

Management of Aging Infrastructure at Sites with DOE Defense Nuclear Facilities

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Defense Nuclear Facilities Safety Board**

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Why Worry about Aged Infrastructure?



Aged infrastructure reduces personnel safety and performance

- Reduces morale in workers
- Encourages acceptance of lower standards
- Increases housekeeping needs
- Places heightened pressure on maintenance personnel
- Increases the potential for errors and accidents
- 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
- Reduces system resilience by limiting ability to respond to off-normal needs
- Introduces common-cause failure modes that challenge safety analysis
- Creates failure modes that challenge SSCs or triggers unanticipated accident sequences

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 the Department’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

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

*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.)

19 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.* (Institute for Defense Analysis, 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.)



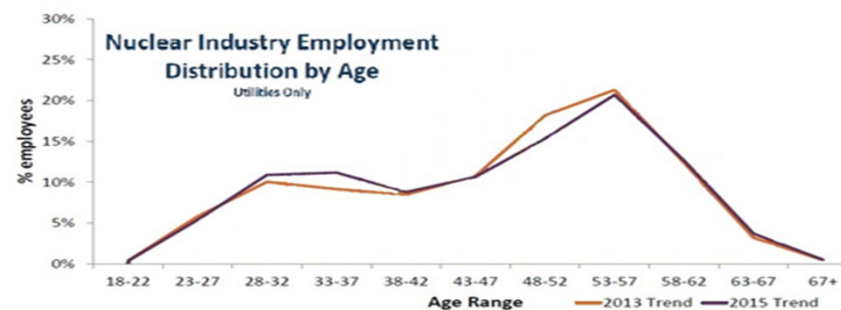
Why No Continuity?

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

- Frequently changing missions, priorities, budgets, leadership, and world events
- The urgent need for continued and expanded operations in aging facilities
- Aged property 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



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, not just about aging management as a technical process.

Recipe for Success



Consider some of the most successful safety improvements in DOE:

- **Integrated Safety Management Systems** have been a 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

What do these programs have in common?

- The requirements are **integrated** into DOE's overall system of directives
- The requirements **and essential elements** are **established at the Secretarial level**
- The approach includes **formal processes and adequate 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 personnel or facility safety function at a DOE defense nuclear facility, regardless of whether those assets are within or outside the facility's DSA-designated boundary
- Examples include
 - Electrical substations and distribution systems
 - Fire stations, firewater tanks, pumphouses, and firewater pipes
 - Emergency Operations Centers and facility assembly areas

Examples



SRS H-Canyon Exhaust Tunnel Structural Integrity

- Originally constructed in 1953, tunnel is critical part of facility's safety class ventilation system
- Age-related degradation in tunnel has been documented and monitored since 1990
- Remotely-conducted observations since 2011 have noted that degradation has become severe and may impact post-seismic functionality
- Board and DOE evaluated this issue since 2011 with multiple analyses, letters, and briefings
- In 2019 DOE decided to pursue an alternative safety strategy that did not rely on the tunnel as a post-seismic safety class system





Examples (cont)

NNSS Device Assembly Facility Firewater Supply Tank

- Tank identified as Safety Class SSC in DSA
- Seismic vulnerabilities with the tank recognized around 2006
- Tank replacement project identified as planned improvement in Oct. 2008 DSA
- 2010 inspection reported significant rust and blisters in coatings but no deep pitting
- Inspection in 2022 reported widespread rust and blisters with significant deep pitting
- Facility is now operating under a JCO, replacement project 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 the individual assets as components of the bigger system**
- **DOE's infrastructure is already significantly aged**, DOE needs to consider establishing adequacy as a strategic goal and facility safety as a priority for the near-term restoration of its infrastructure
- Understanding risks is the key to decision-making; DOE should consider implementing an **enterprise risk management system as the foundation** for managing its infrastructure
- There are agencies and international consensus standards that address aging management, such as NRC, IAEA, and IEEE. **DOE should consider incorporating demonstrated processes from those entities into its strategies for managing its aging infrastructure**



Conclusion

- The Board is **encouraged to see the increased focus on aging infrastructure at DOE**
- 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 risks to the DOE enterprise and support sound decisions on infrastructure upgrade and replacement 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**
- And finally, DOE's **missions will also benefit from an improved infrastructure**