The Nuclear Regulatory Commission and Safety Culture: Do As I Say, Not As I Do

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Workers at nuclear power plants are the front line of nuclear safety, and the ones most likely to detect safety problems when they arise. However, the safety of our nation's nuclear power plants suffers if workers are ignored or even retaliated against. Indeed, several nuclear plants have experienced such a chilled work environment and have had severe safety problems for just these reasons, notably the Millstone plant in Connecticut and Davis-Besse in Ohio.

The Nuclear Regulatory Commission (NRC), which oversees US power plants, believes that a positive safety culture—one in which there is a "collective commitment by leaders and individuals to emphasize safety over competing goals to ensure protection of people and the environment"—is vital to nuclear safety.[1] Safety should not be the only factor in decision making, but should be given proper emphasis. A positive safety culture is one that manages reactor safety risks despite aging equipment, staff turnover, budget cuts, and other challenges.

But it is not just nuclear plants that must maintain a positive safety culture—the NRC must, too. If plant workers are nuclear safety's front line, the NRC's inspectors and reviewers are the best insurance that the front line is fully staffed and reliable. NRC's workers must be confident that they can report any problems they observe without reprisal and that the NRC will address them. However, there are ample signs that the NRC itself has safety culture problems.

At nuclear power plants, the NRC does not directly assess safety culture; rather, that responsibility falls to the plant owners. However, it often gets indications that safety culture problems may exist. For example, plant workers have informed NRC inspectors that they are reluctant to report problems to management. Some workers have also alleged to the NRC that their employers have retaliated against them for raising safety concerns. In such cases, the NRC warns plant owners that a chilled work environment may exist at their plants, and this warning prompts the owners to take steps to assess and address the situation. The NRC's inspectors then monitor these activities. When dissatisfied by the pace or thoroughness of the efforts, the agency may take measures such as ordering owners to take additional steps or fining owners for missteps in their attempts to create a positive safety culture.

The NRC's interventions have restored a positive safety culture at several nuclear plants and prevented the accumulation of unresolved safety problems from growing to epidemic proportions. But evidence suggests that conditions *within* the NRC are as bad as—if not worse than—those that existed at these troubled plants. Just as nuclear plant owners have downplayed and dismissed clear and present signs about safety culture problems at their plants, the data suggest that the NRC's management is just as dismissive of indications that it has a poor safety culture. When it comes to chilled work environments, the NRC may have the largest refrigerator in town.

When the workforce and management in an organization have trust and confidence in each other, workers feel free to raise problems. When that trust gets broken, poor safety cultures develop. With clear evidence that a sizeable portion of the NRC's workforce lacks trust in NRC management, as outlined below, Congress must require the NRC to take the steps necessary to restore a positive safety culture—steps that the agency has successfully required so many plant owners to take.

[1] For additional information on the NRC's position on safety culture, see http://www.nrc.gov/about-nrc/safety-culture.html. For additional information on the NRC's position on safety culture for operating nuclear reactors, see http://www.nrc.gov/about-nrc/safety-culture/sc-nuclear-reactors.html.

Safety Culture Woes at Nuclear Plants

The Union of Concerned Scientists (UCS) examined some of the safety culture afflictions experienced at nuclear power plants over the past two decades—and what the NRC did to address those problems. This provides important context for considering the NRC's own safety culture, discussed later in the report. The two most egregious cases were the Millstone plant in Connecticut and the Davis-Besse plant in Ohio.

Safety Problems at the Millstone and Davis-Besse Plants

Millstone

The discovery of a large number of unresolved safety problems at the Millstone nuclear plant in the mid-1990s sharpened the NRC's focus on safety culture. Prominent among the many problems were the refueling practices for the Unit 1 reactor. The reactor's operating license prohibited the transfer of irradiated fuel bundles from the reactor core into the spent fuel pool within 150 hours after shut down in order to allow the fuel to cool; however, the fuel transfers frequently began before the 150 hours had passed. The reactor's safety studies assumed that only some of the irradiated fuel would be transferred into the spent fuel pool, but the routine practice was to offload the entire core into the spent fuel pool, with the heat load higher than the cooling system was designed to handle (NNECO 1993). All three reactors at Millstone were shut down in early 1996 to address these safety problems. Unit 1 never restarted. Units 2 and 3 remained shut down for more than three and two years, respectively (UCS 2006a; UCS 2006b). The NRC imposed a then-record $2.1 million fine for the many safety problems that had accrued over the years (USNRC 1997a). The costs of fixing the problems combined with no revenue being generated by the shutdown reactors nearly pushed the owner, Northeast Utilities, into bankruptcy.

Separate investigations by the plant owner, an independent contractor, and NRC inspectors revealed that these safety problems accumulated at Millstone because workers feared retaliation by management if they reported problems. The NRC fined the owner when it substantiated individual acts of retaliation and ordered the owner to hire an independent firm to oversee its Employee Concerns Program (USNRC 1996a; USNRC 1996b). Some nuclear plants maintain employee concerns programs to provide workers with a way to report safety or other concerns without going to their supervisors.

Davis-Besse

A few years later, safety culture problems mired another nuclear reactor in a two-year outage. In early March 2002, workers discovered extensive corrosion of the reactor vessel head at the Davis-Besse nuclear plant. A small amount of cooling water leaking from the reactor vessel over an extended period corroded away nearly six inches of the metal vessel, leaving only a quarter-inch-thick layer. Had that thin layer been breached, the rapid loss of cooling water through the opening could have caused an accident worse than Three Mile Island (Lochbaum 2016a; Lochbaum 2016b). A poor safety culture was the root of this problem, as management repeatedly stymied the cleaning and inspection efforts due to cost and pressure to restart the reactor as soon as possible.

The NRC imposed a record (as of this writing) $5.45 million fine for the many safety problems that accumulated during years of neglect (USNRC 2005). It took the Davis-Besse plant owner two years to fix its safety problems (UCS 2006c). The NRC allowed Davis-Besse to be restarted in March 2004 on the condition that the owner hire an independent firm to conduct annual assessments of the safety culture at the plant for at least five years (USNRC 2004a).

Safety Culture Woes at Other Nuclear Power Plants

Millstone and Davis-Besse may be the poster plants for safety cultures gone awry, but they certainly are not the only plants to experience the problem. In chronological order from the time of Millstone to the new millennium, other examples are:

1997 – Zion (Illinois)
The NRC informed the owner in July 1997 that it had received 27 allegations so far that year from plant workers, with more than half (15) of the allegations contending that management discriminated against or harassed workers for raising safety concerns (USNRC 1997b). The NRC conveyed its concern that this information suggested that plant workers might not report safety problems for fear of reprisals. The NRC requested a meeting with the owner to discuss steps it had taken and planned to take to ensure workers felt free to raise safety concerns. The company announced on January 15, 1998, that it was permanently closing the two reactors at Zion rather than attempt to correct the many known, unresolved safety problems (Feder 1998a).

1998 – South Texas Project (Texas)
The NRC determined that a supervisor retaliated against four workers for raising safety concerns, potentially creating an environment in which other workers would feel reluctant to raise concerns. The NRC ordered the owner to conduct periodic assessments of the safety culture at the plant and to factor input from employees into the annual appraisals of their supervisors (USNRC 1998b).

2004 – Salem and Hope Creek (New Jersey)
In January 2004 the NRC informed the owner of the neighboring Salem and Hope Creek nuclear plants about the results of a special review it had conducted in late 2003 (USNRC 2004b). The special review was conducted in response to the NRC's concerns about the work environment at the plants, particularly involving decisions to continue operating the reactors with safety equipment known to be broken and impaired. The owner retained three outside teams to investigate matters at the plants.[2] A workforce survey conducted by one team revealed that 15 to 20 percent of workers did not view the Employee Concerns Program as a viable method of reporting problems (O'Hanlon et al. 2004). All three teams concluded that the primary problem was untimely and ineffective fixes to safety problems. The repeated failures to fix safety problems gave many workers the impression that management simply did not care whether safety equipment worked or not.

The NRC made efforts to restore a positive safety culture, following up its January letter by meeting with the plant owner in March to ensure there was a common understanding of the problem and the steps to be taken to remedy it (USNRC 2004c). The NRC met with the owner again in October to review progress and remaining actions (PSEG 2004). The owner told the NRC that it had created an executive review board in April tasked with reviewing proposed disciplinary actions, promotions, and transfers of workers to ensure no adverse actions were taken for raising safety concerns. The owner also told the NRC that it had instituted monitoring in May for corrective actions that were overdue and those with target deadline extensions and in July began tracking the number of maintenance tasks needing to be redone.

2009 – Susquehanna (Pennsylvania)
The NRC received allegations in 2006 about a "chilled work environment" from workers performing refueling activities. A workforce survey conducted in late 2006 by the plant owner indicated safety culture problems within the maintenance and radiation protection departments. While the number of allegations received by the NRC dropped during 2007, the number significantly increased in 2008. In January 2009 the NRC issued a letter to the owner warning of a potential chilled work environment at the power plant (USNRC 2009a). The NRC ex-

[2] The three efforts were by the Synergy Consulting Services Company (December 2003), the Utility Services Alliances (March 2004), and the Independent Assessment Team (May 2004).

pressed concern that the company's efforts to stem and reverse a declining trend in the safety focus of the work environment at the site warranted more attention and better results. The NRC met with the owner in July (USNRC 2009b), listened to the owner's action plan, and outlined steps the agency would take to ensure that a proper safety culture existed at the plant.

2010 – San Onofre (California)
The NRC issued a letter to the plant owner in March 2010 stating that a significant increase in the number of allegations received from workers in different departments at the site indicated a growing reluctance among them to raise safety concerns (USNRC 2010a). Nearly 25 percent of the workers interviewed by the NRC believed that management would retaliate against individuals who relayed safety concerns to the agency. The NRC met with the plant's owner in September and heard about the 33-step action plan the management had developed to remedy safety culture problems at the plant (USNRC 2010b). The NRC met again with the owner in December (USNRC 2011). The owner updated the NRC about steps taken and provided results from metrics monitoring parameters such as the timeliness and quality of corrective actions taken to resolve safety issues.

2013 – Palisades (Michigan)
The NRC identified a chilled work environment within the security department at the plant in December 2013. A primary concern involved a security manager permitting unqualified individuals to hold security positions at the plant. In July 2014 the NRC ordered the owner to take several remedial steps, including five steps specifically intended to improve the safety culture within the security department (USNRC 2014a). The NRC conducted a follow-up security inspection in December 2014 to verify that these steps had been completed (USNRC 2015a).

2016 – Watts Bar (Tennessee)
The NRC issued a letter to the owner in March 2016 after receiving allegations from several licensed control room operators that management was making decisions based on meeting schedules rather than safety considerations (USNRC 2016a). The owner responded to the NRC in April identifying several senior management changes, communication efforts, and process changes that it had implemented to restore the positive safety focus at the plant (TVA 2016).

Financial Consequences of a Chilled Safety Culture

Poor safety culture manifested itself in two different ways at Millstone and Davis-Besse, but with similar adverse consequences:

> *At Millstone, employees felt constrained from raising issues because of a fear of retaliation, which is indicative of a poor safety conscious work environment. Employees at Davis-Besse, on the other hand, did raise issues, but they observed that these issues were not adequately addressed or were allowed to go uncorrected for long periods of time. While individuals continued to raise issues, little was done to address the issues they raised. Consequently, the effectiveness of the corrective action program was significantly reduced* (USNRC 2003a).

Whether workers were silenced or ignored, poor safety cultures prevented known safety problems from being corrected at Millstone and Davis-Besse. The longer the poor safety culture persisted, the longer the list of unresolved safety problems grew. The longer the list of safety problems, the more likely the NRC would require that the plant remain shut down until the backlog was eliminated.

The problems afflicting Millstone and Davis-Besse have often been characterized as having been caused by management placing production ahead of safety. But both reactors were shut down—not generating a dime of revenue—for more than two years while the owners paid more than $100 million for an army of workers to belatedly fix the problems. If management placed production ahead of safety, they obtained neither. These sites did not simply have

poor safety cultures—they had poor business cultures, too. Safety performance and financial performance are two sides of the same management competence coin.

The NRC's Actions to Remedy Safety Culture Problems at the Plants

In each of the examples above, intervention by the NRC was the catalyst needed for the owner to take steps to improve the safety culture at its plant. The plant owners had all the data available to the NRC plus considerable additional data, yet were unwilling or unable to connect the dots to see the full picture until induced to do so by the NRC. That's the bad news—external intervention was necessary to get the owners to take measures to restore a positive safety culture in which workers feel safe flagging the safety issues they observe.

The good news is that the NRC's interventions were both successful and sustainable.[3] Although several of the plants discussed above—including Millstone, Davis-Besse, and South Texas Project—have reported safety problems since these interventions, the causes have been such things as poor maintenance, deficient procedures, and equipment malfunctions, and not manifestations of a poor safety culture.

The NRC's Own Safety Culture

The NRC can best promote a positive safety culture at nuclear power plants by cultivating a positive safety culture internally. As the international Nuclear Energy Agency recognized:

> *By nature of its role, one of the stakeholders who most deeply influence the licensees' safety culture is the regulatory body.… Hence, the regulatory body needs to be conscious of its own safety culture's impact on the safety culture of the organisations it regulates and oversees in order not to hamper those organisations' willingness and efforts to take on their primary responsibility for safety. For this reason, it is paramount that the regulatory body not only consider safety culture as a matter of oversight, but also as a matter of self-reflection* (NEA 2016).

The NRC's mission involves establishing and enforcing regulations that manage the risk from nuclear plant operation to an acceptably low level. The NRC needs a positive safety culture in order to fulfill its vital mission. In the Millstone case described above, the NRC knew about the unsafe refueling practices but tolerated them via a "no blood, no foul" policy until the NRC's Inspector General identified the safety violations. In the Davis-Besse case, the NRC perceived the plant to be the safest in the region, if not the entire country, and reallocated its oversight resources to other plants. But by not looking at Davis-Besse, the NRC failed to notice the clear and present signs of danger. A half-baked safety culture at a plant and a half-baked safety culture at the NRC can add up to a fully-baked nuclear nightmare.

The evidence strongly suggests that the NRC's own safety culture is in distress. The good news is that the NRC knows how to remedy poor safety cultures—it merely needs to take the medicine it has prescribed so often to others.

The NRC has intervened when it became aware that workers—even if only a small number—at nuclear plants feared reprisals for raising safety concerns. For example:

- San Onofre (2010) – 25 percent of the plant's workers stated to the NRC that individuals would be retaliated against if they reported concerns to the agency (USNRC 2010a).

- Davis-Besse (2003) – 7 percent of the workers told the NRC they could not raise concerns without fear of retaliation (First Energy 2003).

- Salem/Hope Creek (2003) – 6 percent of the

[3] Zion was permanently closed soon after the NRC's intervention, making it impossible to know whether it would have been successful.

workers indicated to the NRC that they could not raise concerns to the Employee Concerns Program without fear of retaliation, and 6 percent indicated they could not raise concerns via the corrective action process without such fear (O'Hanlon et al. 2004). (Employee Concerns Programs allow workers to report problems—anonymously or confidentially if desired—outside their normal chain of command. The corrective action process is used by plant owners to comply with federal regulations that require safety problems to be found and fixed in a timely and effective manner.)

- Millstone (1997) – 11 percent of the workforce told the NRC that they knew of co-workers who would not report concerns to the Employee Concerns Program (Little Harbor Consultants 1997a).

Unfortunately, NRC's own workers have similar fears. NRC workers experienced the following:

- **Fear of reprisal:** The percentage of NRC workers who stated they could not disclose a suspected violation of any law, rule, or regulation without fear of reprisal increased yearly from 8 percent in 2010 to 13 percent in 2015 (USNRC 2015b). In 2016, 15 percent of NRC workers filing Equal Employment Opportunity complaints cited reprisal as the basis for the complaint (USNRC 2016b); in 2015 this reason was cited by 18 percent of the filers (USNRC 2015e). Even more disturbing, in 2012 the survey found that 39 percent of the NRC workforce did not believe they could report the truth to their supervisor without fear of reprisal (USNRC 2015b; USNRC 2014b).

- **Reluctance to formally disagree with an NRC position:** NRC workers may formally disagree with a final position taken by the NRC under the agency's Differing Professional Opinion Program (USNRC 2015c). The percentage of the NRC workforce that felt that using this program would have negative career consequences ranged from 22 percent in 2005 to 16 percent in 2009 to 18 percent in 2012. Similarly, in 2009 and 2012, only 15 percent of the NRC workforce reported that they would be willing to raise a concern via the differing professional opinion process.

- **Reluctance to refuse to sign onto an NRC final document:** NRC staff who review draft technical documents may elect under the agency's non-concurrence process not to sign onto the final document if they disagree with the contents. In 2013, 53 percent of the NRC workforce stated that their co-workers would not use the non-concurrence process to raise a concern (USNRC 2014c).[4]

The percentage of the NRC workforce that feared retaliation for raising concerns is comparable to, and sometimes higher than, the percentage of nuclear plant workers who feared retaliation, which compelled the NRC to intervene to restore a positive safety culture. The troubling situations at Watts Bar, San Onofre, Davis-Besse, Millstone, and other plants warranted the NRC's attention. The same situation within the NRC warrants attention, too.

The NRC took action when a fairly low percentage of workers reported retaliation for having raised safety concerns at nuclear plants:

- In 2014, the NRC concluded that the Security Department at the Palisades plant in Michigan had a chilled work environment because "some" security staff members believed two security supervisors had been fired for raising concerns (USNRC 2015d).

[4] Nuclear plant workers receive training on their legal obligation to identify safety problems, and most workers believe they will do the right thing even in the face of pressure. However, safety culture consultants have found that workers tend not to concede wrong-doing even within the confidentiality of a survey. Therefore, surveys often probe this subject by asking about co-workers' likely behaviors.

- In 2003, 8 percent of the workers at the Davis-Besse plant reported having been harassed, intimidated, retaliated against, or discriminated against for raising concerns, and 15 percent reported knowing co-workers who had experienced such treatment (First Energy 2003).

- In 1997, 39 percent of the workers at the Millstone plant reported knowing co-workers who had raised concerns and suffered repercussions.

- In 1997, the NRC received allegations from 15 workers at the Zion plant in Illinois (with a staff of nearly 1,000) that they had been discriminated against for raising concerns (USNRC 1997c).

And retaliation has also been reported by NRC's own workers:

- Of the NRC workers who submitted a non-concurrence report in 2013, 75 percent reported feeling that their subsequent performance appraisals were adversely affected, 63 percent reported that they had been excluded from work activities as a result, and 25 percent reported that they had been verbally abused by their supervisors and/or other NRC managers (2014c).

- Of the NRC workers who submitted a differing professional opinion in 2013, 22 percent reported that they had been excluded from work activities as a result, 11 percent reported that their subsequent performance appraisals were adversely affected, and 22 percent reported that they had been relocated or reassigned to a different job as a result (USNRC 2014b).

Once again, the percentages of NRC workers who reported reprisals after raising concerns is comparable to the percentages of nuclear plant workers who reported reprisals, which spurred the agency to intervene. Similar symptoms of a disease warrant similar treatments in response.

Congress Must Act

The owners of nuclear power plants with poor safety cultures rationalized away the information they possessed about these problems. Only after the NRC pointed out the problems did the owners see them and take the steps necessary to restore a positive safety culture. Similarly, NRC senior managers may be rationalizing away the agency's own safety culture problems. While three-quarters of senior and middle-level managers at the NRC have positive opinions of the agency's processes for handling differing views, less than half of the NRC's workers share that outlook.

Like nuclear power plant owners, NRC senior managers will probably also require external stimuli to compel them to take the steps needed to cure the agency's safety culture woes. Congress has oversight of the NRC and must induce the agency to take the same medicine it has so often prescribed for nuclear plant owners.

As a start, House and Senate oversight committees should hold hearings on NRC safety culture and bring in NRC managers to testify. There are two vacant seats on the NRC Commission; during their confirmation hearings senators should ask the candidates about their commitment to restoring a positive safety culture within the NRC. These and other congressional actions will help to strengthen the safety culture of the NRC, giving it the force to carry out its responsibilities for ensuring safe nuclear power for the nation.

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