Leadership in Integrated Safety, Design, Construction, Start-up, and Operation

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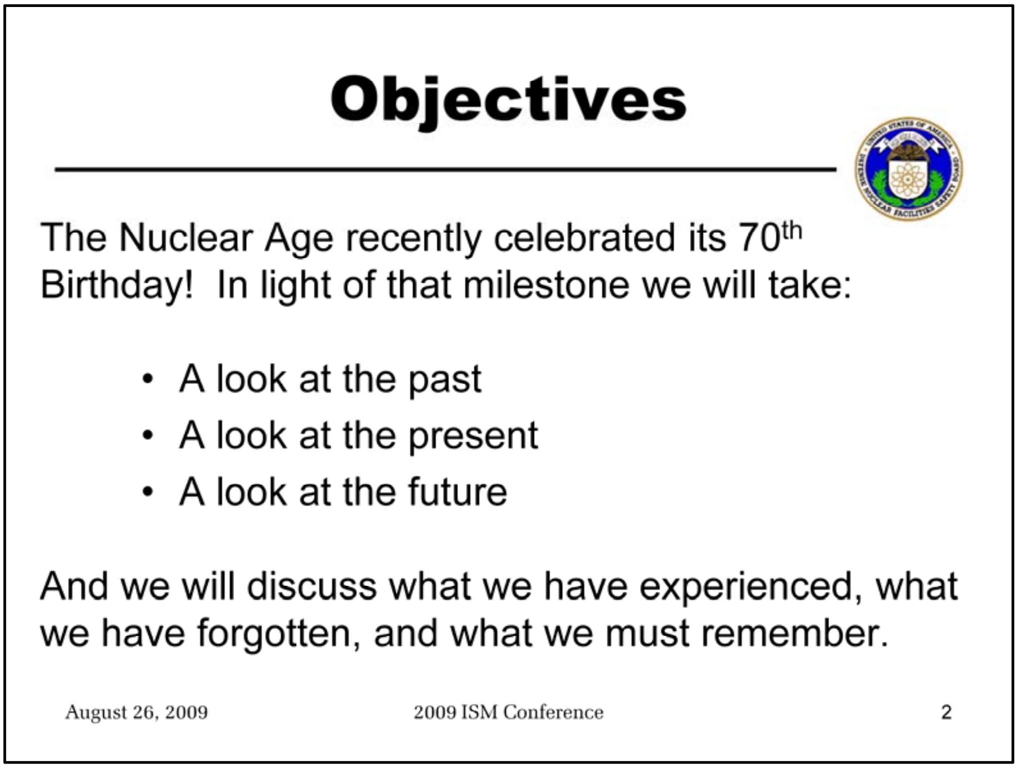
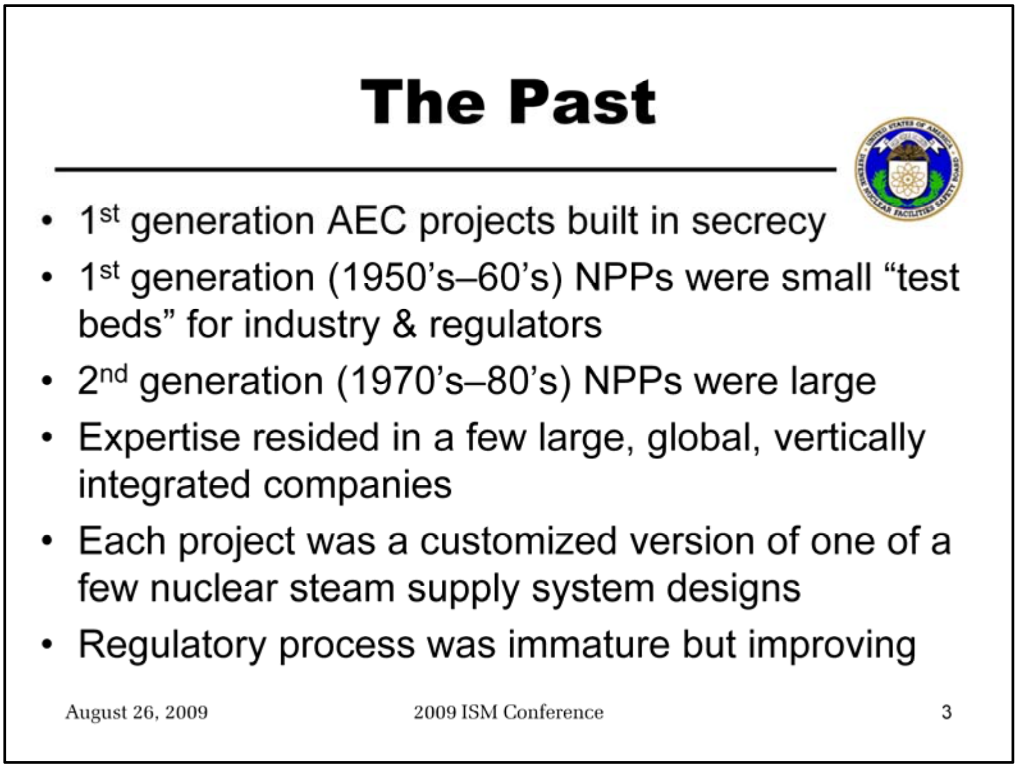
Thank you for inviting me to speak on Integrated Safety Management, a topic of great interest to the Board. As a Board member, I am encouraged by the demonstrated support by senior managers from DOE, NNSA and the contractor organization to reinvigorate ISM implementation.



It was 1938 when Otto Hahn, Lise Meitner, and Fritz Strassman first recognized the process of nuclear fission. In the over 70 years that have passed since then, the nuclear age has spawned at least three definitive periods of activities. First, due to the immediacy of World War II, there was a rapid and highly secretive effort to learn how to control the atom's nuclear energy for military applications. After that initial rush, then efforts began on developing other applications, most notably nuclear power and nuclear propulsion reactors. After these first two periods, both of which involved huge investments in the design and construction of new equipment and facilities, the nuclear age settled down to a long period of reasonably stable operations without significant amounts of new construction.

Now we are entering a new period, a period with a renewed interest in commercial nuclear power, a commitment to clean up the legacy of environmental impacts from those early years, and a concern about the crumbling infrastructure of our nuclear weapons complex. Today I want to talk a little about all of these periods, past, present, and future. We learned much during those past efforts, but based on current observations I fear that we have forgotten too much of it. We have lost much of the original industrial base, and we have significant holes in all levels of staffing. When we consider where we want the nuclear industry to go in the future, then there is much that we need to relearn and remember from the past.



"Vertically integrated" refers to the concept that one company or vendor provided essentially all of the design, procurement, fabrication, and installation services associated with a product. This is in contrast to current practices where responsibilities and capabilities are typically spread among multiple corporate entities in either partnership arrangements or in tiered layers of sub-contractors.

We will discount the first-generation experiences of the DOE/ERDA/AEC nuclear facilities. Most of those major facilities were built under the veil of secrecy and the urgency of the cold war environment. Therefore, the design and construction experiences were not well documented, and the requirements on these unique facilities were not well defined.

Past Experiences

Frequently observed issues in those early nuclear construction projects:

- Concrete placement
- Piping installations
- Safety-related welding
- Reworks & additions due to changing requirements
- Inadequate management of quality
- Inadequate management involvement
- Organizational interfaces not controlled

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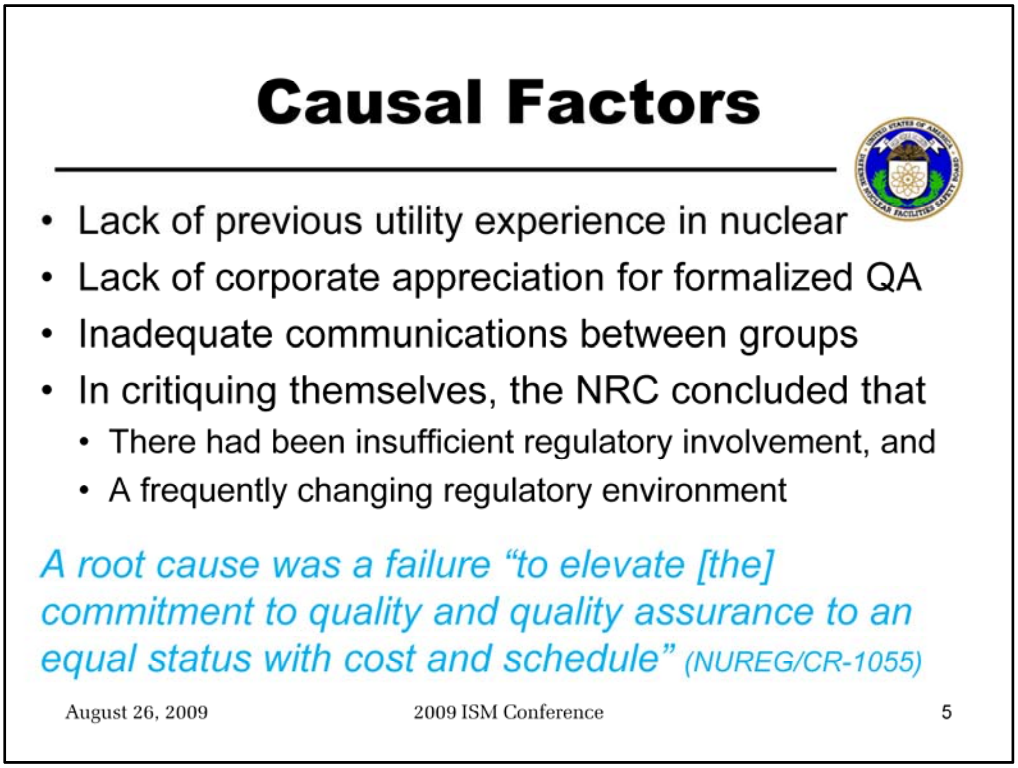
There is a good collection of observations concerning the design and construction of the first generation of commercial Nuclear Power Plants in the United States. In 1984, at the request of Congress, the Nuclear Regulatory Commission (NRC) evaluated this collection of observations to develop NUREG/CR-1055, "Improving Quality and the Assurance of Quality in the Design and Construction of Nuclear Power Plants." The reason that Congress requested this study was that projects like Marble Hill, Midland, Zimmer, South Texas, and Diablo Canyon had received widespread attention during their construction due to problems in the quality of their design or construction. In fact, some of these projects were either never completed or converted to non-nuclear applications because of the extent of the problems or the cost of correcting them. To many of us, that first generation on nuclear construction is still a difficult and sometimes painful memory that we do not want to repeat.



All of the information on this page came from NUREG/CR-1055, *Improving Quality and the Assurance of Quality in the Design and Construction of Nuclear Power Plants*, written in 1984.

The Present

- In US, most current new construction is in DOE
  - 25 major projects, 7 under construction now
  - Estimated costs of $28.3B if all completed
- Applications for several new US commercial NPPs are under review at NRC
- 9 US utilities have ordered long-lead forgings, coolant pumps, and containment shells
- One US enrichment plant is under construction
- NPPs are under construction In Europe & China

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NOTES:

-The 7 Department of Energy (DOE) projects now under construction are Waste Treatment Plant and the Immobilized High-Level Waste Interim Storage Facility at Hanford; the Integrated Waste Treatment unit Project at Idaho; the Criticality Experiments Facility at the Device Assembly Facility at Nevada; the Salt Waste Processing Facility and the Waste Solidification Building at Savannah River; and the Highly Enriched Uranium Materials Facility at Oak Ridge.

-The Waste Treatment Plant is divided into four sub-projects; construction is underway on all subprojects even though the designs are not complete yet. On average, the those sub-projects are 41% constructed even though their designs are, on average, only 78% complete.

-The fuel cycle plant under construction is a gas centrifuge enrichment plant being built by Louisiana Energy Services (LES) in New Mexico.

-According the DOE’s Office of Nuclear Energy as of May 2009:

 -Nine US utilities have ordered large, long-lead component forgings from three reactor vendors.

 -Four containment shells and 24 reactor coolant pumps have been ordered for AP1000 units.

 -Two domestic large component facilities are being built.

 -Japan Steel Works is only manufacturer of ultra-large forgings; “worldwide-capacity limited.”

The Present

What has changed?

- Improved design & construction technologies
- Mature standards & regulatory environment
- Standardized designs in commercial NPPs
- Increased understanding of materials
- Better educated workforce (but no nuclear experience)
- More corporate diversity, e.g., less vertical integration in contractors, suppliers, and vendors
- More complexity in project interfaces

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This is self-explanatory.

Present Experiences

- Issues that arose during design (DOE):
  - project management
  - fire protection, seismic, structural engineering
  - process-specific hazard controls
- Issues that arose during construction (DOE):
  - Rebar installation
  - Concrete placement
  - Procurement & Commercial Grade Dedication
  - Inadequate management of quality and organizational interfaces

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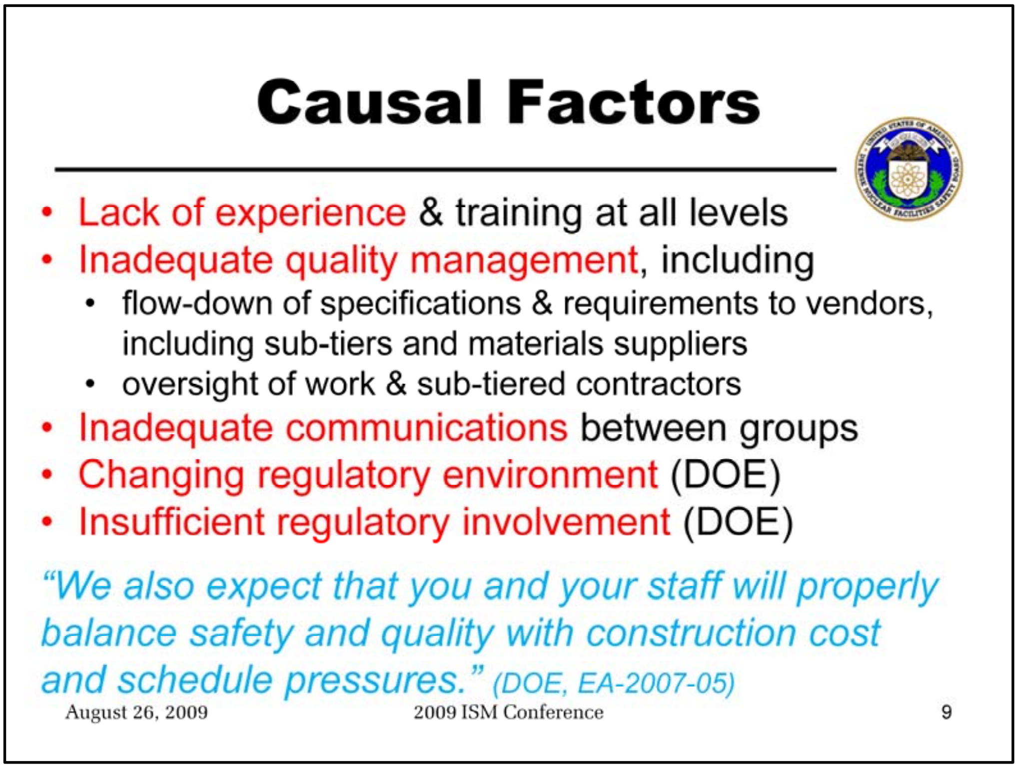
Notes:

- Currently, DOE is ahead of the US commercial nuclear in new construction projects. In the commercial sector construction has only begun on the one fuel enrichment plant. Therefore, all of these observations come from DOE projects. But since both DOE and the commercial licensees draw from the same cadre of suppliers, vendors, and workforces, one may argue that the observations may be applicable to both sectors.

-The concerns for the DOE designs were taken from the most recent Defense Nuclear Facilities Safety Board Quarterly Report to Congress on the status of unresolved technical issues concerning design and construction of new DOE Defense Nuclear Facilities.

-The construction concerns identified were drawn from Nuclear Safety Rule enforcement actions taken by DOE at Hanford and Nevada, DOE Inspector General studies of procurement at Savannah River, and NRC observations at the Mixed Fuel Fabrication Facility at Savannah River. Similar problems have also been documented at Oak Ridge Y-12 and Los Alamos in the United States. Internationally, concrete placement and rebar problems have resulted in regulatory intervention and construction delays at both the Olkiluoto 3 NPP in Finland and the Flamanville 3 NPP in France, both currently under construction.



Notes:

All of these causal factors were identified within the evaluations and investigations of the previously mentioned projects.

The quote comes from a DOE Price-Anderson enforcement letter against Bechtel National for multiple nuclear safety violations at WTP.

In 1999, NASA lost the Mars Climate Orbiter during insertion into Mars orbit. The failure was traced to a communication error between two teams validating flight parameters; one team was using metric units, the other was using English units. During that same year NASA also lost the Mars Polar Lander and two Deep Space 2 probes. The Polar Lander was lost during landing when an electrical noise signal confused the computer causing it to shut down the decent engines early. The design was known to be vulnerable to such noise but the spacecraft had not been tested for it. NASA never determined the exact cause of the Deep Space probes' failures, but believes that they were also lost to a known vulnerability. System tests that could have challenged that vulnerability were cancelled to save money and time. These failures led NASA to understand that one could not simultaneously achieve the three goals of "faster, better, and cheaper."

The Northeast Blackout was created by the same company that was responsible for the Davis-Besse reactor vessel head corrosion problems, FirstEnergy. There are similarities in the causes of the two events. FirstEnergy was reducing costs by minimizing compliance with design and operation standards, deferring maintenance on lines and facilities, and did not provide adequate training, tools, and support to the staff operating the electrical distribution system. Also, regulators were not adequately involved in the day-to-day operations of the interconnected grids and they did not have adequate powers to enforce the regulations.

The collapse of the I-35W bridge in Minneapolis illustrates how design weaknesses can lay undetected for many years until the conditions are "just right." Those weaknesses could have been easily identified during review of the design or detected later during surveillance of the completed bridge, if established processes had been followed. State and Federal oversight organizations were not rigorous in their evaluations of the original bridge design and of later modifications, and inspectors were not aggressive when concerns were identified.

Finally, the tragedy of the Crandall Canyon Mine collapses that killed 6 miners and 3 rescuers also contains many of the same causal elements. There had been an analysis and design of the mine, but it was inadequate and contained multiple errors; the oversight organizations (MSHA) approved the design without adequate review. The regulator was not adequately involved in the operations underway at the mine. The management of the mine did not comply with MSHA regulations and did not operate the mine in a manner that was conducive to the safety of the miners.

The Future

- Increasing external pressures:
  - The need for new nuclear facilities
  - The public demand for quality & safety
  - Financial & schedule influences
  - More specialized & restrictive standards
  - Stronger & more invasive regulations
- Increasing competing priorities:
  - Corporate and environmental sustainability
  - Physical safeguards and security
  - Preserving intellectual and proprietary information

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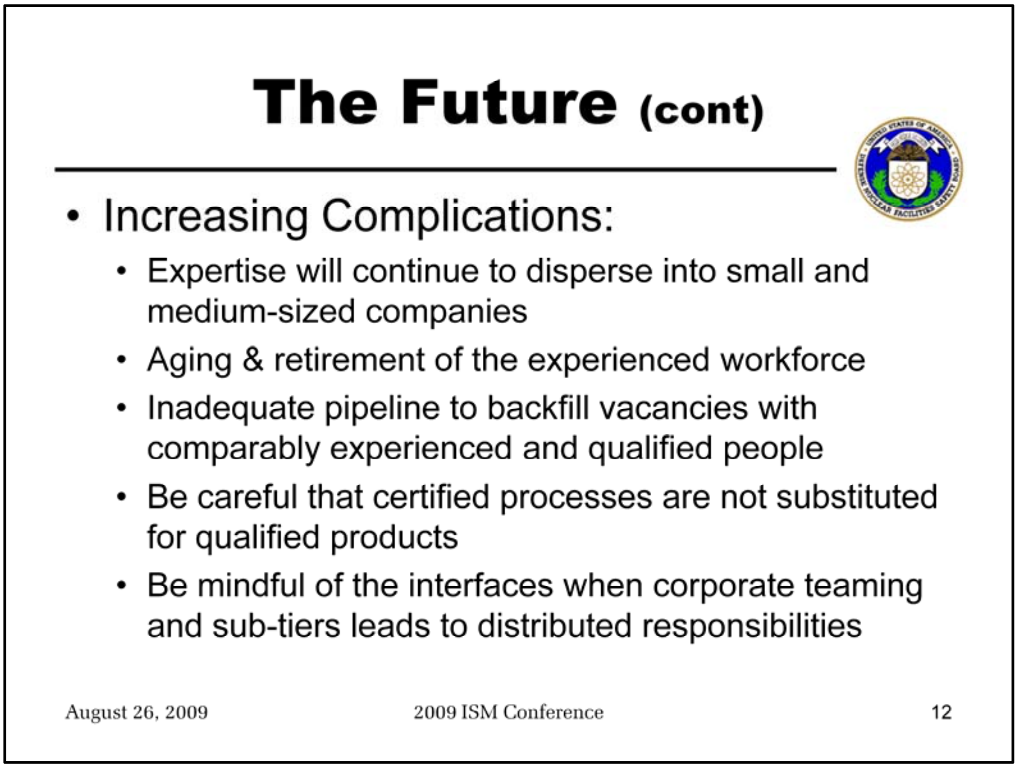
Existing DOE defense nuclear facilities are aging, and in some cases decaying. New facilities are also necessary to complete the US commitment to cleaning up the legacy of the early years. As pressure continues to build for reducing carbon emissions, commercial nuclear power must be one of the dominant solutions. All of this points to an increasing need for new nuclear construction.

The public has become a strong and sophisticated stakeholder in all public endeavors, and their demand for quality and safety is constantly growing.

Financial & schedule pressure increases goes without saying.

Standards continue to improve and become more restrictive as the state-of-the-art moves forward and the pool of experiences broadens. Regulations will continue to change for the same reasons.

Current examples of priorities that compete with safety are safeguards & security and environmental protection.



Business trends will continue to favor smaller and more specialized companies.

The current workforce with nuclear experience is aging, and the long gap in nuclear construction activities has created a void in the pipeline for backfilling the vacancies in that workforce.

Certified processes (such as ISO-9000) are important, but should not be viewed as an alternative to the qualification of individual products against applicable standards such as NQA-1. The best practice would be for certified processes that yield qualified products.

The concern about corporate teaming (such as Limited Liability Corporations) is that it may distribute and divide key responsibilities and supporting expertise across the parent companies rather than concentrating them within the group responsible for the project.

The Solutions

Given these trends,

- QA/QC processes must be formal & robust
- Inter- and intra-corporate responsibilities and interfaces must be defined and used
- Expectations (e.g., requirements, specifications) must be clearly communicated in writing
- Internal & external assessments must be rigorous
- Regulatory environment must be stable & mature
- Managers must be directly involved & supportive

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Beware of the sub-tiers – check the checkers; check the product as well as the QA paperwork.

Beware of the interfaces!

Expectations need to be stated in simple, direct terms.

The Conclusion

- To implement these solutions requires, above all else, strong and committed LEADERS
- Leaders must be experienced, qualified, respected
- Leaders should be selected for values as well as technical or managerial expertise & experience
- Succession planning must be extensive & rigorous
- Leadership development must be structured, values-based, and tied to the succession plan
- Rewards system must emphasize safety goals