

Management of Aging Infrastructure at Sites with DOE Defense Nuclear Facilities

**Thomas A. Summers, Vice Chair
Defense Nuclear Facilities Safety Board**

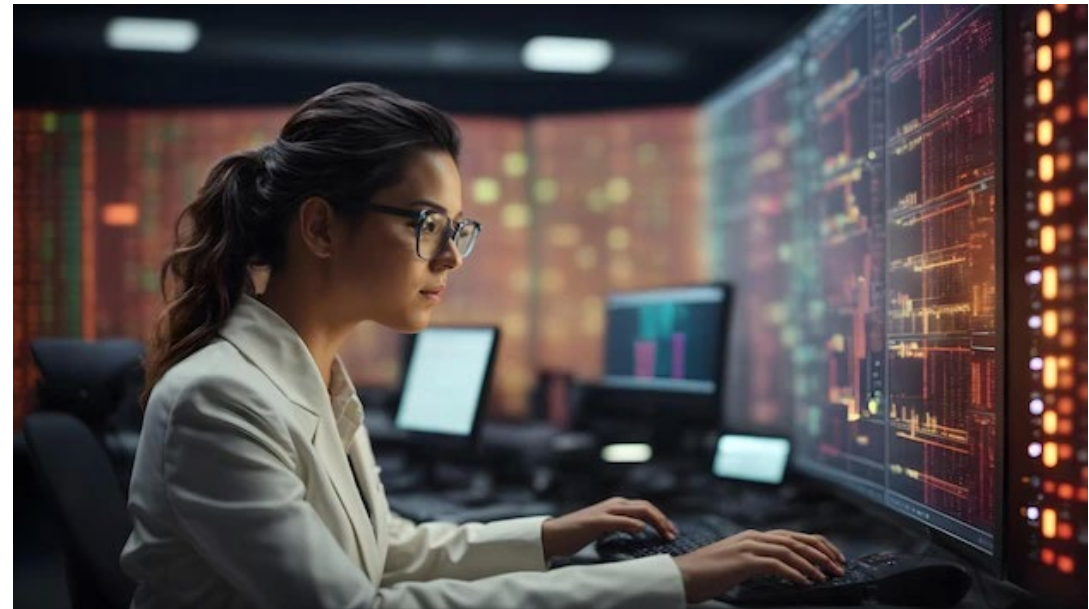
**EFCOG Cybersecurity Working Group 2023 Workshop
October 25, 2023**

Infrastructure and Cybersecurity



There are overlapping concerns between cybersecurity and infrastructure

- The Board's focus is on DOE's aging real property assets and their installed equipment that support DOE's defense nuclear facilities
- The Board is also concerned with DOE's current approach to managing risks associated with that aging infrastructure
- The EFCOG cybersecurity work group's work plan for 2023 states that the working group's focus includes:
 - Industrial control systems and distributed control systems
 - Internet of Things (IoT)
 - Smart technologies, and
 - Risk management and governance



[Source of picture: Freepic.com]

Why Worry about Aged Infrastructure?



Aged infrastructure reduces personnel safety and performance

- Reduces worker morale and encourages acceptance of lower standards
- Increases housekeeping needs and the potential for errors and accidents
- Places heightened pressure on maintenance personnel
- Interferes with safe conduct of work and leads to declining productivity

Age-related degradation increases risk to facility safety

- Increases component failure rates and reduces system reliability
- Introduces common-cause failure modes that challenge safety analyses
- Reduces system resilience by limiting ability to respond to off-normal needs
- Creates failure modes that challenge SSCs or trigger unanticipated accident sequences

Technical obsolescence increases the number of vulnerabilities and exposures that may provide unauthorized access to smart systems, resulting in an unanalyzed risk to facility safety

What is “Infrastructure?”



- In this discussion, the word **infrastructure** refers to all **real property assets and their installed equipment that enables or supports activities or DOE’s mission** at a site
- Basically, **infrastructure is a system of systems**; the functionality of an infrastructure is created by the combined functionality of the individual real property assets that support it
- **Infrastructure management** is about making informed decisions based on a systematic approach to evaluating component and system adequacy and vulnerability, understanding intersystem dependencies, and determining the potential consequences of system failure
- **Aging management programs** are some of the tools of infrastructure management, but the two are not synonymous



Aerial view of Pantex Plant

Board Perspective on Infrastructure



*DOE's challenges extend to managing its aging infrastructure, ...**particularly in systematically evaluating the infrastructure that supports the safe operation of its defense nuclear facilities.***

*DOE appears to struggle with implementing and maintaining necessary infrastructure and safety controls, **even after recognizing the importance of those systems and controls** to DOE's ability to ensure adequate protection of its workers, the public, and the environment.*

Defense Nuclear Facilities Safety Board
33rd Annual Report to Congress, March 2023

Aging Infrastructure Impact on NNSA



*A well-organized, well-maintained, and modern infrastructure system is the bedrock of a flexible and resilient nuclear security enterprise. **More than 60 percent [of NNSA's assets and facilities] are beyond their life expectancy, with some of the most important dating back to the Manhattan Project.***



Building 9212, Y-12 National Security Complex. Built in 1945.

NNSA Administrator Jill Hruby
House Armed Services Committee
Subcommittee on Strategic Forces
March 28, 2023



Aging Infrastructure Impact on EM

*Hanford's 56 million gallons of radioactive and chemical waste stored in 177 aging storage tanks represent EM's greatest environmental risk and financial liability. **Recognizing that additional delays bring greater environmental risks, exacerbate the impacts of already aging infrastructure, and increase costs, we are focused on moving the entire Hanford tank waste mission forward.***

William "Ike" White
Senior Advisor for DOE-EM
Senate Armed Services Committee
Subcommittee on Armed Forces
April 18, 2023



Waste Treatment Plant, Hanford



241-C Tank Farms, Hanford

DOE's Continuity Challenge



41 years ago: *Some multiprogram laboratory facilities are in obvious need of repair. **DOE management is aware of this, [but] it does not know the true condition of all facilities.*** (GAO, February 1982)

33 years ago: ***DOE faces major challenges including modernizing facilities** that have deteriorated over the 30 to 40 years since their construction. DOE must also...ensure that it operates in compliance with current environmental, safety, and health standards.* (GAO, September 1990)

20 years ago: ***The seriousness of infrastructure deficiencies, combined with competing needs...and historical weaknesses in project management,** make implementing plans for infrastructure revitalization a management challenge for [DOE].* (GAO, January 2003)

11 years ago: *Of the few major [NNSA] projects that were successfully completed...**we could find no successful historical major project that both cost more than \$700 million and achieved CD-4 in less than 16 years.*** (IDA, November 2012)

5 years ago: *NNSA may have to defer certain modernization work planned for fiscal years 2018 through 2021. ...**this deferral could exacerbate a significant bow wave of modernization funding needs that NNSA projects for the out-years.*** (GAO, February 2018)

DOE's Cybersecurity Challenge



- *The National Nuclear Security Administration (NNSA) and its contractors have not fully implemented six foundational cybersecurity risk practices in its traditional IT environment. NNSA also has not fully implemented these practices in its operational technology and nuclear weapons IT environments. (GAO, GAO-22-104195, 2022)*
- *We recommended that the Departments of Energy, Health and Human Services, Homeland Security, and Transportation...establish and use metrics to assess the effectiveness of sector IoT and OT [Operating Technologies] cybersecurity efforts and evaluate sector IoT and OT cybersecurity risks. As of December 2022, none of these recommendations had been implemented. (GAO, GAO-23-106415, 2023)*
- *NNSA's efforts to address cybersecurity at the system level in the OT environment remain in the early stages of development and implementation. In our September 2022 report, we noted that NNSA has made limited progress—after several years of effort—to implement risk management practices that would help it inventory OT systems and assess and mitigate the risks to such systems. (GAO, GAO-23-106309, 2023)*



Why No Continuity?

As a government agency, DOE faces inherent challenges that complicate its ability to maintain continuity on long-term programs like infrastructure renewal

- Frequently changing missions, priorities, budgets, leadership, and world events
- Extremely complex missions with rapidly evolving technology
- Urgent need for continued and expanded operations in aging facilities
- Aged assets may degrade faster than they can be refurbished or replaced
- High costs associated with nuclear and specialized products and construction
- Changing workforce and loss of corporate knowledge and experience



Tritium Facility, Savannah River Site

Department of Energy/National Nuclear Security Administration | April 2023

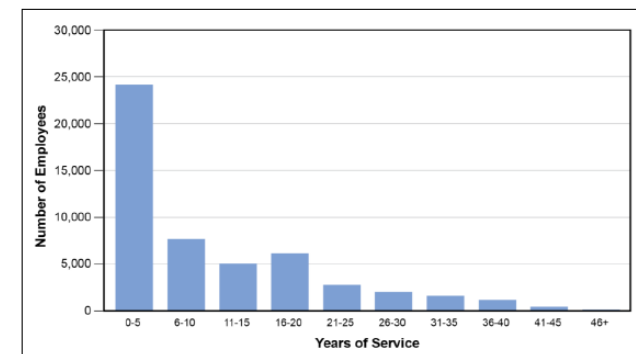


Figure C-4. Headcount by years of service

Sub-recommendation 1 of R2020-1



The approach needs to be integrated into DOE's current real property and nuclear facility management processes.

Requirements need to be established at Secretarial level (i.e., directives)

***From reaffirmed Recommendation 2020-1:
Develop and implement an integrated approach—including requirements—for the management of aging infrastructure that includes formal processes to identify and perform infrastructure upgrades necessary to ensure facilities and structures, systems, and components can perform their safety functions.***

The approach needs formal processes for identifying and performing necessary infrastructure upgrades

The concern is about DOE's management of aging infrastructure and the need to ensure that it can continue to perform its safety functions.



Recipe for Success

Consider some of the most successful safety improvements in DOE:

- **Integrated Safety Management Systems** have been key to personnel and facility safety for almost 30 years
- **DOE Facility Representatives** have provided vital day-to-day oversight of facility operations for over 30 years
- **Operational Readiness Reviews** have helped ensure the safe startup of facilities for over 30 years
- **DOE System Safety Engineers** have ensured the quality and availability of the safety systems that the nuclear facilities rely on for over 20 years

What do these programs have in common?

- The **requirements are integrated** into DOE's system of directives
- The **essential elements are established at the secretarial level**
- The approach includes **formal processes and appropriate guidance**
- The **scope and intent** of the programs **are well defined** and understood

Scope of Sub-recommendation 1



The Board perceives that there has been some confusion about the scope of the aging infrastructure sub-recommendation

- The Board's concern extends to **all real property assets and installed equipment that provide or support a safety function** at a DOE defense nuclear facility, **regardless of whether those assets are inside or outside the facility's DSA-designated boundary**
- Examples include
 - Electrical substations and distribution systems
 - Centralized process steam and heat plants
 - Fire stations, firewater tanks, pumphouses, and firewater pipes
 - Emergency Operations Centers and facility assembly areas
 - Access roads and bridges

EM Example



SRS H-Canyon Exhaust Tunnel Structural Integrity

- Constructed in 1953, the tunnel is a critical part of H-Canyon's safety class ventilation system
- SRS has monitored and documented age-related degradation since 1990
- Evaluations since 2011 noted that degradation is severe and may impact post-seismic functionality
- Since 2011, Board and DOE have evaluated this issue with multiple analyses, letters, and briefings
- DOE is now pursuing a new safety strategy that does not rely on the tunnel for post-seismic safety





NNSA Example

NNSS Device Assembly Facility Firewater Supply Tank

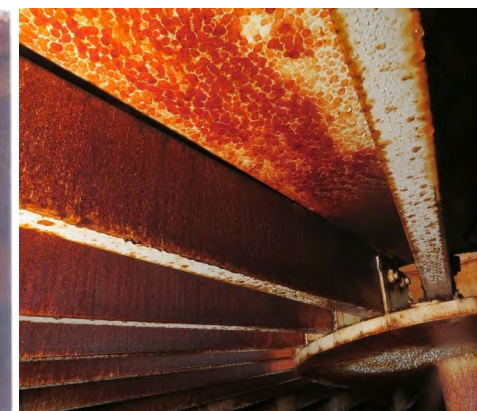
- Constructed in 1985, the tank is a safety class SSC in the current DSA
- Seismic vulnerabilities recognized around 2006
- Tank replacement was a planned improvement in the 2008 DSA
- An inspection in 2010 reported significant rust and blisters in coatings but no deep pitting
- By 2022, inspections reported widespread rust and blisters with significant deep pitting
- Facility is now operating under a JCO, and replacement project is scheduled for 2025



NNSS Device Assembly Facility



Ceiling Section 2010



Ceiling Section 2022

What Needs to be Done?



- DOE needs a **set of requirements that create an integrated, systematic framework** for managing its infrastructure
- Infrastructure is a system of systems; **DOE needs a framework that considers individual assets as components of the bigger system**
- **DOE's infrastructure is already significantly aged**, DOE should consider **adequacy as a strategic goal** and **facility safety as a priority**
- Understanding risks is key to decision-making; DOE should implement an **enterprise risk management system as the foundation** for managing its infrastructure
- There are agencies and consensus standards bodies that address aging management, such as NRC, IAEA, and IEEE; **DOE should look to those groups for demonstrated processes and strategies for its infrastructure**

Moving Forward



- The Board is encouraged to see the increased focus on DOE's aging infrastructure
- Both EM and NNSA are building enterprise-level views of their infrastructure and identifying performance metrics
- That effort will aid senior managers in understanding the infrastructure risks DOE faces and support their decisions on infrastructure strategies
- DOE needs to build on this increased focus by institutionalizing it into clear and adequate directives before momentum is lost to another priority
- Short term investments in infrastructure improvement will have a big payback

Most importantly, DOE's missions will also benefit from improved infrastructure

Your Role is Important



- There are direct links between cybersecurity and age-related degradation
- As DOE addresses its real property infrastructure challenges, you have a great opportunity to apply your expertise to their efforts
- The cybersecurity working group's work plan aligns with DOE's needs in addressing its infrastructure
- If you are already engaged in improving DOE's infrastructure, **EXCELLENT!**
- If not, find a way to engage, your talents are needed!