plans, and content associated with the contention responses, including pleadings, strategic outlines, expert witness information, depositions, and status of hearings processes.

Data content: Specific to each new domain only; NWM data would need to be cleared out to provide an empty database for new content.

Readiness for use: Ready once the system is provisioned and configured, data is cleansed, and a readiness check has been passed.

Software licensing: None; custom developed software owned by DOE reusing the original code, modernized and implemented with the SQL server platform provided by the Azure Cloud. Involves a one-time purchase of ColdFusion, under a license that covers both RAIRS and the LA database.

Comments and analysis: The Contentions Response System was developed under the guidance of DOE OGC and its external counsel to support the NRC hearings process. It collects all submitted contentions, categorizes and groups the contentions, and manages assignments, plans, and content associated with the contention responses, including pleadings, strategic outlines, expert witness information, depositions, and status of hearings processes. It is not as complex as the LA database or RAIRS, but it is a purpose-built application that will support the information needs of participating in NRC's adjudicatory process.

Alternatives: As noted above, this system is not so complex or so unique in its functionality as to be extremely difficult to replace, but it is a modernized system designed for its very specific purposes. The NWM Cloud Team considers this application to be optimized for its intended use.

A.29. Archived NWM Content not needed for ISF

There is some archive content that was retained in the NWM Cloud that would not be required in a cloud domain implemented in support of an ISF project. That content includes:

- **"O:drive"**—The YMP network fileshare (known as the O:drive or "Group Drive") archive contains all the group drives used at the YMP for organizational fileshares as well as the fileshares supporting some of the other YMP information systems (e.g., the LA Database) and the repository design model which comprised 9 TB of data in 51,000 files (non-operational without a current PDS license). This non-record data is archived in the NWM Cloud, but there is no value in copying it to an ISF cloud domain.
- **ymp.gov Lotus Notes email warehouse**—The Email Warehouse was an archive of Lotus Notes emails containing email sent or received by individuals with ymp.gov email accounts. It was archived for future reference and discovery. It is now hosted in the NWM cloud as an archive using a Lotus Notes client. There is no value in copying it to an ISF cloud domain.

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