NUCLEAR SAFETY AND PUBLIC CONFIDENCE

Energy Facility Contractors Group (EFCOG) Executive Council

Joyce L. Connery
Chair, Defense Nuclear Facilities Safety Board
June 10, 2021

[Thank the host for the invitation to speak and the introduction and thank the people for attending.]

Many of us in this virtual room are public servants—we are public officials, federal employees, and federal contractor leaders. We work for the American public, and our primary responsibilities are their health, safety, and welfare. And as for all public servants, our work is strongly influenced by public opinion.

My agency's role is to advise the Secretary of Energy on issues of public health and safety in her role as regulator and operator of DOE's defense nuclear facilities. We are required by law to perform that role in a transparent way to help overcome public concerns about DOE's history of safety and environmental problems.

Now all of us understand that public confidence is established by maintaining the combination of a good safety record and a high-quality performance record. Not surprisingly, we also know that the same combination of positive attributes helps to win new contracts and new work. And lest we forget, safety and quality in nuclear operations is written into our DNA as nuclear professionals.

So why have I started this discussion with a simple lesson on public confidence? Last week, I came across a recent article by Doctors Baron and Herzog from Yale University.[1] In that article, they emphasized that the American public has been skeptical of nuclear energy for decades. While opinion polls in the 1950s and 1960s showed high approval of nuclear power, polls conducted in the mid-1970s showed a rapid decline in public support. That support further declined following the Three Mile Island and Chernobyl commercial nuclear power plant accidents.

[1] Jonathon Baron, Stephen Herzog
Public opinion on nuclear energy and nuclear weapons: The attitudinal nexus in the United States
Available online 06 June 2020 via Elsevier

As cited by Doctors Baron and Herzog,[2] studies on this topic have found that one of the drivers of this decline is, and I quote, "negative perceptions of safety—especially regarding accidents and radioactive discharge," end quote. Another factor is associated with, and I quote, "historical management and engineering failures at waste sites, leading to leaks," end quote. As part of this study members of the public were asked to describe the first image that comes to mind when seeing the word 'nuclear.' Respondents overwhelmingly associated the word 'nuclear' with 'destruction.' That study concluded that, and I quote, "the extent to which respondents associated destructive imagery with the mere mention of 'nuclear,' [signifies] a belief that most, if not all, nuclear technology is inherently violent or dangerous," end quote.

The Three Mile Island and Chernobyl accidents drove some initiatives for improving safety in DOE's nuclear activities. In 1987, the National Research Council was very critical of safety conditions at DOE's reactor facilities, identifying both managerial shortcomings and

[2] Jonathon Baron, Stephen Herzog
Public opinion on nuclear energy and nuclear weapons: The attitudinal nexus in the United States
Available online 06 June 2020 via Elsevier

technical problems. In 1989, the Council identified numerous problems with non-reactor facilities, including problems with aging facilities.

In the late 1980s, public concern about the DOE nuclear complex was growing. In-depth congressional reviews and national media coverage informed the public of extensive safety problems and environmental contamination associated with DOE's nuclear complex. At that time, restoring public confidence in DOE's ability to conduct its activities safely became an imperative duty. In part, that combination of public concerns over the Chernobyl accident and DOE's safety problems drove Congress to establish my agency in 1988.

During the early years of our operation, the Board primarily focused on DOE's most urgent problems that were impacting its ability to meet its mission. At the top of the list were restarting production reactors at the Savannah River Site, restarting pit production at the Rocky Flats Plant, dealing with high-level liquid waste at Hanford, Idaho, and Savannah River, and starting up WIPP to provide a disposal

pathway for the large amount of transuranic waste accumulating at the DOE sites.

The Board's technical oversight activities set an energetic pace, yielding seven sets of formal recommendations in the first year, six sets in the second year, and another seven in the third year. Examples of the issues that the Board addressed in those early recommendations included the quality of the training and qualifications of reactor operators and supervisors at Savannah River; the generation of hydrogen in high-level liquid waste tanks; and the conduct of operations, criticality safety, and plutonium accumulation in systems at Rocky Flats.

The Board's second recommendation, to develop and apply standards related to nuclear safety, was its first to address complex-wide issues. Reviewing standards and their implementation at the defense nuclear facilities was, in fact, the first function Congress assigned to the Board in its enabling legislation. That recommendation, Recommendation 90-2, was focused on the development and application of standards related to nuclear safety and was the first step in guiding

DOE toward a standards-based nuclear safety program. Two other early and important complex-wide recommendations covered the training and qualifications of DOE's contractor staff and the technical competence of federal technical personnel.

Today the Board still focuses on safety standards and technical competency. We just reaffirmed a recommendation on DOE's nuclear safety standards in early June. And we are currently conducting reviews on personnel training and qualifications, which have been impacted by the workplace restrictions associated with the pandemic.

The complex has come a long way from those earlier days and the safety posture of the nuclear complex has greatly improved. Unfortunately, the complex still experiences events that negatively impact the public's confidence in DOE; some of the early concerns are re-emerging as the facilities continue to grow older.

I'm going to focus on a few DOE incidents that affected public confidence, but I suspect that each of you can identify your own

examples given the diverse amount of nuclear-related work that DOE is responsible for completing each year.

Three events in recent years illustrate the complexities inherent in chemical interactions involving packaged radioactive waste. In these events, **unexpected** energetic chemical reactions within the waste resulted in breaches and significant releases of radioactive material from the packages.

The keyword here is "**unexpected**." None of these events revealed any new scientific or technical information that we didn't already know. Instead, these events reminded us that we need to continue to pay attention to past lessons. The failure to heed those lessons damages the public's confidence in DOE and the reputation of its contractors.

The first event occurred at WIPP, where on February 5, 2014, a fire involving an underground vehicle led to WIPP suspending operations. Then, on February 14, 2014, an incident occurred that resulted in a breached drum and expulsion of radioactive material into

the mine. A large portion of the mine was contaminated, and a small amount of radioactive contamination was released into the environment.

DOE suspended disposal of transuranic waste **for almost three years** while it investigated both the fire and radioactive release accidents and implemented corrective actions. DOE concluded that the release event was due to energetic chemical reactions over-pressurizing and breaching a waste drum. Prior to shipment to WIPP, the drum had been subjected to chemical compatibility screenings and was incorrectly classified as not ignitable. DOE also determined that the amount of radioactive material released during the accident was larger than the amount predicted by DOE standards by almost two orders of magnitude. Waste disposal at WIPP did not resume until January 2017, with an estimated total cost of two billion dollars and a growing backlog of waste at generator sites across the complex, which DOE is still working through today.

Only 15 months after WIPP reopened, energetic chemical reactions occurred in four waste drums at Idaho National Laboratory. The drum

lids were ejected, and radiological material was spread within the facility. The drums contained legacy waste that had been repackaged that day, and Idaho personnel had relatively little information on the chemical composition of the waste in those drums.

The contractor's investigation of this event identified several chemical reactions that may have been involved with the release event. As with the WIPP event, those chemical reactions could have been anticipated and properly remediated had an adequate evaluation been conducted prior to packaging of the waste.

The third event occurred on February 26 of this year at Los Alamos' Plutonium Facility. Again, the event involved waste, although in this case it was being packaged. Workers heard a noise and observed sparks emanating from a waste drum attached to a glovebox. The workers left the room, pulled a fire alarm, and contacted the operations center. The contractor's subsequent evaluation determined that the waste items in the drum included filters from an inert atmosphere glovebox used to weld non-radioactive metals including titanium alloy.

The likely explanation was that welding condensates of titanium on the filters underwent a pyrophoric reaction when a different waste item was added to the drum and breached a bagged filter allowing the influx of oxygen. The event was not energetic enough to cause an explosion but could have become an ignition source leading to a glovebox or room fire.

So, what impact have these events had on DOE? First, there are the obvious impacts on DOE's budgets and schedules. But I would argue that the more important impact is the loss of public confidence that DOE suffered following each of these events. Except for cost and schedule, the physical impacts of the events were small. None of the incidents injured workers or members of the public, contaminated any publicly accessible areas, or badly damaged any facilities. But DOE suffered reputational damage from the public's mental images of exploding drums spewing clouds of radioactive waste.

Since that first event in 2014, the Board has been evaluating how DOE analyzes hazards and implements controls at facilities that

generate, process, and store radioactive waste. During this time the Board has communicated several safety issues, common themes, and deficiencies to DOE regarding the need for expanded chemical compatibility evaluations, a technically defensible release fraction for energetic reaction events, improved control strategies to protect against energetic reactions, and necessary revisions to the DOE standards that address waste packaging activities.

Those communications include a Board letter and a technical report issued last year regarding lessons learned from the WIPP and Idaho release events. In the letter, the Board outlined specific areas of concern that DOE should address during the revision of the standard, including the need to conduct chemical compatibility evaluations for waste not destined for WIPP; to use defensible release fractions for safety analyses and derivation of controls; to apply the defense-in-depth strategy for control of chemical reaction events to the management of waste; and to address the potential for flammable gas buildup and deflagration in vented drums.

Other areas of concern to the Board include non-conservative and indefensible assumptions about waste container performance and DOE's apparent lack of urgency in promulgating and implementing the applicable standards.

Although the Board so far has chosen not to communicate these concerns in formal recommendations, we strongly encourage DOE to act on our advice. Those actions would assist those performing the work to perform those activities safely, which in turn would help increase public confidence in DOE. The good news is that over the course of 2020, the Board's staff has worked with the DOE team that is revising DOE Standard 5506[3] -- a standard which specifies how to analyze and control hazards at TRU waste facilities in the DOE complex -- regarding concerns highlighted in the Board's letter, as well as additional concerns that the staff provided via the DOE review and comment system.

The technical report provided a site-specific case study on how the safety bases for several different facilities at Los Alamos treat the

[3] DOE Standard 5506, *Preparation of Safety Basis Documents for Transuranic (TRU) Waste Facilities*

hazards posed by energetic chemical reactions. In the report, we concluded that these safety bases do not consistently or appropriately consider a potential energetic chemical reaction involving transuranic waste.

In those safety bases the Board noted identified hazard analyses that lack systematic evaluations of the chemical compatibility of waste streams, and accident analyses that assume inappropriate initial conditions and do not defensibly estimate the quantity of radioactive material that may be released during an energetic chemical reaction. Consequently, additional credited safety controls may be necessary to protect workers and the public.

Furthermore, some facilities store transuranic waste without any engineered controls beyond the waste container. The radiological release events that occurred at WIPP and Idaho National Laboratory have demonstrated the importance of incorporating multiple layers of protection to reduce the consequences of an accident.

We learned a lot from the WIPP event. In essence, that event taught us that there is a need to better understand what is in waste and a need to conduct defensible chemical compatibility evaluations. The later events at Idaho and Los Alamos revealed that those lessons had not been applied as broadly as we had hoped. These events highlighted that most of the focus has been on WIPP operations, rather than the waste while it is created, stored, and staged at the generator sites.

Waste characterization is also a challenge for legacy waste at the Hanford and Savannah River sites. It must be resolved successfully to complete the clean-up missions in Washington State and South Carolina.

There are other areas that can also cause incidents that reduce public confidence. Conduct of operations, training, and qualification programs continue to be weak spots at some sites. We must do better, and holistically address these issues, rather than addressing only individual concerns. Training refreshers and recertification are particularly important now, given the impacts of the COVID-19 pandemic.

There are many modernization and new construction efforts happening across the complex. Whether it is to modernize aging infrastructure or implement new congressional requirements, DOE must strive to implement best practices, state-of-the-art technologies, and the latest requirements and standards, if practicable, to ensure safety of operations at the defense nuclear facilities, and assure the public that safety is its number one priority.

In closing, we must always remember that public confidence, like trust, is very hard to earn but very easy to lose.

We all know that DOE will continue to make mistakes, for it is an enterprise that faces and overcomes highly technical challenges with large inherent uncertainties. But when it does make a mistake, it must seek to learn from the mistake and address what it has learned. Making the same mistake twice, or more than twice, is a clear failure in the eyes of the public.

But most importantly we all, and I mean both DOE and my agency, must demonstrate to the public our commitment to safety. We

must stay vigilant in our field of work. We must demonstrate that commitment and vigilance in our actions, not only in our words. And above all, we must strive to keep both the public, the workers, and the environment safe.

Thank you; I'll be happy to answer any of your questions.