

Why Transforming the DOE Nuclear Weapons Complex Is So Difficult (Part I)

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The National Research Council's (NRC) February 2012 report on *Managing for High-Quality Science and Engineering at the NNSA National Security Laboratories* is the latest in a series of studies that lament the state of science and engineering (S&E) and the management of S&E in the Department of Energy (DOE) Nuclear Weapons Complex.¹ To date, the National Nuclear Security Administration's (NNSA) vision for transforming the Nuclear Weapons Complex has focused on site closures, consolidating foot prints, and more recently the consolidation of Management and Operating (M&O) contracts at facilities like the Y-12 National Security Complex, Pantex, and the Savannah River Tritium Operations. This is the first in a series of articles that argues that NNSA's vision of transformation should be broadened to include *organizational* transformation in response to the NRC Report and proposed legislation in the FY 2013 Defense Authorization Act, including the shift of construction activities for the Uranium Processing Facility (UPF) and the Chemistry and Metallurgy Research Replacement-Nuclear Facility (CMRR-NF) to the Department of Defense.² The article also explains why this kind of organizational transformation is so difficult within the DOE Nuclear Weapons Complex.

A History of Transformation

Established by Congress in 2000 under Title 32 (50 USC 2401) as the "National Nuclear Security Administration Act," the NNSA was designed to be a semi-autonomous agency within DOE responsible for enhancing national security through the military application of nuclear science. The NNSA carries out programs that visibly address three major national security endeavors: a) employing science to maintain the safety, security, and effectiveness of nuclear weapons and capabilities that deter our adversaries and reassure our allies and partners; b) accelerating and expanding our efforts here in the homeland and around the world to reduce the global threat posed by nuclear weapons, nuclear proliferation and unsecured or excess nuclear materials, technology or expertise; and c) providing safe and effective nuclear propulsion for the United States Navy.

Over the past two decades DOE has been transforming the Nuclear Weapons Complex to right-size (and modernize) its infrastructure by reducing the number of sites from 15 to eight and consolidating the overall footprint to support the infrastructure that is essential to sustaining the required *capabilities* needed to manage the nuclear weapons stockpile.³ Currently, NNSA HQ envisions a future Nuclear Security Enterprise (NSE) that integrates interdependent centers of excellence at eight sites, in modernized facilities within smaller site footprints; and staffed by a world class, highly trained, engaged, and motivated workforce. The *capacity* of this complex will be based on the minimum scale of the facilities necessary to maintain the supported essential capability. This approach will drive consolidation of activities while surplus and outdated facilities will be dispositioned to achieve square footage reduction targets. Overall, a "capability-based" complex will produce long term reductions in maintenance and security costs that can be applied to improved maintenance and security of the remaining facilities.

One of the main drivers for these changes within NNSA is that the international security environment has changed dramatically since the end of the Cold War. As described by the *2010 Nuclear Posture Review Report*, while the threat of global nuclear war has become increasingly remote, the risk of

nuclear attack has actually increased with the immediate danger of nuclear terrorism.⁴ These changes in the nuclear threat environment have altered the hierarchy of America's nuclear concerns and strategic objectives. The massive nuclear arsenal we inherited from the Cold War era of bipolar military confrontation is poorly suited to address the challenges posed by suicidal terrorists and unfriendly regimes seeking nuclear weapons. Therefore, it has been essential that the U.S. better align its nuclear policies and posture to our most urgent priorities – preventing nuclear terrorism and nuclear proliferation. One of the key elements of this strategy is arms control, including the New Strategic Arms Reduction (START) Treaty that officially entered into force of law with the exchange of instruments of ratification between Secretary Clinton and Foreign Minister Lavrov of Russia in Munich on February 5, 2011. The *bottom-line* is that the role that the DOE Nuclear Weapons Complex must play in addressing this new international security environment has irrevocably changed from the Cold War era, and NNSA HQ and field elements must ensure that these changes happen across the Nuclear Weapons Complex.

In addition, the current economic situation in the U.S. and mounting socio-political pressure to reduce Government spending have *intensified* the strategic challenge of transforming the Nuclear Weapons Complex, placing NNSA under increased scrutiny as stewards of taxpayers' dollars. Although the overall high level of award-fee performance ratings of DOE's M&O contractors are an indicator that the NNSA HQ is pleased with the performance of *individual* facilities like Y-12, Pantex, and the Savannah River Tritium Facility, from an enterprise-wide *systems* perspective NNSA HQ has stated over the years that it sees the Complex-wide processes for designing, constructing, maintaining, and disassembling of nuclear weapons as being outdated, redundant, and lacking the kinds of economies of scale and scope, and synergies that they envision for the high-performance NSE of the 21st Century. The "siloes" Complex-wide processes and facilities that do exist are often linked together with meetings, IT systems that don't "talk" to each other, and cross-Plant-Lab systems and processes that have become increasingly costly and ineffective.

To address these issues, NNSA HQ has recently moved into the next phase of transformation by consolidating key M&O contracts like the contracts at Y-12 and Pantex, with an option to include the Savannah River Site Tritium Operations.⁵ NNSA HQ believes that this consolidation will simplify organizational interfaces and has the potential to improve effectiveness and efficiency by eliminating redundancies, achieving economies of scope and scale, the adoption of best practices from among the consolidated facilities, and synergies created by a single organization doing work planning to improve product flow. NNSA envisions that the consolidated M&O contracts will also reduce the interfaces between nuclear and non-nuclear production and ultimately result in potential savings of about \$1 billion over a 10-year period.

But in light of the multiple studies conducted on more efficiently overseeing the Nuclear Weapons Complex over the past two decades (e.g., Galvin Task Force, Chiles Commission Report, Foster Report, SEAB Task Force, Stimson Center's Task Force Report, etc), NNSA needs to broaden its vision to include *organizational* transformation in the ways suggested by the NRC Report and proposed legislation in the FY 2013 Defense Authorization Act.⁶

What Is Organizational Transformation?

The government sector often assumes that they should emulate the leadership and management approaches used by commercial for-profit corporations. But as Jim Collins points out, "We must reject the idea – well intentioned, but dead wrong – that the primary path to greatness in the social sectors is to become 'more like a business.' Most businesses – like most of anything else in life – fall somewhere between mediocre and good. Few are great."⁷ In a section of his book *Out of Crisis* entitled, *Principles for Transformation of Western Management*, W. Edwards Deming argues strongly

that commercial for-profit organizations must also be transformed, “Western style of management must change to halt the decline of Western industry, and to turn it upward... There must be an awakening to the crisis, followed by action, management’s job... The transformation can only be accomplished by man, not by hardware (computers, gadgets, automation, new machinery). A company cannot buy its way into quality.” Deming’s prophetic words have a more poignant ring of truth today than when they were first published by the MIT Center for Advanced Engineering Study in 1982.⁸ The point of referencing Collins and Deming here is to underscore the fact that the issues facing NNSA HQ in transforming the Nuclear Weapons Complex are part of the larger leadership and management problems that afflict major corporations across the US, including M&O contractor organizations and their parent companies. In fact, case studies of dozens of mergers, acquisitions, and transformation projects in the commercial sector indicate that the vast majority show failed or marginal results, so trying to run NNSA and its M&O contractors “more like a business” is not necessarily a silver bullet for achieving organizational transformation.⁹

As defined in the business literature, *organizational transformation* refers to deep, fundamental, (often radical) changes in an organization’s mission, strategy, structures, systems, ways-of-working, and culture, as opposed to incremental improvements. Transformation is often a response to forces and demands in the business environment that require an organization to change how it does business in order to survive in the market place. Over the last 25 years, organizational transformation has been called many things including, reengineering, rightsizing, and more recently culture change. But the basic goal of all these approaches has been similar; e.g., to make fundamental changes in how an organization structures, organizes, and uses its human, material, and financial resources to act on (and react to) changes in the business environment.

Organizational transformation has two elements: change and transition. The *change* required to align an organization’s structures, systems, and resources around a new mission and strategy that increases the value delivered to customers is situational and tends to happen quickly; e.g., functional “silos” are consolidated with new leadership and directed to achieve even larger goals with fewer human, financial, and material resources. The *transition* element of transformation is a protracted cultural and psychological process that people go through to learn new ways-of-working and to let go of the old organizational reality and identity that they had before the change took place.¹⁰ Over time, managers and staff members must gain ownership in (and come to terms with) their new role in the reconfigured organization. The most important lesson to be learned from dozens of documented transformation initiatives is the necessity to manage *both* change and transition throughout the entire process.¹¹ Managing both change and transition is an extremely powerful Design Principle that provides a high-level framework for shaping and defining the overall goals and intent of organizational transformations, and helps to assure that transformation initiatives have integrity and consistency in execution.

Change and transition are “managed” by determining *how much* change and transition is required to achieve the end-state vision of transformation.¹² On the one hand, too much change within too short a time-span overwhelms people with learning new ways-of-working and interacting. Too much change and failing to lead people through transition almost guarantees that transformation will not happen. On the other hand, if there is *too little* change, or if the changes are not focused on the underlying *Common Causes* in the organization’s structures, systems, and culture, organizational transformation won’t happen either. Multiple initiatives that create too little change fatigue organizational morale and undermine trust because managers and staff members come to view these failed attempts cynically as the “flavor of the month.”¹³

Too Little Change and Insufficient Autonomy for NNSA

It's important to note that the management problems described in the NRC Report pre-date the existence of NNSA by more than a decade and are woven into the fabric of the DOE's "culture." The key indication that an issue is "cultural" is the existence of patterns of organizational behavior that span long-periods of time and are invariant under change in leadership, organizational structure, and management strategy. The NRC Report documents the existence of these issues back to 1995, but many of the same problems date back to the late 1980s when: a) the Defense Nuclear Facilities Safety Board (DNFSB) was formed to provide oversight for DOE, and b) Secretary Watkins created and deployed 38 Tiger Teams across the DOE enterprise. The issues described by the NRC Report span the Administrations of five U.S. Presidents (Reagan, H.W. Bush, Clinton, W. Bush, and Obama), eight Secretaries of Energy (Herrington, Watkins, O'Leary, Pena, Richardson, Abraham, Bodman, and Chu), and re-organizations, changes in both Federal and M&O leadership, and flavor-of-the-month "change" initiatives too numerous to recount.

Congress used the National Defense Authorization Act of 2000 to create the NNSA and the new law clearly defined NNSA's mission and organization, including roles and responsibilities for NNSA HQ, Site Offices, and the Laboratories.¹⁴ But by 2002, the Foster Panel Report stated that there was a "...disturbing gap between the nation's policy that maintaining a safe and reliable nuclear stockpile is a supreme national interest, and the actions taken to support this policy. Congress created the NNSA to address this situation and other longstanding problems. Although progress has been made, much more needs to be done."¹⁵ Subsequent studies continued to echo these findings; e.g., the 2003 SEAB Blue Panel Commission, 2005 SEAB Task Force on Nuclear Weapons, 2008 Defense Science Board Report, 2009 Stimson Center Task Force, and the 2009 Strategic Posture Commission Report.¹⁶ The NRC Report confirms that although NNSA was given *formal* authority over a range of operations, the execution of that authority in day-to-day operations was resisted by DOE from the NNSA's inception. For example, "During the first term of the Bush Administration, the DOE General Counsel effectively prevented any NNSA actions exempting the NNSA from any DOE regulations, arguing any such action required DOE staff concurrence."¹⁷

If we use the Design Principle of managing change and transition to help understand these events, it becomes clear that NNSA was not able to create *enough* change to "extract" itself from its parent DOE organization, nor did the new agency address the underlying Common Causes of DOE's management problems that: a) work together to maintain the status quo and prevent change from actually happening, while at the same time b) giving the "appearance" that things will now be different through flavor-of-the-month change initiatives. Over time, multiple failed attempts to change give rise to the belief that "things won't really change" – at least not a fundamental level. This belief becomes a self-fulfilling prophecy that both frustrates (and comforts) Federal and M&O contractor employees – most of whom would much prefer the status quo to positive change.

Over time, M&O contractors and NNSA have been overcome by what Bob Wilson (Fermilab's first director) called *creeping bureaucracy*. In a handwritten memo that was circulated among his staff he pleaded, "Dear Colleague: An all too common failing of large institutions is to fall into the bureaucratic morass – complicated procedures, red-tape, and all that. That's terrible. Let's try hard to keep the good old can-do informal spirit of Fermilab alive! I ask each of you to be intolerant of creeping bureaucracy." Creeping bureaucracy frustrates and undermines mission-program goals by consuming valuable human, material, and financial resources; it decreases the productivity and effectiveness of day-to-day operations; it sentences managers to struggle against the flow of overly complex systems that decrease morale, increase frustration, and undermine organizational trust; it discourages line management from taking full responsibility for environment, safety, security, health, and quality issues (ESSH&Q); and it creates a false sense of security among workers that oversight

by organizations like DOE Office of Health Safety and Security (HSS) and the DNFSB actually improves (rather than undermines) effective ESSH&Q implementation in day-to-day operations.¹⁸ So the second Design Principle that NNSA should adopt as part of its change strategy is to minimize bureaucracy and non-value-added compliance with directives, policies, and procedures.

What Needs to Be Changed?

One of the most troubling issues in the NRC Report is the existence of excess *formality of operations*. This includes an increased number of budget and reporting categories; overly centralized science and technology planning and direction by NNSA; transactional “follow the numbers” type oversight of operations; an overemphasis on security and safety and associated paperwork; paper-work intensive milestone reporting and formal reviews that have displaced productive bottom-up communication between senior Lab management and S&E staff about science and engineering issues; and burdensome requirements for purchasing, safety checks, and certifications on complex experimental work that discourage scientists and engineers from conducting the kinds of experiments needed to strengthen S&E and attract the very best graduate students, post-docs, and scientists to the Laboratories.

Interestingly, the NRC Report states that, “While some Lab S&E staff believes the excess use of operational formality is a choice imposed by the M&O contractors, or by the contracts, the study committee did not see evidence of that. When Laboratory employees were questioned about heavy-handed bureaucratic processes, they could not point to their origin: that was true even of managers. The contracts and their incentives do not seem to encourage or mandate this.”¹⁹ While Lab managers and S&E staff are concerned about the *effects* that excess formality of operations is having on day-to-day operations, they could not identify the *Common Causes* (or origin) of these effects, so it’s unlikely that the changes they propose will actually solve the problem long-term. As the history of the past eight Secretaries of Energy and a long line of M&O contractors show, trying to make positive change by reorganizing, changing leadership, implementing new management programs, or issuing (or eliminating) DOE Orders and directives without a clear understanding of the underlying causes of the problems they are designed to “fix” *creates change*, but tends to solve one problem and unintentionally creates others.

The NRC Report identifies the root cause (origin) of excess formality of operations as a lack of *trust* between Federal and M&O contractor personnel. The study committee’s focus on the “broken” and “dysfunctional” nature of the NNSA/M&O contractor *relationship* is of enormous positive import and has the “ping” of truth about it. As the report states, “An erosion of trust on both sides of the relationship shapes the oversight and operation of the Laboratories. This in turn has resulted in excessive reliance on operational formality in important aspects of Laboratory operations, including the conduct of science and engineering at the Laboratories. Operational formality is the application of specific rules and predetermined procedures to the accomplishment of tasks. This approach derives from industrial practices, where it is often important to assure goals such as safety by specifying exactly how tasks are to be done and then taking measures to ensure that these steps are strictly followed. While the application of ‘follow the numbers’ to ensure safety in selected tasks seems obvious, so does the mismatch of this approach to creative activities such as S&E.”²⁰

Trust is the foundation of all human interactions, and the cornerstone upon which high-performing organizations are built. Researchers like Deming and Abraham Maslow have warned against the debilitating effect that fear can have on both individual and organizational performance.²¹ It makes people afraid to share their best ideas; expand their capabilities and skills; admit mistakes; suggest process improvements; question the underlying purpose and reasoning of decisions or procedures; or even to act in the best interest of the organization. Managers and staff members fear: a) being the

object of real or perceived retribution, b) being passed over for promotion, c) receiving lower performance ratings, d) looking uninformed or like a trouble-maker, e) being assigned to “grunt” work, rather than the more visible projects, and f) being seen as not having sufficient intellectual horsepower, experience, and savvy to advance beyond their current position. Fear ultimately leads to padded figures, increased ESSH&Q incidents, distorted measures of performance, and the tendency to sanitize, spin, and reinterpret what’s really going on in an organization as information flows up through organizational levels to top management.

A culture of fear and mistrust creates the kind of “broken” and “dysfunctional” relationships identified in the NRC Report. The NRC Report identified two key elements of trust: reliance and confidence. “*Reliance* means believing in the other party’s character and ability: can the other party be believed? Does the other party know what he/she is talking about? Do I have faith in the other party’s knowledge and expertise? *Confidence* means believing that I can depend on something in the future regarding another individual or group. Can I rely on the other person to do what they said they would do? Based on extensive discussions, the study committee thinks that if it were to ask NNSA, the Laboratory managers, or the scientists and engineers at the Laboratories these questions, none would answer in the affirmative.”²² But the NRC Report provides little or no insight into the historical, systemic, Common Causes (origin) of this erosion of trust.

The Event, Pattern, and Trust Process (EPT Process) describes the underlying mechanism for building trust in one-on-one relationships and in organizations.²³ At an individual manager-employee level, the first time a manager has to speak to an employee about a performance problem, the manager is talking about a *single event*; e.g., the “E” in the EPT Process. The second or third time the manager has to discuss this same issue, a pattern-of-interaction begins to form that is a qualitatively different issue than a single isolated event; e.g., the “P” in the EPT Process. If the problem continues, the employee’s performance begins to undermine the manager’s trust in their capabilities and/or character, and eventually it undermines trust in the relationship; e.g., the “T” in the EPT Process. Normally, employees in this position want to continue to talk about the latest “event” that has occurred, long after the problem has morphed into a pattern-of-behavior or a trust issue.

The EPT Process also describes the level of trust between organizations. On one side of the trust relationship, NNSA HQ and Site Office elements see the historical “events” and a pattern of increased cost, schedule, and quality problems on large construction projects like: a) the National Ignition Facility, b) the Highly Enriched Uranium Materials Facility and Uranium Processing Facility, c) the Mixed Oxide Fuel Fabrication Facility; and e) the Chemistry and Metallurgy Research Replacement project; combined with e) episodic operational “events” related to achieving performance goals and ESSH&Q issues as tangible evidence that M&O contractors have difficulty delivering on commitments which undermines trust. This gives the appearance (to Congress and the media) that NNSA is not fulfilling its fiducial responsibility to be “good stewards” of taxpayer dollars. It is also reflected by the fact that NNSA has been on the High-Risk List of the Government Accounting Office for more than a decade because of problems in managing large construction projects, with day-to-day operational problems described in the 2011 GAO report entitled, *Modernizing the Nuclear Security Enterprise*, and in current Congressional discussions about safety and security incidents at Sandia National Lab, Los Alamos National Lab, Lawrence Livermore National Lab, and the Nevada National Security Site’s Device Assembly Facility.²⁴

On the other side of the trust relationship, M&O contractors have been increasingly subjected to a risk-averse, one-size-fit-all approach to excessive formality of operations. While theoretically, there should be an *essential tension* between NNSA’s mission-program and oversight activities, M&O contractors see the perspectives, interests, and concerns of NNSA HQ mission-program personnel and NNSA Site Office oversight personnel as being different than (and in some cases opposed to) each other because the primary focus of their time and energy is on getting the results they’re being held directly accountable for

– *either* mission-program goals, *or* oversight goals, rather than what Jim Collins calls both-and-thinking.²⁵ Consequently, the perspectives, interests, and concerns of NNSA HQ mission-program personnel and M&O contractors tend to be more aligned than those with NNSA Site Offices because they’re focused on S&E and mission which creates a “triangulation” that prevents these three organizations (NNSA HQ, Site Offices, and M&O contractors) from working together as an effective “team” who shares a common fate where one cannot succeed without the other, and undermines trust.

The NRC Report makes four key recommendations for repairing the broken trust in the relationship. Recommendation 4-1 states that NNSA and its M&O contractors should commit to the goal of rebalancing the managerial and governance relationship as a way to build higher levels of trust.²⁶ Recommendation 4-2 states that NNSA and M&O contractors: a) should develop a set of principles (e.g.; operating principles) that clearly define the boundaries of roles and responsibilities for the Federal and M&O management structures, and b) that NNSA HQ program managers, Site Offices, and M&O contractors be directed to abide by these principles. Recommendation 4-3 states that these agreements and the operating principles should be memorialized in a memoranda of understanding (MOU) between NNSA and its M&O contractors, with the performance of both Federal and contractor personnel on the goals of the MOU being assessed on an annual basis, over a five-year period, with the results reported to Congress. The commentary surrounding these recommendations in the report acknowledges that mistrust is a “highly stable phenomenon” that can last for years (or decades), so a quick-fix strategy for rebuilding trust is unlikely to succeed.

In addition, the proposed legislation in the FY 2013 Defense Authorization Act is designed to make NNSA a more semi-autonomous agency by transferring oversight authority for ESSH&Q from DOE HHS to NNSA; requiring that NNSA adopt OSHA standards for non-nuclear work and develop its own policies for nuclear work; revising NNSA directives to streamline operations; developing a new system of governance using performance-based oversight, rather than transactional-based oversight; and reducing the head count in NNSA’s Office of the Administrator to 800 by October 1, 2014 to help drive the transition to performance-based oversight.²⁷ Congress is also proposing to modulate the oversight authority of external entities like the DNFSB to eliminate the duplicative and excessive burden of external oversight; e.g., checkers checking the checkers.²⁸

But to return to our discussion on the Design Principle of managing both change and transition; even if these recommendations are fully implemented, will they create enough change to actually reduce (or eliminate) excessive formality of operations, and to rebuild trust between NNSA and M&O contractor personnel? Do the recommendations address the underlying *Common Causes* of excessive formality and mistrust in the organization’s structures and systems that are “cultural” as evidenced by long-term patterns of organizational behavior? What level of confidence do we have that the time and expense involved in trying to implement these changes will actually produce tangible results that disconfirm the self-fulfilling prophecy that “things won’t really change?”

Transition to Part II

Part II in this series of articles describes three interdependent *Common Causes* that are likely to frustrate and undermine the effective implementation of the NRC and Congressional recommendations, while giving the appearance that real change and transformation are happening. Not directly addressing the three *Common Causes* described in Part II almost guarantees that the change strategy developed by NNSA and its M&O contractors will not: a) create enough change to reduce (or eliminate) excessive formality of operations, or b) rebuild the level of trust between NNSA and its M&O contractors.

To continue on and read Part II of this article, use an Internet search engine like Google or Bing to search for the title, *Why Transforming the DOE Nuclear Weapons Complex Is So Difficult (Part II)*.

End Notes

¹ See National Research Council, *Managing for High-Quality Science and Engineering at the NNSA National Security Laboratories*, Prepublication, (Washington, DC: The National Academies Press, 2012).

² A description of this proposed legislation can be found in Exchange Monitor Publications Inc, *Nuclear Weapons & Materials Monitor*, April 27, 2012 Volume 16, Numbers 18 &19, pp. 2-4, and May 11, 2012 Volume 16, Number 21, pp. 2-4

³ The substance of this section is based on the *Predecisional Draft DOE/NNSA Strategic Plan* dated November 2nd, 2010, p. 7. Also see the *DRAFT U.S. DOE Strategic Plan* dated February 2011.

⁴ The substance of this section is based on the *Nuclear Posture Review Report*, April 2010, published by the Department of Defense, p. iv ff.

⁵ The substance of this section is based on the *NNSA Nuclear Production Contract Merger Summary*, U.S. Department of Energy, National Nuclear Security Administration, 2010.

⁶ See National Research Council, *Managing for High-Quality Science and Engineering at the NNSA National Security Laboratories*, Prepublication, (Washington, DC: The National Academies Press, 2012), p. 56.

⁷ See Jim Collins, *Good to Great and the Social Sectors*, (Boulder, CO: Jim Collins, 2005), p. 1.

⁸ W. Edwards Deming, *Out of Crisis*, (Cambridge, MA: MIT Center for Advanced Engineering Study, 1982).

⁹ See John Kotter, "Leading Change: Why Transformation Efforts Fail" in *Harvard Business Review*, January 2007, Reprint R0701J.

¹⁰ See William Bridges, *Managing Transitions*, (New York: Addison-Wesley Publishing Company, 1991).

¹¹ See John Kotter, *Leading Change*, (Boston: Harvard Business School Press, 1996), and John Kotter and Dan S. Cohen, *The Heart of Change*, (Boston: Harvard Business School Press, 2002).

¹² Different kind of change are discussed in Linda Ackerman, "Development, Transition, or Transformation: The Question of Change in Organizations" in Donald Van Eynde, Judith Hoy, and Dixie Cody Van Eynde (Eds.) *Organization Development Classics*, (San Francisco: Jossey-Bass, 1977), pp. 45-58.

¹³ Deming describes the distinction between *common* causes and *special* causes in W. Edwards Deming, *Out of Crisis*, (Cambridge, MA: MIT Center for Advanced Engineering Study, 1982), p. 309 ff.

¹⁴ See National Research Council, *Managing for High-Quality Science and Engineering at the NNSA National Security Laboratories*, Prepublication, (Washington, DC: The National Academies Press, 2012), p. 51.

¹⁵ See the cover letter from John Foster (Panel Chairman) to Senator Carl Levin, Chairman of the Committee on Armed Services entitled, *FY 2001 Report to Congress of the Panel to Assess the Reliability, Safety, and Security of the United States Nuclear Stockpile*.

¹⁶ See National Research Council, *Managing for High-Quality Science and Engineering at the NNSA National Security Laboratories*, Prepublication, (Washington, DC: The National Academies Press, 2012), p. 56.

¹⁷ See National Research Council, *Managing for High-Quality Science and Engineering at the NNSA National Security Laboratories*, Prepublication, (Washington, DC: The National Academies Press, 2012), p. 52.

¹⁸ See Exchange Monitor Publications Inc, *Nuclear Weapons & Materials Monitor*, May 4, 2012 Volume 16, Number 20, pp. 2-3.

¹⁹ See National Research Council, *Managing for High-Quality Science and Engineering at the NNSA National Security Laboratories*, Prepublication, (Washington, DC: The National Academies Press, 2012), p. 24.

²⁰ See National Research Council, *Managing for High-Quality Science and Engineering at the NNSA National Security Laboratories*, Prepublication, (Washington, DC: The National Academies Press, 2012), p. 24 and pp. 23-24.

²¹ See W. Edwards Deming, *Out of Crisis*, (Cambridge, MA: MIT Center for Advanced Engineering Study, 1982), p. 59, and Abraham Maslow, *Maslow on Management*, (New York: John Wiley & Sons, 1998).

²² See National Research Council, *Managing for High-Quality Science and Engineering at the NNSA National Security Laboratories*, Prepublication, (Washington, DC: The National Academies Press, 2012), p. 26.

²³ See Mark Bodnarczuk, *Making Invisible Bureaucracy Visible: A Guide to Assessing and Changing Organizational Culture*, (Boulder, CO: Breckenridge Press, 2009), p. 47.

²⁴ See, *Department of Energy Contract and Project Management Concerns at the National Nuclear Security Administration and Office of Environmental Management*, Testimony before the Subcommittee on Energy and Water Development, Committee on Appropriations, House of Representatives, GAO-09-406T, March 4th, 2009, and *Modernizing the Nuclear Security Enterprise: The National Nuclear Security Administration's Proposed Acquisition Strategy Needs Further Clarification and Assessment*, GAO-11-848, September 20th, 2001, Report to the Subcommittee on Energy and Water Development, Committee on Appropriations, House of Representatives. In addition, the *Nuclear Weapons & Materials Monitor* describes a May 8, 2012 letter by Rep. George Miller (D-California) and Lynn Woolsey (D-California) that listed safety incidents at Sandia National Lab (sled track in 2008); Lawrence Livermore National Lab (beryllium exposure in 2008 that was revealed in 2010); Los Alamos National Lab (radiation exposure and near fatal electrocution event in 2009); Nevada

National Security Site's Device Assembly Facility; and patterns of security violation at Sandia National Lab, see Exchange Monitor Publications Inc, *Nuclear Weapons & Materials Monitor*, May 11, 2012 Volume 16, Numbers 21, pp. 4-6.

²⁵ See James C. Collins and Jerry I Porras, *Built to Last: Successful Habits of Visionary Companies*, (New York: Harper Business, 1994), pp. 43-44 ff.

²⁶ See National Research Council, *Managing for High-Quality Science and Engineering at the NNSA National Security Laboratories*, Prepublication, (Washington, DC: The National Academies Press, 2012), p. 26.

²⁷ See Exchange Monitor Publications Inc, *Nuclear Weapons & Materials Monitor*, April 27, 2012 Volume 16, Numbers 18 & 19, pp. 2-4.

²⁸ See Exchange Monitor Publications Inc, *Nuclear Weapons & Materials Monitor*, April 27, 2012 Volume 16, Numbers 18 & 19, pp. 9-11.