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LOS ALAMOS NATIONAL LABORATORY HUMAN AND INTELLECTUAL CAPITAL FOR SUSTAINING NUCLEAR DETERRENCE

by

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A Research Report Submitted to the Air Force Fellows
in Partial Fulfillment of the Graduation Requirements

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Preface

This topic is very dear to me as an author. I have been involved with nuclear deterrence my entire Air Force career. Having the opportunity to see how the nation began the nuclear age and how Los Alamos National Laboratory continues to provide this foundational capability has been unique and extremely satisfying. I believe that people provide the foundation necessary to continue providing this capability and keep our nation free. Los Alamos National Laboratory has provided a unique service to the nation for well over 70 years, and I believe they will continue to provide that capability for another 70 years. In order to do that, the nation needs to ensure that people are recruited, retained, and trained in all things nuclear to the best of our ability.

In doing this research, I have met many superb people that have assisted me in understanding the problem and providing me advice. First, all the experience I have gained, throughout my career, from working with outstanding education, personnel, and manpower specialists. Second, I owe a huge thank you to all the personnel at Los Alamos National Laboratory that have provided me with unique insights and crucial data, especially in the personnel, weapons, physics, and computational coding areas of expertise. Finally, I owe particular thanks to my family for supporting me through the short notice move and the time spent preparing this paper and expanding my body of knowledge on the nuclear enterprise. As the Air Force works on rebuilding the nuclear enterprise after years of neglect, I hope to take some of the knowledge gained while here and apply it to the issues the Air Force and Department of Defense face as an institution.

Abstract

This paper provides an overview of the current human and intellectual capital at Los Alamos National Laboratory, through specific research into the statistics and demographics as well as numerous personal interviews at all levels of personnel. Based on this information, a series of recommendations are provided to assist Los Alamos National Laboratory in ensuring the future of the human and intellectual capital for the nuclear deterrence mission. While the current human and intellectual capital is strong it stands on the precipice and action must be taken to ensure Los Alamos National Laboratory maintains leadership in developing and sustaining national nuclear capabilities. These recommendations may be applicable to other areas of the nuclear enterprise, including the Air Force, after further research and study.

Chapter 1

Foundations of the Nuclear Enterprise

Indifference would not be so serious if nuclear weapons were disappearing from the world. If the trend was toward their irrelevance, American benign neglect of nuclear issues might help speed it up. But the bomb isn't disappearing; it isn't fading into the background. More countries have the bomb and are modernizing their forces, and the bomb is deepening its grip on the Middle East, South Asia, and East Asia.

—Paul Bracken, *The Second Nuclear Age*

Nuclear weapons have provided the foundation for the United States' national security strategy since World War II and will continue to provide that foundation for the long-term future. Many groups, most notably Global Zero, have recently advocated the significant reduction or even elimination of all United States nuclear weapons.[1] However, the national nuclear posture review has acknowledged that "as long as nuclear weapons exist, we will maintain a safe, secure and effective nuclear arsenal."[2] In order to continue to do this the United States must possess "a highly capable workforce with the specialized skills needed to sustain the nuclear deterrent and support the President's nuclear security agenda."[3] It is essential that the National Laboratories, specifically Los Alamos National Laboratory (LANL), develop, implement, and sustain a comprehensive human and intellectual capital plan that includes recruiting, training, and retaining key personnel and the intellectual capital they represent. As the latest study for Congress on the nuclear enterprise makes clear, while there have been several studies over the

years that address this subject, there have not been the necessary cultural and functional changes to institutionalize the nuclear enterprise development of human capital.[4]

This focus on human capital is consistent with every nuclear policy review.[5,6,7] A former deputy defense secretary, stated "First, there is an important reason the United States must have nuclear weapons: Other nations have them, and more seem to want them. We still must deter potential opponents, avoid nuclear intimidation by other powers and prevent strategic surprise by aspirant nations. America also extends its deterrence to many allies so that they do not feel compelled to build nuclear weapons of their own. Thus we must maintain a credible nuclear deterrent force, as well as **theoretical and operational knowledge of nuclear weapons superior to that of anyone else** (emphasis added)."[8] A key element in ensuring the nation's knowledge remains superior is the personnel at the national nuclear labs, especially LANL.

Future of the Nuclear Enterprise for the United States

There are three key assumptions about the nuclear enterprise that are critical to understanding why the development of the human and intellectual capital in essential. First, deterrence will remain a pillar of United States national security for decades to come. Second, the United States will continue to adhere to the principles of the Comprehensive Test Ban Treaty. Finally, the science-based Stockpile Stewardship Program will continue to apply leading edge experimental, computational, and engineering tools to assure the President that the United States nuclear weapons are safe, secure, and effective.

Deterrence

As long as nuclear weapons exist, NATO will remain a nuclear alliance. The strategic nuclear forces of the Alliance, particularly those of the United States, are the supreme guarantee of the security of the Allies.

- Wales Summit Declaration, 5 September 2014

The United States' nuclear weapons and their contribution to deterrence will continue to be an element of US and NATO strategy for the foreseeable future. While the numbers and types of weapons may change, the need for nuclear weapons will not diminish in the next several decades. The National Nuclear Security Administration (NNSA) has a plan to maintain a nuclear capability well past 2030; however, there are no plans for the development or deployment of any new nuclear weapons.[9] This must be done without a return to any underground nuclear weapons tests.

Testing

Although the US Senate has never voted to ratify the Comprehensive Test Ban Treaty, the United States has signed it and remains in compliance. Barring significant international or domestic political change, this will remain the position and policy of the United States.[10] This assumption will require that the labs continue to find other means to test components of nuclear weapons.

Stockpile Stewardship Program (SSP)

Since 1994, the SSP has provided assurance to our national leadership that our current weapons in the stockpile are safe, secure and effective.[11] The SSP has made tremendous progress in understanding the basic science behind the operation of nuclear weapons and allowed a paradigm shift away from the traditional cycle of build, test, modify, and deploy.[12] Today at LANL, scientists conduct thousands of experiments, from small scale to fully integrated, to

better understand weapon component behavior and validate and refine computer codes used to predict weapons performance. In addition, LANL also relies on archived data from the thousands of nuclear tests conducted from 1945-1992. In order to continue the nation's mastery in nuclear expertise, there are three key skill sets that are critical to the nuclear enterprise's, particularly LANL's, human and intellectual capital.

CRITICAL SKILL SETS AT LANL

There are a number of key skill sets with unique knowledge within the nuclear lab infrastructure. Much like military officers and non-commissioned officers, these personnel must be recruited, trained, and then retained within the nuclear enterprise for decades to maintain the nation's predominance in nuclear weapons knowledge. Three specific skill sets, weapons physics designer, codes developer, and systems engineer, are especially critical to the maintenance and design of our current and future stockpile. While the national labs are able to initially recruit people with basic skills in science and engineering, these personnel are not nuclear weapons experts.

The first position is that of a nuclear weapons physics designer. The personnel in this position are the core of developing the physics portion of the weapon. There is no United States university that graduates doctoral candidates with a degree in nuclear weapons design. LANL must take newly minted PhD's (only US citizens) in physics and other career fields and train them in the art and science of nuclear weapons design. It takes years of specialized experience within the nuclear weapons complex to generate a person with knowledge and judgment to not only maintain our current stockpile while supporting the non- and counter-proliferation mission

at LANL, but, if necessary and directed, to develop new weapons in the future. The physics designers must work closely with the code developers and system engineers to be effective.

The second position, the nuclear weapons code developers are also very important in the SSP for their unique understanding of programming difficult physics problems into computer code to predict performance of nuclear weapons.[13] These personnel provide the foundation for the development and implementation of the simulation codes used in analyzing test data for nuclear weapons. Both the physics designers and code developers work closely with the last critical position, the weapons systems engineer.

The weapons system engineer integrates approximately 6000 components, nuclear and non-nuclear, into a device that can be manufactured and delivered to the military. Developing an individual that understands how all of the pieces behave and how each contributes to providing a safe, secure and reliable nuclear weapon is critical for deterrence. This knowledge is significant because the ability to build functional nuclear weapons is not available outside the nuclear enterprise.

These individuals are highly sought after, both in government and industry, both for their outstanding ability to emulate difficult problems, as well as security clearances.[14] All of these personnel develop judgment through their experience in working with nuclear weapons. This judgment is critical in ensuring a safe, secure, and effective nuclear weapon for the nation's deterrence capability. The interpretation of data from experiments and observation will always be incomplete, so the experience and judgment of these personnel is critical for the future of the nuclear stockpile. In order to develop the human and intellectual capital necessary, LANL must understand its requirements, and then recruit, train and retain the necessary personnel.

Notes

[1] Global Zero Official Web Site, http://www.globalzero.org (accessed 9 January 2015).

[2] Department of Defense, *Nuclear Posture Review Report*, April 2010, iii.

[3] Ibid, 40.

[4] The Honorable Norman R. Augustine and Admiral Richard W. Mies (US Navy (Retired), *A New Foundation for the Nuclear Enterprise Report of the Congressional Advisory Panel on the Governance of the Nuclear Security Enterprise* (November 2014), 10.

[5] Department of Defense, *Nuclear Posture Review 1994*, 27.

[6] Department of Defense, *Nuclear Posture Review 2001*, 9.

[7] Department of Defense, *Nuclear Posture Review 2010*, xv.

[8] John J. Hamre, "Toward a Nuclear Strategy," *Washington Post*, 2 May 2005, http://www.washingtonpost.com/wp-dyn/content/article/2005/05/01/AR2005050100833.html (accessed 23 January 2015)

[9] Department of Energy, *Fiscal Year 2015 Stockpile Stewardship and Management Plan*, Report to Congress April 2014, 2-32.

[10] *Nuclear Posture Review 2010*, xiv.

[11] Public Law 103-160, Section 3106, para f(3)(A).

[12] Charlie Nakleh, Los Alamos National Lab (presentation to Maj Gen Sandra Finan and staff, Los Alamos National Lab, NM, 28 January 2015).

[13] Bill Archer (Los Alamos National Lab), Interview by author, 12 November 2014.

[14] Unattributed interviews with several senior lab personnel, Oct – Nov 2014.

Chapter 2

Demographics and Requirements at LANL

At the root of the challenges faced by the nuclear enterprise is the loss of focus on the nuclear mission across the nation and within United States leadership as whole since the end of the Cold War.

— A New Foundation for the Nuclear Enterprise

Demographics

Overall, the age of the nuclear workforce is similar to the lab population as a whole. However, with 53% of the lab's workforce greater than 50 years (average age of 49.4) there is serious concern in the impending "age out" of the experts in the nuclear career fields.[1] This age demographic has outpaced the industry average by more than 5% over the last 3 years.[2] Figure 1 shows 30 percent of the workforce in these positions is eligible or close to being eligible to retire (age 55 and older). While a mass exodus is not expected (barring significant contract or personnel policy changes), appropriate succession planning should be addressed to ensure the knowledge that these individuals possess is transferred to the next generation.

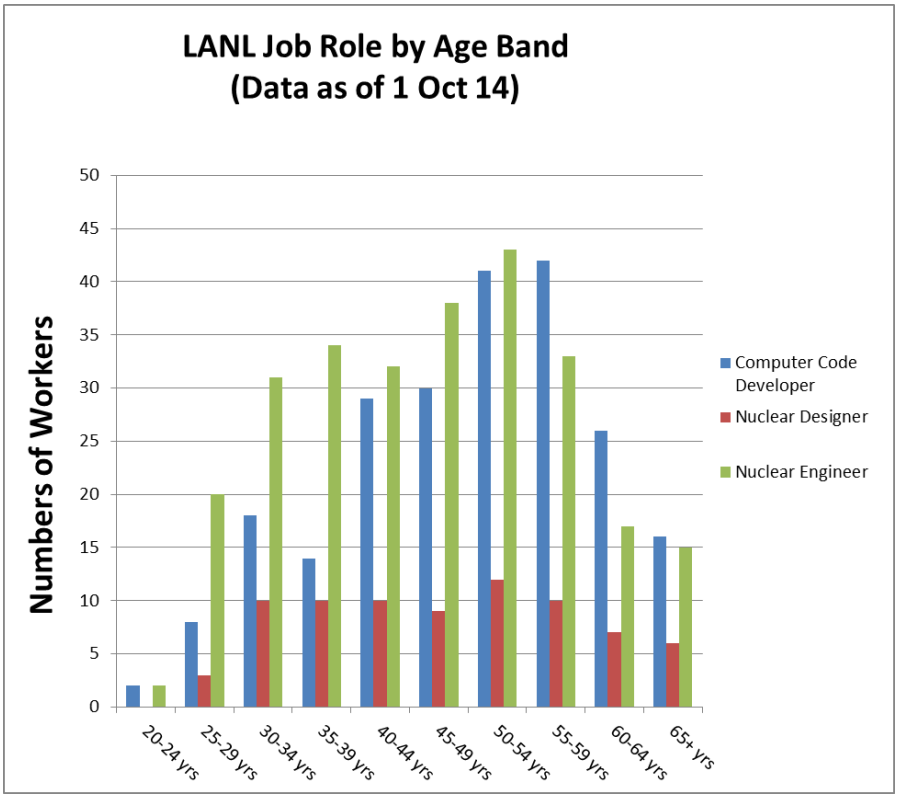


Figure 1 - LANL Job Role by Age Band (Provided by Human Resources at LANL)

While age is an important demographic when addressing retirement potential, another critical element in understanding expertise is in "years of relevant experience." Figure 2 demonstrates that there is 40 percent of the population in these positions that have more than 26 years of experience within the nuclear enterprise. This experience level is important to understand because underground nuclear tests ceased 23 years ago. The personnel in this experience demographic are among the last personnel to have contributed to those tests and obtained unique experience. These personnel are critical to training the next generation and ensuring the intellectual capital has been transferred in preparation for the next iteration of life extension programs, alterations, modifications, and potential replacement of the weapons in the current stockpile.

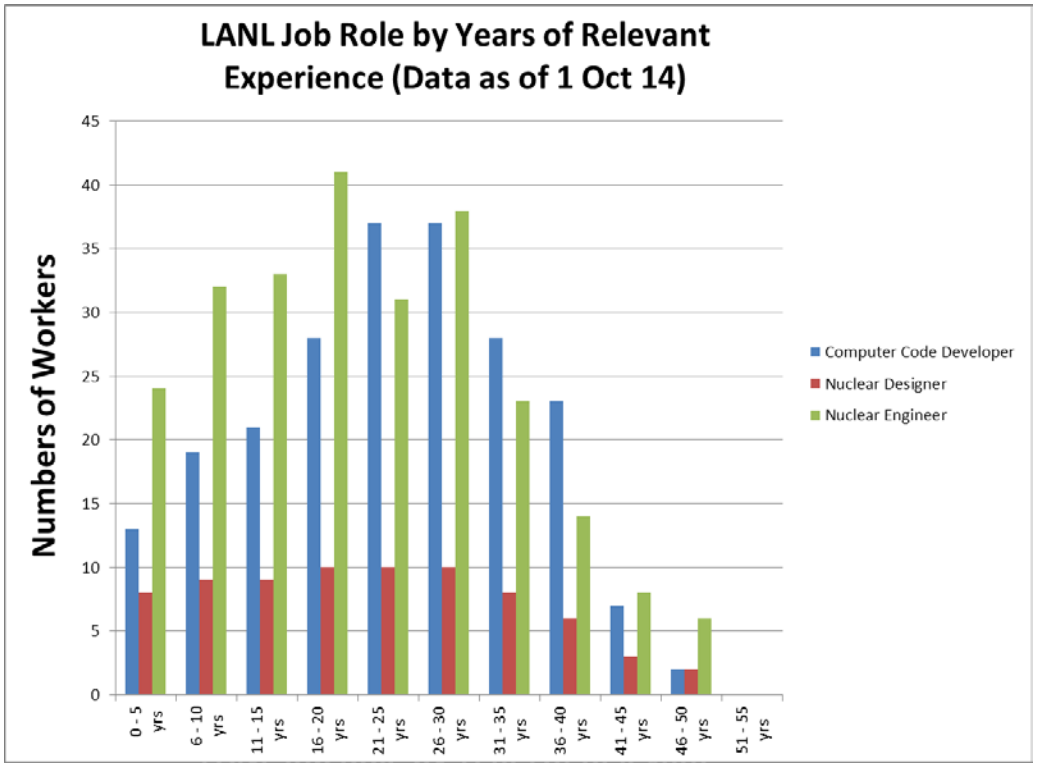


Figure 2 - LANL Job Role by Years of Relevant Experience (Provided by Human Resources at LANL)

Understanding demographics is an important element to determine future personnel planning, but it is also important to understand what skills the current workforce possesses in relation to the required skills. While LANL currently has methods to track skills, they are either too detailed or too general to be of use in day-to-day evaluation of gaps and requirements. Furthermore, there is no lab-wide mechanism to require personnel to update their skills or have their current skills validated by leadership at the lab.[3] This inability to effectively track and validate the skills of the current workforce can lead to gaps in skills and development plans that are not optimized for the employee and organization. Understanding training requirements, demographics, and skill levels of the current workforce are essential to ensuring the long-term health of the human and intellectual capital in the nuclear enterprise.

Requirements for LANL Workforce

The nuclear weapons in the US stockpile were designed and built to be replaced with new designs and builds every 10 to 15 years, or sooner if the US defense strategies required it. Now these weapons have lived beyond their expected lifespans and their components continue to age.

— Clay Dillingham, "But Will It Work," National Nuclear Security, Apr 13

Right-Sizing

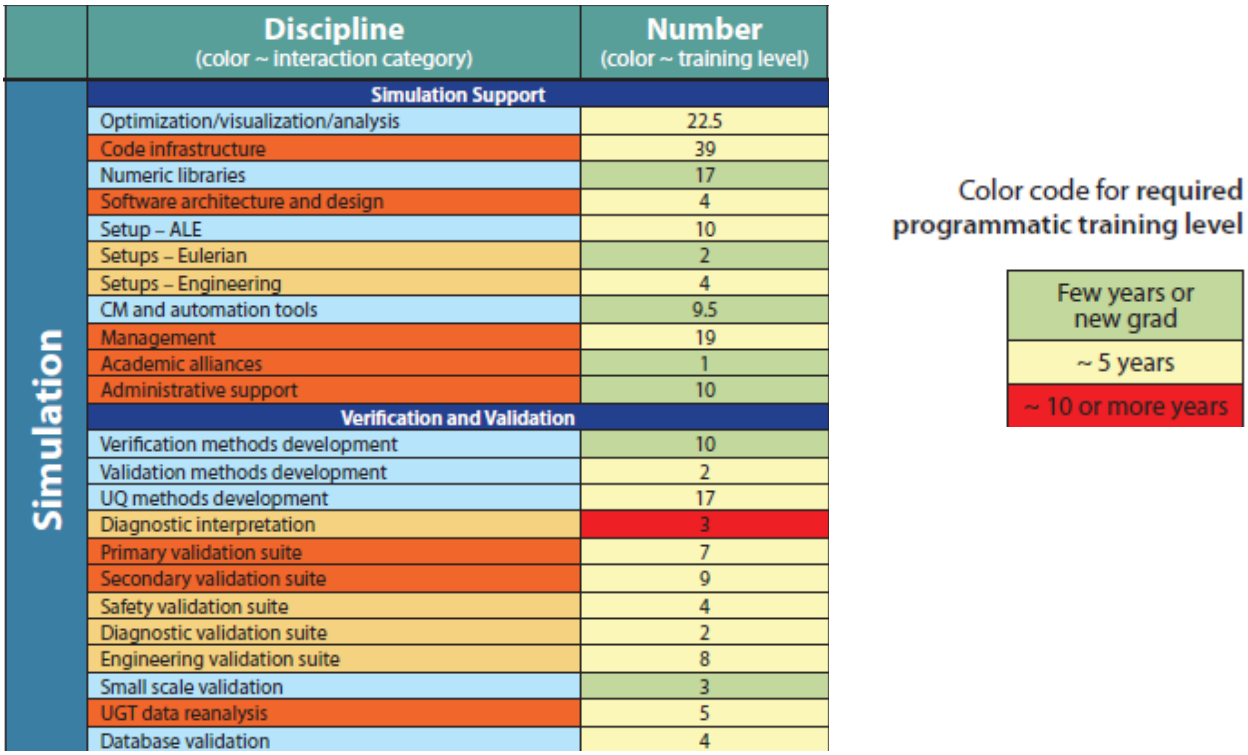
"Right-Sizing" means knowing the number of personnel and the required skills that are essential to ensure the long-term health of the critical positions. Right-sizing is a complicated question that must take numerous requirements, such as the unique computational and experimental demands of the stockpile stewardship program, into account. While there is not a direct industry correlation to the work done at LANL, it is important to validate personnel requirements with accepted industry standards enabling leadership to be more effective in addressing budget and job scope concerns.

Sector	Discipline Group	Staff Needed
Simulation	Code generalist	15
	Hydrodynamics and materials	92
	Transport and plasmas	98
	Direct numerical simulation	32
	Engineering	105
	Simulation support	138
	Verification and validation	74
Simulation Totals		554

Figure 3 - Right Size of the ASC Work Force (Office of Advanced Simulation and Computing, National Nuclear Security Administration Defense Programs, Advanced Simulation and Computing: Right Size Determining the Staff Necessary to Sustain Simulation and Computing

Advanced Simulation and Computing, which includes the position of the nuclear weapons code developers, conducted a right-size study in conjunction with Lawrence Livermore National Lab.[4] This study provided two key pieces of information. First, the study identified the

number of personnel required to accomplish the mission, including within each discipline. The breakdown by specific discipline groups and the total number of personnel required, as shown in Figure 3, enables the ASC organizations to better manage and develop their workforce, as well as providing a solid foundation to address staffing and budget challenges. Second, it identified the unique skills and training required for each skill in order to accomplish the mission (excerpt in Figure 4).[5]



	Discipline (color ~ interaction category)	Number (color ~ training level)
Simulation	**Simulation Support**	
	Optimization/visualization/analysis	22.5
	Code infrastructure	39
	Numeric libraries	17
	Software architecture and design	4
	Setup – ALE	10
	Setups – Eulerian	2
	Setups – Engineering	4
	CM and automation tools	9.5
	Management	19
	Academic alliances	1
	Administrative support	10
	Verification and Validation	
	Verification methods development	10
	Validation methods development	2
	UQ methods development	17
	Diagnostic interpretation	3
	Primary validation suite	7
	Secondary validation suite	9
	Safety validation suite	4
	Diagnostic validation suite	2
	Engineering validation suite	8
	Small scale validation	3
	UGT data reanalysis	5
	Database validation	4

Figure 4 - Required training time (excerpt) for ASC Simulation Skills

(ASC Study, p. 10-11)

Neither of the other two critical positions, Nuclear Weapons Physics Designer nor Weapons Systems Engineer, has done this level of detailed study to determine their manning and skill level requirements. While these organizations have developed staffing plans that help considerably, these plans may not be detailed enough, nor possess the necessary rigor to objectively analyze and advocate for staffing challenges. In addition, they fail to identify the

necessary skills across the workforce, which affects the ability to properly develop personnel through various types of training.

Education and Training

Once LANL has recruited personnel with the appropriate basic skills, knowledge, education, and background it is critical to provide training in the identified skills to ensure proficiency and experience in nuclear weapons. Proficiency is developed by two key methods. The first method is academic (beyond their degree). There is a level of knowledge required so personnel can effectively understand the processes, procedures and theory behind nuclear weapons life cycle. The second method is experiential or what the individual needs to experience on-the-job to be proficient.

Academic Requirements

The positions of weapons physics designer, code developer, and weapons systems engineer have several training requirements in common.[6] Each of the three positions identified have disparate entry level academic requirements. In most cases, nuclear weapons physics designers have an entry requirement of a doctorate degree in a scientific field, generally physics or chemistry.[7] This academic degree is an essential first step for understanding the science; however, this is not sufficient to becoming an expert in nuclear weapons design. For both the code developers and the weapons system engineers, a varied technical, academic background from bachelor's degrees through doctorate degrees is essential to provide a solid foundation for understanding the concepts in nuclear weapons design.

All of these positions require an academic (post-graduate) understanding of nuclear weapons in general and how they have evolved from the original designs to the current designs. This knowledge is essential to provide a common background for all those personnel involved in

maintaining and, if called upon, developing nuclear weapons. In addition, these personnel require an understanding of the entire nuclear enterprise and the processes and procedures necessary to accomplish their work, including the elements of cooperation and overlap between different portions of the enterprise. After LANL identifies and recruits an individual with the appropriate background, it is important for LANL to provide specific post-graduate academic knowledge regarding nuclear weapons that is not available elsewhere.

In order to provide these individuals the academic training, Los Alamos National Lab Weapons Physics Division has developed a program called Theoretical Institute for Thermonuclear and Nuclear Studies (TITANS). The first objective of this program is to "Educate staff members in nuclear weapons science emphasizing the physics of modern thermonuclear weapons."[8] This course is a graduate level course that "spans over three years consisting of 12 course credits and 9 credits of thesis research."[9] This course provides an academic foundation for new nuclear weapons physics designers' in-depth knowledge of how nuclear weapons function. This program is internal to the division and is accomplished outside of normal staff duties, projecting a tremendous workload on those individuals involved. While both code developers and weapons systems engineers have and will continue to attend the TITANS program, it is specifically developed for physics designers.

Experience

Experience is critical to successfully maintain and develop nuclear weapons expertise. Some of this experience is garnered through individual projects and experiments within a specialty; however, the most beneficial experiential training is participation in joint projects and experiments requiring coordination between different specialties.[10] Successfully understanding

all elements of a project ensures each member of the team understands the limitations levied by other divisions or manufacturing processes.

While the code developers, through the ASC study, identified the necessary disciplines and approximate time necessary to develop those skills (excerpt in Figure 4), the study did not specify how individuals became proficient in these disciplines.[11] Most of these skills have been acquired strictly through on the job training. This method works but is extremely time-consuming and not consistent in deliberate development of individuals.

The requirement for experience is seen as more essential for system engineers.[12] Most new hires into the systems engineer division are from the support divisions at the lab and are hired for their proven ability to complete projects or studies successfully.[13] In addition, leadership emphasized the need for an opportunity to work on real-world projects at increasing levels of responsibility.[14] This experience, both prior to, and more importantly, within these disciplines is critical to development of the skills necessary at LANL.

As the number of personnel with the requisite expertise diminish, it becomes more critical to provide academic training to complement experience. LANL has continued to perform its mission admirably, many of the personnel in these critical positions are eligible to retire, and there are **weaknesses in transferring this knowledge from the previous generation to current and future generations of personnel**.

Notes

[1] Lab Director Briefing, *Los Alamos National Laboratory Current Climate and long-term viability*, 18 July 2014, 9.

[2] Ibid, 10.

[3] Ben Fresquez (Los Alamos National Lab), interview by the author, September 2014.

[4] Office of Advanced Simulation and Computing, National Nuclear Security Administration Defense Programs, *Advanced Simulation and Computing: Right Size Determining the Staff*

Notes

Necessary to Sustain Simulation and Computing Capabilities for Nuclear Security, October 2010, i.

[5] Ibid, v.

[6] Unattributed interviews with leaders in weapons program by mutual agreement, Sep-Oct 14.

[7] Charles Nakleh (Los Alamos National Lab), interview by author, September 2014.

[8] Los Alamos National Lab, "TITANS Program Description," http://int.lanl.gov/org/padwp/adx/theroretical_design/TITANS/index.shtml (accessed 20 January 2015).

[9] Los Alamos National Lab, "TITANS Program Graduation Requirements," http://int.lanl.gov/org/padwp/adx/theroretical_design/TITANS/GraduationRequirements.shtml (accessed 20 January 2015).

[10] Multiple unattributed interviews with senior lab personnel, Sep – Nov 2014.

[11] Bill Archer (Los Alamos National Lab), Interview by author, 12 November 2014.

[12] Unattributed interviews with members of weapons program by mutual agreement, Sep-Oct 14.

[13] Unattributed interviews with leaders of weapons program by mutual agreement, Sep-Oct 14.

[14] Nakleh, Interview by author, September 2014.

Chapter 3

Challenges at LANL

Los Alamos National Lab faces unique and common challenges in recruiting and retaining personnel. These challenges include location, compensation (both direct and indirect), and the need for lifelong commitments in what is seen as a declining career.

Location

Los Alamos faces a unique challenge among the national nuclear labs in its relatively remote location. Situated in the mountains of northern New Mexico, it is a small town lacking many amenities. While there are many personnel who like and prefer small towns, it presents a unique challenge in recruiting the best and brightest from around the country, many of whom have grown up or attended college in a larger city with more options. This lack of amenities leads to a discussion of compensation, both direct and indirect.

Compensation

Compensation is a factor to personnel making the decision to move to a new location and, ultimately, to stay. A direct comparison with industry is challenging, as the personnel within the nuclear enterprise at LANL develop unique skills that may not be comparable.[1] Figure 5 demonstrates that LANL provides very competitive direct compensation at entry level (R&D and Scientist Level 1) across all positions. However, as individuals are promoted within LANL

	Job Title	* Difference * LANL Avg Salary to Market Avg Salary
ADW	R&D Engineer 1	10.3%
	R&D Engineer 2	-2.6%
	R&D Engineer 3	-4.9%
	R&D Engineer 4	-2.8%
	R&D Engineer 5	-10.3%
	R&D Engineer 6	5.0%
	Scientist 1	-0.2%
	Scientist 2	-0.4%
	Scientist 3	-7.8%
	Scientist 4	-6.5%
	Scientist 5	-10.6%
ADX	R&D Engineer 2	5.0%
	Scientist 1	4.0%
	Scientist 2	2.5%
	Scientist 3	-1.3%
	Scientist 4	-1.0%
	Scientist 5	-0.2%

Figure 5 – Pay Differential for Nuclear Career Fields (HR at LANL)

(Scientist and Engineer 2-5), the compensation levels compared to their peers working in industry shrink, and eventually disappear. By this point, the lab has invested significantly in establishing security clearances and providing academic training and experience. Providing competitive, if not above average direct compensation to take their unique skills into account, is one element to retaining personnel at the first decision point in a young professional career. In addition, the changes in retirement plans from a pension based system to a 401K based system with employee matching has had a significant effect in retention at LANL due to the portability of these plans.[2]

Another key element, primarily due to its location, is indirect compensation. An old saying in the Air Force is "we recruit individuals but retain families." The same can be said at LANL. While Los Alamos city does offer some outstanding features, such as an outstanding public school system, there are other areas that may apply more broadly or directly to those employees at the first decision point in their careers. Typically, the five to seven-year time in service point for an employee is a critical retention time for LANL. This timeframe is also when younger employees are making a decision to start or expand their family.[3] Combined with the growing gap in direct compensation, the indirect compensation becomes even more critical. Based on numerous conversations with junior lab employees, some examples of indirect compensation are quality fitness facilities and affordable daycare. Addressing matters of

appropriate compensation will enhance the possibility of employees choosing to remain at LANL and make a lifelong commitment.

Organization and Job Satisfaction Leading to Lifelong Commitment

To become an expert in the nuclear enterprise requires a lifelong commitment due to the unique nature of the job, the specialized training, and the required security clearances. With the millennial generation, that lifelong commitment is less certain. The millennial generation has very different expectations on job loyalty. "Sixty-six percent expect to switch careers" and "one-third of those who have found their career expect to switch employers."[4] With only one-third of personnel expecting to stay in a given career it becomes imperative for our national security and the health of the human and intellectual capital at LANL to capitalize on those millennials and entice more than one-third to make a lifelong commitment to the nuclear deterrence mission at LANL.

While not unique to LANL, organization and job satisfaction throughout the nuclear complex is increasingly difficult. The millennials have a different attitude than past generations about organization and job satisfaction. "They think, *Life's too long. If the job isn't your passion, you don't like the culture, or there's not much opportunity to get ahead or make a difference, you owe it to yourself to find something else (emphasis in the original).*"[5] The challenge for leadership at LANL is to ensure that the millennials are satisfied in what they are doing and feel they are making a difference, or LANL should expect them to depart in increasing numbers. Making the job satisfying can be extremely difficult in today's misunderstood view of the value of nuclear weapons, both among the public and policy-makers.

The national policy is to strive for the elimination of nuclear weapons, and "Nowhere is this more evident than among those working in the nuclear enterprise, many of whom feel they

are working in a declining career field."[6] It is crucial that LANL leadership work with national leadership continue to highlight the importance of the nuclear mission and demonstrate how critical it is to national security. While this is significant, a key element of organizational satisfaction is the amount of bureaucracy involved in accomplishing the mission.

"The nuclear enterprise is greatly burdened by DOE/NNSA's counter-productive management culture."[7] This culture has created a division between those who maintain our nuclear arsenal and those overseeing them. The "focus has shifted from mission accomplishment to one of compliance."[8] When the young millennials begin disliking the organization due to the risk-adverse bureaucracy, they lose focus on the mission. These personnel need interesting problems to solve, and be able to see the results of their work.[9] To accomplish this goal, mission accomplishment must have priority over compliance, and the work should push boundaries of known problems. These ideas of job and organization satisfaction are critical for the next generation of professionals to make a lifelong commitment to the nuclear mission.

As identified in the most recent review of the nuclear enterprise, many of these issues have been identified in several past studies, but the solutions have been forgotten, ignored, or failed to be institutionalized into the system.[10]

Notes

[1] Lynette Burgert (Compensation expert at Los Alamos National Lab Human Resources), 12 January 2015.

[2] Multiple unattributed interviews with senior lab personnel, Sep – Nov 2014.

[3] Unattributed interviews with junior employees (Los Alamos National Lab), September 2014-January 2015.

[4] Haydn Shaw, *Sticking Points: How to Get 4 Generations Working Together in the 12 Places They Come Apart(ebook)*, (Tyndale Online, 2013), 271.

[5] Ibid, 278.

[6] *A New Foundation for the Nuclear Enterprise*, x.

[7] Ibid, 37.

[8] Ibid, 37.

[9] Charlie Nakleh (Los Alamos National Lab), presentation 28 January 2015.

Notes

[10] *A New Foundation for the Nuclear Enterprise*, 10.

Chapter 4

Recommendations for LANL in Recruiting, Training, and Retaining Critical Personnel

The purposeful development of leaders, managers, and staffs is essential to any governance system.

— A New Foundation for the Nuclear Enterprise

Understanding the demographics and requirements, both in terms of size and skills, of the current workforce allows an organization to begin developing courses of action to recruit, retain, and develop the workforce to meet long-term mission requirements. Sixteen recommendations follow to preserve and enhance the human and intellectual capital at LANL within the specified skill sets.

Overall Recommendations

Recommendation #1: Understand workforce requirements (Numbers and Skills)

Using the model developed by Advanced Simulation and Computing the nuclear weapons physics designers and the weapons systems engineers divisions should conduct a similar study to enhance and refine the existing staffing plans.

Recommendation #2: Track and validate skills of the workforce

LANL/NNSA's system for tracking and validating employee skills is not sufficient for ensuring a properly trained workforce. In order for LANL to understand where it requires improvement, it is important that a useful system for LANL leaders and managers is developed

to track and validate the skills of the current workforce as LANL defines them. This database will provide a basis for personal development plans for current employees as well as determining skills shortfalls for managers so they may more effectively recruit and hire new employees.

In conjunction with determining LANL workforce needs and the capability of the current workforce, LANL should take several actions related to recruiting, retaining and training the next generation of nuclear weapons experts.

Recruiting Recommendations

Recommendation #3: Enhance media/public presence

LANL conducts significant science and engineering work that pushes the boundaries in many areas of study, yet it is not widely recognized by the nation as a whole, or the young millennial generation in particular. While LANL has made significant improvement in this area in the last decade, there is more work that needs to be done to enhance and target media presence in both the scientific and academic community. This enhanced presence can raise the stature of LANL and assist in recruiting efforts for new employees.

Recommendation #4: Expand mid-late career recruiting initiatives

Due to several factors over the last twenty years, there is a slight dip in mid-late career employees available at the lab to fill critical leadership and management roles. LANL should expand their partnership with industry and the military to recruit experienced scientific, engineering, and management personnel to fill critical positions. While these personnel may not have the in-depth background in nuclear weapons, they can bring other skills to the workforce and, with appropriate training, fill the gaps in their knowledge.

Recommendation #5: Expand scope of early recruiting policies

LANL has considerable success in recruiting summer students and post-doctorate students to the workforce (approximately 90% of post-doctorate to PhD staff hires in 2013).[1] LANL has made significant strides in maintaining the student and post-doctorate programs, at significant cost, as well as making changes to the length of appointments.[2] These measures are essential in attracting and retaining young employees, however, in order to continue recruiting the best and the brightest from around the nation, LANL should enhance and expand their relationships with top level science and engineering universities from around the country (e.g. MIT, CalTech). Expanding the scope of these relationships will enhance recruiting and ensure a wide variety of viewpoints available to LANL.

Retention Recommendations

Recommendation #6: Improve Direct Compensation

As Figure 5 demonstrated, the direct compensation within these positions at LANL begins lagging industry at the same decision point when personnel are deciding to stay at LANL or pursue other opportunities. LANL has invested time and money in clearances, training, and providing unique knowledge to the personnel in these positions. It is essential that LANL address mid-career compensation, to not only make it equivalent, but more competitive than industry. This will ensure LANL does not lose its investment in developing unique knowledge in these critical skills.

While LANL does not have insight into the other labs compensation structures, the National Nuclear Security Administration (NNSA) does. A critical element of direct compensation is ensuring that all of the national nuclear labs have equivalent direct

compensation structures. The NNSA must do one of two things. Either allow the labs to set their direct compensation structure without oversight and approval authority or ensure that the labs are equivalent in their compensation for the same work at or above industry averages.

It will become imperative that the lab addresses the retirement system in the future years. The increased portability of the 401K based retirement system is a distinct paradigm shift from the past pension based retirement. LANL should conduct industry studies to understand how other organizations retain personnel without a pension plan. LANL should adjust its retirement system or workforce strategies to compensate for the need to increasingly retain mid-career personnel in these critical career fields.

In addition, LANL should streamline reimbursement (as much as possible within government regulations) for travel expenses, especially for junior employees. Travel from Los Alamos can have significant cost and for junior personnel, carrying this cost for significant time can cause financial hardships.

Recommendation #7: Improve Indirect Compensation at Los Alamos National Lab

LANL faces some unique challenges with its remote location. As discussed, Los Alamos has some outstanding indirect compensation benefits; however there are some areas that should be improved. LANL should poll the workforce, with a focus on the post-baccalaureate/doctorate personnel, to determine what methods of indirect compensation are necessary to enhance retention.

In discussions with junior personnel, two key areas of indirect compensation LANL should address immediately are the lack of modern, readily available fitness facilities and the lack of affordable or on-site day care. While Los Alamos features a wide variety of superb outdoor fitness options, they are not available year around, nor does everyone enjoy them. While

LANL maintains a wellness center, it has limited hours and dated equipment and facilities. In order for the lab to better control long-term health care costs and ensure a fit force, they should provide an option for clean, modern, and readily available fitness facility. Improving fitness options could be done in a variety of ways, either through a lab-private partnership or by further developing institutional infrastructure.

Another important compensation tool to entice young professionals is the availability of affordable and possibly on-site day care. Many young personnel that are recruited into the lab after college or their doctorate program will begin considering starting or expanding their family in the time after joining the lab, usually within the first five years. One of the critical factors they consider is the availability of affordable, and in many cases, on-site daycare. While there is certainly some concern in affecting the local economy, competition is not a bad thing, and taking care of the LANL employees is paramount. Daycare is a critical element of indirect compensation that LANL should address in order to retain the best of the millennial generation.

Recommendation #8: Position Rotation Policies

One key question many millennials ask themselves when deciding to stay at an organization is, "But if you like your organization, why leave? Just do a different job."[3] This critical question is essential for the lab to address through rotation policies within the lab structure. As discussed earlier, the millennial generation workforce is expecting to change positions, not necessarily companies, several times throughout their career, in order to expand their knowledge/skills and refrain from getting bored. LANL has an outstanding multi-disciplinary capability that enables significant cooperation to solve unique problems, both within LANL and externally. LANL should explore and further develop policies that allow individuals to easily and frequently rotate positions within the lab, both within and across these disciplines

and organizations. A key aspect of rotational policies is to expand the cooperation between global security and the weapons program to enhance the workforce and ensure that the skills common between these organizations are utilized and shared on a regular basis.

Recommendation #9: Develop worker-friendly personal electronic device (PED) policies

"Millennials are the first generation to grow up digital, surrounded by technology. Millennials spend more than fifty-three hours a week with media because they use more than one kind at the same time. For Millennials, a smartphone is a bodily appendage."[4] While there are certainly valid security and safety concerns in many areas of LANL that require the prohibition on personal electronic devices, it is imperative that the lab explore better risk mitigation versus risk avoidance strategies in regards to these devices. As an example, there are many offices in the National Security Science Building that do not have classified work being accomplished. Having multiple places that are electronically isolated to store electronic devices when classified conversations commence would be more beneficial than forcing personnel to store those devices outside the building or in their vehicles. In today's interconnected world with a desire for a younger workforce, this type of strategy will be essential to recruit and, more importantly, retain individuals.

Recommendation #10: Return to mission focus vice compliance focus

As the report "A New Foundation for the Nuclear Enterprise" notes, the labs have been forced under the current contract to focus more on compliance and less on mission accomplishment. This attitude adversely affects the job satisfaction of the personnel within these career fields and places undue burdens on accomplishing the mission. In one example, a senior lab fellow was able to reduce the cost and time of fielding a specific experiment by assuming authority and taking responsibility for the experiment, thereby reducing the oversight and

bureaucracy by force of personality.[5] This type of initiative raises job satisfaction, reduces costs, and eliminates unnecessary oversight. LANL must work with DOE/NNSA to institutionalize this approach to mission accomplishment over compliance to ensure the long-term health of the capabilities at LANL.

Recommendation #11: Improve Infrastructure

LANL has existed for over 70 years, and over 45% of the weapons program facilities are well over 20 years old.[6] In order to recruit and retain world-class scientists and engineers, working in clean, modern facilities is a key factor in job satisfaction. It is imperative that LANL works with NNSA to develop and follow a plan to upgrade and renovate existing facilities, as well as build new mission facilities when necessary. In addition, some buildings maintain old equipment that is no longer used or serviceable. This equipment should be appropriately disposed of to ensure space is available for personnel and new capabilities. These plans should be public and published, with annual emphasis by LANL in budget discussions with NNSA to obtain funding from the federal government. The commitment to improving infrastructure will require a large capital outlay over a decade or more, but is critical not just for the mission, but for retaining high-quality personnel as well.

Recommendation #12: Increase frequency of experiments and tests

To succeed the laboratory's scientists must, above all, be free to think critically and examine all possibilities.

- Charlie McMillan, 2nd Los Alamos Primer, Jul 2013

A fundamental aspect of keeping people engaged and satisfied with their position is the opportunity to "do something." LANL should work with NNSA to enhance and expand the lab's experimentation program. LANL should also work with the Navy and Air Force to expand flight tests to allow full system testing and evaluation of new experiments. This expanded testing

program should push limits of understood science and provide new opportunities to validate existing models and increase margins of error. These types of activities expand the scientific understanding of nuclear weapons and their interaction with the environment, improving the safety, security, and effectiveness of our nuclear arsenal. An expanded testing and experimentation program would also serve to enhance the infrastructure and provide a critical element in training and educating the entire workforce.

Training and Education Recommendations

Recommendation #13: Training new personnel on the history of nuclear weapons design

Training personnel on the basics of nuclear weapons and nuclear weapons design is critical for the future of the workforce. Many senior designers, coders, and engineers have significant knowledge on why certain choices were made in the design and development of nuclear weapons. It is critical that the next generation receives this knowledge before senior personnel retire. While TITANS is certainly a significant program, it is much too in-depth for most weapons systems personnel. Something is needed, sooner in an employee's career, at a less in-depth level. LANL should develop and institutionalize a professional training element within the weapons directorate that trains nuclear weapons personnel on the history of design for nuclear weapons to the modern designs of today. This element could initially be composed of senior personnel in the physics and engineering disciplines. As the organization develops, this could be seen as an essential position in job rotation within the lab to emphasize the importance of transferring knowledge between generations. This training should not be focused exclusively on the physics, the engineering, or politics of the entire nuclear weapons, but be an overview of all. It should not be as intensive as the TITANS program, but should be of high enough level that it serves as an introduction for all personnel.

Either concurrently or subsequent to this course being established, the divisions should develop an in-depth training program that encompasses a deep-dive into the system or program they will be assigned and have a need to know. As an example, TITANS would be an ideal follow-on for the physics package designers. A similar program for the engineers and code developers should be accomplished. These training requirements should be accomplished for each new hire and take priority over all other responsibilities until completed. An important element of this training should be access to a mentor to answer questions and provide guidance.

Recommendation #14: Mentorship Program

While LANL currently maintains a mentorship program, it is not given much oversight, training or responsibility.[7] LANL should enhance the mentorship program to identify specific responsibilities, train the mentor, and hold the mentor accountable. Accountability could be accomplished through the annual review cycle and be a factor in their evaluation. To ensure effective mentorship, LANL should develop a training plan for mentors, explaining responsibilities to ensuring a complete understanding of all the tools available. The relationship with the mentee should begin as a daily relationship that transitions over the course of time. The mentor should also provide guidance on how to do bureaucratic processes and procedures within LANL structure, from completing training to filing a travel voucher or getting a technical drawing approved. A new employee should have access to a mentor at least through all of their initial training as mentioned in recommendation #13.

In addition, LANL should develop a program of peer mentorship for the first two years of a new employee's career. This peer mentorship will allow new employees to explore new ideas within their peer group before presenting them to a senior mentor or in a formal project. This idea will lower stress levels of new employees and ensure sound decision-making.

Recommendation #15: Education and Conferences

Continuing education within the science and engineering career fields is important to ensuring these professionals are aware of new discoveries and methodologies for accomplishing solutions. LANL should encourage and mandate some level of continuing education for each of these positions throughout their career. This education could be done on site, through a program similar to TITANS, or through a nationally recognized and accredited university system. Partnering with the University of California to ensure any program is recognized and accredited is beneficial, as it provides credibility within the science and engineering career fields outside of LANL. This continuing education can be addressed through formal education or informal through participation in academic and professional conferences, both as a presenter and an attendee.

LANL must work with DOE/NNSA to address the cumbersome rules and regulations governing conference attendance, especially among junior personnel. From 2011-2013, attendance at academic and professional conferences dropped 33 percent.[8] These conferences are educational opportunities to not only learn about new approaches from other professionals in these fields, but also to present ideas from LANL. This conference attendance will not only raise the influence and credibility of LANL, to assist in recruiting and retention programs, but the personnel at LANL as well. Combining increased conference attendance and presentation with enhanced media presence will significantly raise the public profile of LANL and enhance recruiting and retention efforts for junior through senior personnel.

Recommendation #16: Develop a nuclear weapon practicum

I'm concerned that we stopped doing weapons design and development. It's a bigger risk than to stop nuclear testing.

- Michael Anastasio, National Security Science, Feb 2014

While LANL has expanded practicums within the context of global security, these practicums are severely limited in scope.[9] Over the last 20 years, through a variety of policies and laws restricting the design and development of "new" nuclear weapons, the human and intellectual capital has slowly dwindled to a few individuals who had unique opportunities. It is imperative for the long-term health of the human and intellectual capital that all personnel practice and exercise their ability to design and develop nuclear weapons under a variety of scenarios, from a "new" design to reusing components in new and different ways for the same capabilities. LANL should work with NNSA to develop an annual set of exercises to provide personnel a key opportunity to develop options under various restraints, either through existing legal avenues or by working with Congress to change the law to allow these activities. It is also important to consider the results of these exercises and conduct experiments on some designs to assist in validating and verifying LANL's nuclear code software. By incorporating all elements of the nuclear infrastructure, it allows LANL to better understand capabilities and provides a foundation for the future, to ensure the stockpile remains safe, secure and effective, whether to fix current weapons or develop new ones.

Notes

[1] Lab Director Briefing, *Los Alamos National Laboratory Current Climate and long-term viability*, 18 July 2014, 13.
[2] Ibid, 12-13.
[3] Shaw, 277.
[4] Ibid, 166.
[5] John Pedicini (Los Alamos National Lab), interview by the author, October 2014.

Notes

[6] *Los Alamos National Laboratory Current Climate and long-term viability*, 17.
[7] Unattributed interviews with leaders in weapons program by mutual agreement, Sep-Oct 14.
[8] *Los Alamos National Laboratory Current Climate and long-term viability*, 18.
[9] Nakleh, October 2014.

Chapter 5

Conclusions

We also need to recognize that we cannot simply turn our nuclear capability off and on. History has taught us that reinstating a lost or reduced capability is a very expensive exercise.

- Martin White, "Modernizing for the Second Nuclear Age," National Security Science, Jul 2014

The current health of the human and intellectual capital at Los Alamos National Labs is strong; however, it is on the precipice. While LANL has made significant progress in many areas, these sixteen recommendations address the human and intellectual capital challenges looming for LANL. Without implementing, institutionalizing, and focusing on these recommendations, the human and intellectual capital at LANL faces a crisis within the next decade.

The current LANL director has identified personnel as one of the critical goals for the lab.[1] It is imperative that the human and intellectual capital is addressed sooner rather than later, as the current age of the workforce provides a clear and present challenge, that, if not addressed now, will have a significant impact on the next generation of nuclear weapons personnel and national security. As the President has stated, "As long as nuclear weapons exist, we will maintain a safe, secure and effective nuclear arsenal."[2] With the ever-increasing number of nuclear capable and nuclear aspiring states, it becomes clear that the United States will have these weapons for the long-term security of our nation.

While reducing the nation's reliance on nuclear weapons as a deterrence and potential warfighting tool, the enhancement of human and intellectual capital becomes even more critical. A career in nuclear weapons is still challenging and extremely important to the nation. However, management and leadership practices in the nuclear enterprise are placing the nation in jeopardy unless the nuclear enterprise changes its focus and makes necessary changes in recruiting, retaining, and developing the next generation of professionals at LANL.

Notes

[1] Los Alamos National Lab, *Proud Legacy, Bold Future: Los Alamos National Lab Strategic Plan 2014*, 3.

[2] White House, http://www.whitehouse.gov/the_press_office/Remarks-By-President-Barack-Obama-In-Prague-As-Delivered (Accessed 4 February 2015).

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