



Workforce Analysis to Support Future Pit Production

An analysis of the workforce environments in Aiken, South Carolina and Los Alamos, New Mexico

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Aligning the NNSA Workforce to Support Pit Production

April 2018

Executive Summary

The Department of Defense requires that the United States has the capability to produce 10 war reserve (WR) pits per year (ppy) in 2024, 20 WR ppy in 2025, 30 WR ppy in 2026, and 80 WR ppy in 2030. To meet this requirement, the Department of Energy's National Nuclear Security Administration (NNSA) is evaluating options to support increased plutonium pit production over the next several decades. A factor in the selection of a preferred alternative is the ability of the site to adequately recruit, hire, and retain the highly skilled and specialized production workers needed to produce plutonium pits. NNSA tasked LMI with analyzing the workforce and staffing environments of the Savannah River Site (SRS) in Aiken, South Carolina, and the Los Alamos National Laboratory (LANL) in Los Alamos, New Mexico. A summary of our analysis will supplement an engineering analysis to inform a decision on the preferred alternative.

The LANL and SRS localities demonstrate the ability to meet future staffing requirements. While SRS can draw from a larger and more affordable local labor pool, LANL requires fewer additional staff members due to its base of experienced production staff members. To supplement local hiring, both sites recruit new hires through their regional and national university partnerships and through their attractive regional characteristics.

In addition to our findings, we urge NNSA to take into account the following:

- The hiring and training for future pit production staff members, including the sequence and timing of new hires, on-the-job training requirements, and the availability of production facilities
- The variety of operating models available, including the potential for shared services, the flexibility afforded by multiple locations, and changes to operating models driven by contractors charged with future management of operations
- The impact of pit production on administrative services and other programs.

For the demand side, we used information provided by NNSA and LANL to outline staffing requirements, including the estimated number of workers, and to develop profiles to outline the job types, required skills, and levels of proficiency for the personnel necessary to meet plutonium pit production demand through the year 2030.

For the supply side, we compared LANL and SRS across three factors:

1. Ability of the existing workforce to satisfy staffing requirements
2. Ability of the local labor force to satisfy staffing requirements
3. Ability of the site to attract additional workers to satisfy staffing requirements.

Table ES-1-1 summarizes our findings.

Table ES-1-1. Summary of Findings

	LANL	SRS
Demand analysis		
Staffing requirements (baseline: LANL = 30 ppy, SRS = 0 ppy) ¹	465–512	686–758
Staffing requirements <i>after</i> accounting for site attrition rates	561–618	720–796
% increase over the average hiring levels for the previous 4 years	(b)(4)	
Supply analysis		
Ability of the existing workforce to satisfy staffing requirements		
(b)(4)		
Availability of on-the-job training for pit production	Available onsite	Not available onsite
Ability of the local labor force to satisfy staffing requirements		
Availability of skilled workers in the local area (as of 2016)		
(b)(4)		
Median wage against national average	Above average	At or below average
Population age against national average	Older than average	At or near average
Historical unemployment 2007–2016 against national average	Lower than average	At or near average
Educational attainment against national average	Above average	Below average
Ability of the site to attract additional workers to satisfy staffing requirements		
Housing cost	\$150,000–\$250,000+	\$100,000–\$175,000
Rental cost	\$600–\$950	\$750–\$1,100
Commuting time (minutes)	21.9	23.4
School districts	B+	B+
Healthcare against national average	High availability	Low availability
Crime rates against national average	Below average	At or near average
Cost of living against national average	Above average	Below average
Cultural amenities—nightlife	B-	A
Cultural amenities—outdoor activities	B+	B-
Recruiting relationships—universities	National and regional	Regional and local

The following chapters outline LMI's approach and provide greater detail for the summary of findings listed above.

(b)(4)

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Chapter 1

Introduction

This chapter offers a brief overview of the background and objectives driving concurrent studies sponsored by the Department of Energy's (DOE's) National Nuclear Security Administration (NNSA) and LMI as a third-party contractor.

Background

NNSA is considering alternatives to provide the infrastructure to support increased plutonium pit production over the next several decades. A factor in the selection of a preferred alternative is the ability of the site to adequately recruit, hire, and retain the highly skilled and specialized workforce needed to support this activity, both initially and over time. Previous analyses and decisions have narrowed the site alternatives to two existing NNSA facilities: the Los Alamos National Laboratory (LANL) located in Los Alamos, New Mexico, and the Savannah River Site (SRS) located in Aiken, South Carolina. LANL is currently engaged in plutonium pit production, while SRS is not.

The need for these studies is driven by requirements established by the Nuclear Weapons Council to produce 10 war reserve (WR) pits per year (ppy) in 2024, 20 WR ppy in 2025, 30 WR ppy in 2026, and 80 WR ppy in 2030. Plutonium is a challenging material to work with both because of its properties and the hazards it presents. Its physical properties, such as density and malleability, can change due to miniscule changes in environment, and it can degrade due to interaction with other elements and the effect of its own radioactive decay.² Because of these complexities and the exacting specifications a finished pit must meet, workers producing these pits must be highly trained and meet high security clearance requirements.

Objectives of Study

NNSA tasked LMI with analyzing the workforce and staffing environments in and around Aiken, South Carolina, and Los Alamos, New Mexico, to evaluate ability of SRS and LANL to support pit production requirements. The LMI study summarizes data and analytical results that will be combined with an engineering assessment to inform a decision on the preferred alternative.

Scope of Study

NNSA asked LMI to present an independent, unbiased comparison between the workforce and staffing environments in and around the LANL and SRS sites. We limited our analysis to staffing for current and future pit production and to relevant supply factors in the two geographic areas to support that staffing demand. Our analysis relied primarily on publicly available information at the federal, state, and local levels and was informed by key facts and assumptions from subject matter experts (SMEs) at NNSA, LANL, and SRS. LMI was not tasked with recommending skill sets or the number of employees

² Jonathan E. Medalia, *U.S. Nuclear Weapon "Pit" Production Options for Congress* (Washington, DC: Congressional Research Service, 2014).

needed for pit production, nor were we asked to choose one of the two sites. In addition, workforce analysis needed in support roles tangential to pit production (e.g., administration, safety, facilities management and others) was not within the scope of this tasking.³

Organization of This Report

This report is organized as follows:

- **Chapter 2** outlines our approach to the workforce and staffing analysis and the facts and assumptions that underlie it.
- **Chapter 3** presents our analysis of the demand for staffing requirements at LANL and SRS associated with future plutonium pit production.
- **Chapter 4** presents our analysis of the supply of a qualified and capable workforce to satisfy future staffing requirements for pit production at LANL and SRS.
- **Chapter 5** highlights additional considerations outside the scope of this analysis that may affect future plutonium pit production and staffing.

The appendices contain supporting details related to our research and analysis.

³ Due to the highly technical and specialized nature of the staffing requirements, this report focuses on pit production only. Additional workforce analysis for support staff may be beneficial, as the NNSA expects the number of staff required to be significant.

Chapter 2

Approach

This chapter outlines our approach and key assumptions to developing the workforce and staffing analysis which, combined with the engineering analysis, will inform the site selection for future plutonium pit production.

Analytical Approach

At the outset of this project, we reviewed the literature of workforce studies to support site selection so we could identify best practices and standards for selection criteria and our analytical approach. We developed our analytical framework on the basis of this review and LMI's experience in completing similar studies. Our framework accomplished the following major analytical tasks:

- Describe the workforce and staffing demand for the required levels of plutonium pit production.
- Assess the relative ability of each site alternative to supply the workforce and staffing demand.

For the demand side, we relied primarily on LANL staffing information and input from SMEs supporting the Engineering Assessment to define the workforce requirements with respect to the competencies, education, and years of experience required for pit production. We supplemented LANL's data by gathering and analyzing federal, state, and local data drawn from a range of sources, including the U.S. Office of Personnel Management's classification and qualification standards; the U.S. Department of Labor, Employment and Training Administration's O*NET database; DOE position descriptions, vacancy announcements, and other information describing classification and qualification standards specific to DOE pit production requirements; acquisition documents with defined contractor workforce requirements for pit production; and information from targeted interviews with NNSA staff members and SMEs.

From the information provided by NNSA and LANL, we developed a matrix to outline the number of personnel and the required skills and levels of proficiency necessary to meet plutonium pit production demand through the year 2030. We then developed workforce profiles for each key pit production job role that outline the key responsibilities, skills, education requirements, and salary ranges relevant to each level of experience, along with the number of workers estimated by NNSA as required for each role. We validated these profiles through in-person and virtual meetings with NNSA staff members.

For the supply side, we used the workforce requirements laid out in the staffing profiles to compare LANL and SRS across three focus areas:

1. Ability of the existing workforce to satisfy staffing requirements
2. Ability of the local labor force to satisfy staffing requirements
3. Ability of the site to attract additional workers to satisfy staffing requirements.

Using the staffing profiles, we matched pit production staffing requirements with data on the current staff at each site to determine the ability of existing workers to satisfy requirements, including insight into the number of workers who could be reassigned. Next, we assessed the sites’ ability to fill workforce requirements by employing “local” workers by defining the geographic region from which each site draws employees and analyzing census and education data and labor statistics for each. Finally, we determined the sites’ ability to fill remaining workforce gaps through regional and national recruitment. This report summarizes the results of our analysis.

Key Assumptions

Our analysis rests on the following three assumptions:

1. NNSA studies and input from the field form the basis of staffing requirements.⁴
2. LANL will reach staffing and production milestones to produce 30 ppy by 2026.
3. Area of study focused on the localities where a majority of current staff live.

Basis for Staffing Requirements

In 2012, LANL studied plutonium sustainment and manufacturing with the intent of providing “critical and decisive information on the Plutonium Sustainment Program and pit manufacturing to facilitate valid and informed programmatic decision making for future pit-manufacturing operations.”⁵ The findings and assumptions of this study form the foundation for pit production staffing requirements, augmented by current LANL pit production staffing plans and input from SMEs in the field.

LANL Staffing and Production Milestones

We assumed that LANL will reach key milestones for plutonium pit production as outlined in NNSA’s FY18 Stockpile Stewardship and Management Plan.⁶ Specifically, we assumed that LANL will successfully meet staffing requirements for the ramp-up of pit production to 30 war reserve (WR) ppy by 2026, as shown in Figure 2-1.

Figure 2-1. LANL Production Milestones, 2018–2030

Type	2018	2019	2020	2021	2022	2023		2024	2025	2026	2030
Pit Production Series	Development Builds		Process Prove-in Builds		Qualification Builds	Qualification Builds	W87-like War Reserve Build	W87-like War Reserve Builds			
Pits per year	4	5	5	5	5	5	1	10	20	30	80

Source: NNSA’s FY18 SSMP.⁷

Assuming the staffing for 30 WR ppy is in place at LANL, our analysis therefore focused on the additional 50 WR ppy production levels required in FY30.

⁴ LANL, “The Plutonium Sustainment and Manufacturing Capabilities Study,” Revision 3, LA-CP-12-00299, April 30, 2012.

⁵ Ibid., p. 3.

⁶ NNSA, *Fiscal Year 2018 Stockpile Stewardship and Management Plan: Report to Congress*, November 2017, available at https://nnsa.energy.gov/sites/default/files/nnsa/inlinefiles/fy18ssmp_final_november_2017.pdf (hereinafter NNSA’s FY18 SSMP).

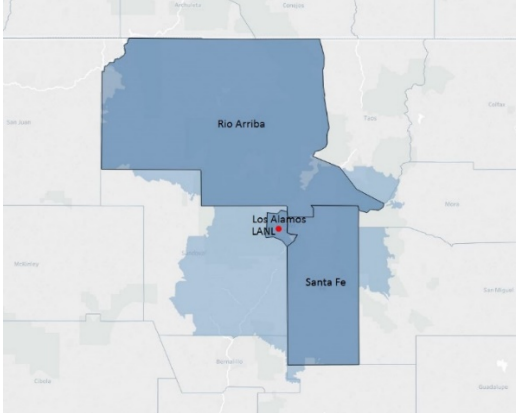
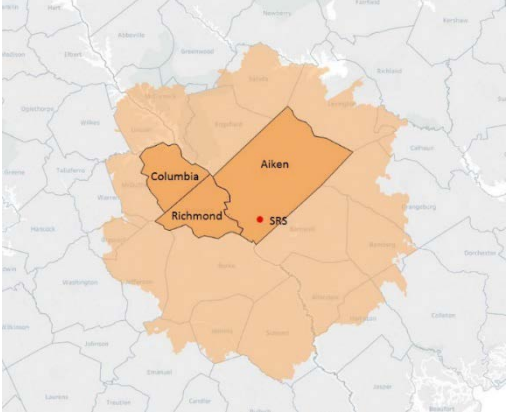
⁷ Ibid., Derived from Table 2-3.

Relevant Areas of Study

For our analysis, LMI only compared factors within the localities surrounding Los Alamos and Aiken where a majority of current employees reside. In Table 2-1, we provide an overview of how the current workforce is distributed between these localities.⁸

Table 2-1. Distribution of Current Employees across LANL and SRS Localities

LANL localities		SRS localities	
Los Alamos County, NM	43%	Aiken County, SC	54%
Santa Fe County, NM	21%	Columbia County, GA	16%
Rio Arriba County, NM	16%	Richmond County, GA	11%

Source: LANL and SRS data.

LMI also gathered and analyzed available data within a 50-mile radius to ensure findings were accurately reflected for each locality.⁹

⁸ Based on analysis provided by LANL and SRS, approximately 80% of current employees live within the three-county areas surrounding both sites.

⁹ The radius was determined using zip codes within 50 miles of LANL and SRS site.

Chapter 3

Demand Analysis

This chapter summarizes the workforce requirements for future pit production. Staffing profiles outline the competencies, education, and years of experience required for pit production. Projected staffing levels detail the number of employees required to reach future pit production milestones.

Summary of Findings

- There are five role categories that encompass the competencies needed for pit production: (b)(4)
- These highly specialized roles require experience in a related field of 2–10 years, depending on the job level, and in many cases at least a bachelor's degree.
- Increased pit production at LANL from 30 to 80 ppy requires 465–512 additional personnel across the five role categories. Launching a pit production program at SRS to reach 50 ppy requires 686–758 personnel across those same categories.

Background

The findings and assumptions of LANL's 2012 capabilities analysis form the foundation for pit production staffing requirements.¹⁰ In addition, sample LANL position descriptions, vacancy announcements, and SMEs validated our analysis.

Approach

LANL's capabilities analysis outlined 14 process competencies in the production of pits and the five role categories that work to fulfill them.¹¹

(b)(4)

¹⁰ LANL, "The Plutonium Sustainment and Manufacturing Capabilities Study," Revision 3, LA-CP-12-00299, April 30, 2012, p. 3.

¹¹ Ibid., based on the "14 Flowsheet Modules," which details the process competencies required in pit production, tables 8–11, pp. 52–55.

(b)(4)

These roles form the basis of LMI's workforce analysis in developing staffing profiles and projections. Together with the sample LANL position descriptions and job postings, we developed general role descriptions, educational requirements, and years of experience.

For staffing levels, we used estimates outlined in LANL's capabilities analysis for the total number of personnel required for 30, 50, and 80 ppy on a single-shift or double-shift operational basis at an average confidence production rate.¹² Using these estimates as the baseline for 30 ppy, we adopted the LANL convention of reducing 2012 staffing levels by (b)(4) to bring the projected levels for 30 ppy in line with planned equipment and pit production process improvements. For 50 and 80 ppy, we used separate 2018 estimates from LANL for an increased production throughput of 90% confidence.¹³ A plus or minus margin of 5 percent was then calculated around the personnel totals to create staffing-level ranges for the five role categories at each production level.

Analysis

The staffing profiles and staffing levels subsections that follow summarize the workforce "demand" required for pit production.

Staffing Profiles

Table 3-1 profiles the five role categories used for this analysis.

¹² Note: LANL staffing plans for single-shift and double-shift operations are the same for total production staff. While exact numbers for the subcategories may shift depending on single- or double-shift operations, a 5% contingency adjustment should help account for these differences.

¹³ These estimates are consistent with the numbers used for the separate Parsons Plutonium Pit Production Engineering Assessment and are based on SME input to that analysis. The numbers are derived from historic staffing levels at Los Alamos and based on the number of staff associated with the equipment set under the alternatives analyzed in that report.

Table 3-1. Staffing Profile by Role Category

(b)(4)

Because Table 3-1 represents an amalgamation of position descriptions under each role category, the years of experience descriptor represents a range. The actual ranges in years of experience for each title may be shorter and vary by type of job and proficiency level.¹⁴

Staffing Levels

Building upon the job competencies and role categories defined in this chapter, LANL's capabilities analysis estimates the total number of personnel required for 30, 50, and 80 ppy on a single-shift or double-shift operational basis.¹⁵ Figure 3-1 and Figure 3-2

¹⁴ See appendix B of this report for expanded information on the sample job postings.

¹⁵ LANL's 2012 capability analysis totals the personnel needed at each level of pit production. Table 13, p. 60, outlines "Case 0" (Base Case), or what the LMI research team calls the "current production level." Table 16, p. 64, outlines "Case 3" 30 ppy, table 18,

show the projected pit production staffing requirements at LANL and SRS, respectively, to support the current production level, an interim production ramp-up to 30 ppy that will be assumed by LANL under either site selection scenario, and alternative future production states in which LANL or SRS assumes the production of the additional 50 ppy to reach the required 80 ppy level.

Figure 3-1. Pit Production Staffing Requirements at LANL, FY18–FY30

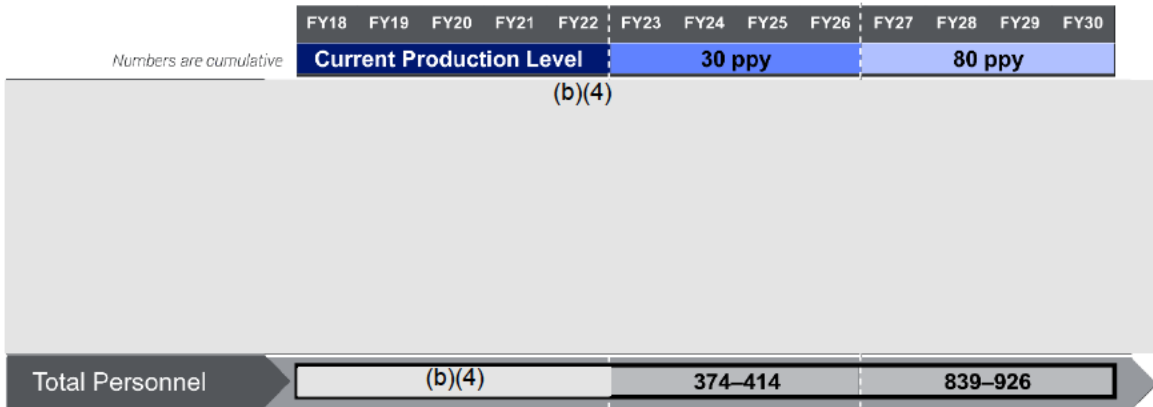
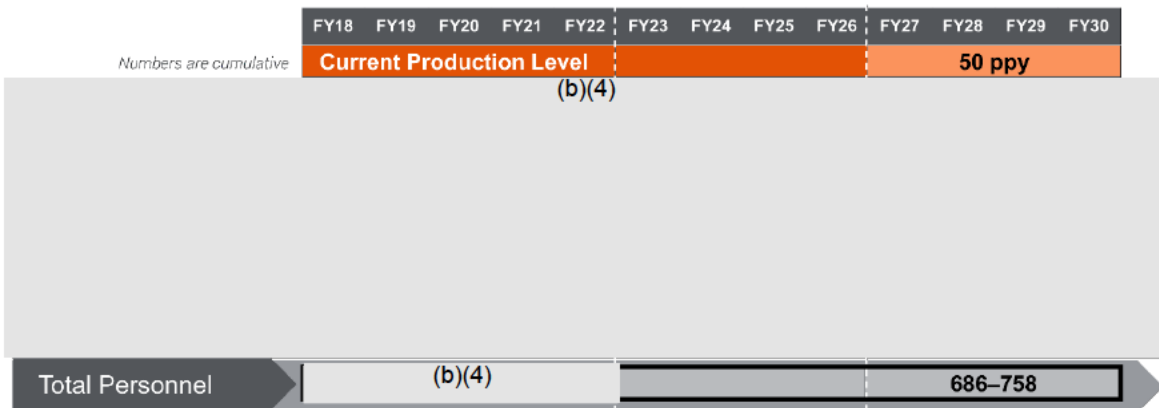


Figure 3-2. Pit Production Staffing Requirements at SRS, FY18–FY30



As illustrated in these figures, an increase of pit production from 30 to 80 ppy at LANL requires a personnel increase of 465–512 personnel across the five role categories. Launching a pit production program at SRS requires between 686 and 758 personnel across those same roles.¹⁶

p. 66, "Case 4" 50 ppy, and table 19, p. 80, "Case 5" 80 ppy. These tables are then laid side by side for comparison in Appendix B, "Personnel Modeling Results," pp. 97–99. Note: Case 1, case 2, and the reuse case are outside the scope of this research. LANL, "The Plutonium Sustainment and Manufacturing Capabilities Study," Revision 3, LA-CP-12-00299, April 30, 2012.

¹⁶ The research team acknowledges that different management and operations contractors may plan the production of pits differently, assigning different numbers of personnel within role categories, job titles, and job descriptions. At this time, only LANL produces pits. Therefore, this analysis uses LANL as its focus, detailing LANL's staffing levels, roles, titles, and training protocols. It is not meant to imply a best-case operational structure for pit production.

Chapter 4

Supply Analysis

This chapter presents our analysis of the supply of a qualified and capable workforce to satisfy future staffing requirements for pit production at LANL and SRS. Our supply analysis compared LANL and SRS across three factors:

1. Ability of the existing workforce to satisfy staffing requirements
2. Ability of the local labor force to satisfy staffing requirements
3. Ability of the site to attract additional workers to satisfy staffing requirements.

Ability of the Existing Workforce to Satisfy Staffing Requirements

This section describes the ability of the existing workforces at LANL and SRS to satisfy future pit production staffing requirements. We compare current staffing levels against pit production staffing requirements and discuss the ability of LANL and SRS to evolve their workforces to meet these future requirements.

Summary of Findings

- Accounting for attrition, LANL needs to hire 561–618 new or repositioned employees—between 140 and 155 per year—on top of 374–414 employees. SRS must add between 720 and 796 new workers, or between 180 and 199 per year. Hiring at these targets will enable the sites to meet demand to produce an additional 50 WR ppy by 2030, beyond the 30 WR ppy being produced at LANL.
- These hiring levels represent a 23 percent increase from LANL’s average hiring levels over the last 4 years and a 45 percent increase over the SRS average over that same period.
- At SRS, it appears that current employees can best supplement the categories of (b)(4) LANL also has staff members who could transfer to pit production. However, at either site these repositioned employees would need to be backfilled, so this would not change the overall hiring requirement in a material way.
- LANL has a core of staff members experienced in pit production who can offer on-the-job training (OJT) to new workers. SRS lacks this capability in-house; to provide OJT to new SRS workers, it appears that experienced LANL workers need to travel to SRS or new SRS workers need to travel to LANL to receive training there. Either approach presents challenges and requires further study.

Background

As outlined in the staffing profiles, NNSA needs to rapidly expand its capacity to produce plutonium pits from the current level of about 10 ppy to 30 ppy in FY26 and 80 ppy in FY30. This requires a rapid expansion of the workforce tasked with producing these pits.

Approach

We looked at four factors in examining this challenge. The first factor is the number of new workers needed to enter the workforce to meet the increasing requirement and backfill attrition. The second factor looks at how this compares with historical hiring levels as an indicator of risk. The third factor examines the need and ability of each site to transition employees performing other duties to pit production. Finally, the fourth factor looks at the ability to prepare new workers to produce plutonium pits.

Analysis

Staffing Requirements with Attrition

The number of new workers required is driven by two factors: the increased production requirement and the need to backfill workers who have left the workforce. Using the staffing requirements outlined in chapter 3 and attrition data from LANL and SRS, Table 4-1 and Table 4-2 outline the staffing requirements accounting for the increase in production requirement and the effects of attrition over time for both sites.¹⁷

Table 4-1. LANL Staffing Requirements with Attrition, FY22–FY30

	Base	Buildup to 30 ppy					Buildup to 80 ppy			
	FY22	FY23	FY24	FY25	FY26	FY27	FY28	FY29	FY30	

(b)(4)

Total	161–177	215–237	268–296	322–356	374–414	491–543	607–671	723–798	839–926
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Source: NNSA's FY18 SSMP and LANL attrition rates.

Note: Due to decimal-point rounding, the total row may have a +/- error of 1–2 workers.

¹⁷ LANL furnished FY17 attrition rates for its full workforce:

(b)(4)

(b)(4) we received total attrition data by job group but received attrition data by retirement and non-retirement status; for consistency, we assumed the same ratio of non-retirement attrition rate to total attrition rate that we found for LANL. We aligned the job categories with role categories for the following breakdown (total attrition and non-retirement attrition, respectively)

(b)(4)

(b)(4)

Table 4-2. Staffing Requirements with Attrition, FY27–FY30

Total	Buildup to 50 ppy			
	FY27	FY28	FY29	FY30
	(b)(4)			
Total required	171–190	343–379	514–569	686–758

Source: NNSA’s FY18 SSMP and SRS attrition rates.

Note: Due to decimal-point rounding, the total row may have a +/- error of 1–2 workers.

The bolded number range in each column indicates the number of new pit production workers needed each year to start producing pits. To meet demand for the additional 50 WR ppy by 2030, LANL must add 561–618 new workers, (b)(4)

This is on top of the base workforce consisting of 374–414 employees assumed to be in place by FY26 to meet the 30 ppy requirement. SRS, meanwhile, must add 720–796 new workers, (b)(4)

Because SRS has not produced pits, it does not have a “base” workforce from which to build. Therefore, SRS needs to hire new workers or transfer employees from other programs. The actual hiring of new employees would need to precede this by 3–5 years to

(b)(4)

Historical Hiring Levels

Table 4-3 shows the number of people hired at LANL and SRS each year from 2014 through 2017.¹⁹ The table also shows the average hiring level over that period for each site and compares that with the highest required increase in the pit production workforce in any year of the buildup to meet maximum pit production.

Table 4-3. Historical Hiring Levels, FY14–FY17

	FY14	FY15	FY16	FY17	Average	Maximum projected	% increase
	(b)(4)						

Source: SRS and LANL data.

For LANL, the number of annual hires increased substantially from 2014 to 2017, due at least in part to preparation for beginning pit production.²⁰ Looking forward, the influx of pit production workers is projected to be highest for FY30 at up to 161 new workers. Assuming historical hiring levels are maintained, this would represent a (b)(4) from the average hiring level (b)(4) over the last 4 years.²¹ This would also be

¹⁸ Based on *Pu Sustainment Staffing: LANL Pu Sustainment Program Review* (2017) and interviews with SMEs (Feb 5, 2018); see Chapter 1—Key Assumptions for greater detail.

¹⁹ Source: SRS and LANL responses to LMI data calls.

²⁰ Based on a working session with NNSA on February 5, 2018, which included SME insight into operations at LANL.

²¹ This assumes that any new pit production staff are hired in addition to regular hires, but LANL may refocus hiring efforts to focus on just pit production staff, leaving the annual hiring number changed by an amount lower than those needed for pit production.

the end of an 8-year buildup during which inflow would have grown steadily, starting with (b)(4) workers in FY23.

For SRS, the number of hires was fairly steady from 2014 to 2016, with an uptick in 2017. As with LANL, the highest influx of workers needed for SRS is in FY30; this requirement of up to (b)(4) represents (b)(4) increase from the average of (b)(4) per year from 2013 to 2017. For SRS, FY30 represents the end of a 4-year buildup that would start with (b)(4) fully operational workers in FY27. The ultimate timing of hiring depends on future workforce hiring plans and facility completion schedules.

Transferable Capabilities of Current Staff Members

LANL and SRS have a significant number of staff onsite who are not involved in pit production. These workers have certain advantages that may be transferable to pit production: they are a known resource, they may have transferrable skills, and they may possess required clearances and training that would expedite the time to be fully operational.

As part of supplemental data requests to LANL and SRS, we asked for information on employees who may be transferred to pit production. Table 4-4 lists current SRS positions that fit into each of the five pit production role categories. The categories are segregated by whether the individuals work for NNSA or another organization and whether they handle fissile materials. The last column expresses the number of workers needed at 50 ppy levels as a percentage of the workforce available to be repositioned. Higher percentages suggest more difficulty in repositioning workers and potentially greater disruption to existing programs.

Table 4-4. Current SRS Employees Who Could Be Repositioned

Role Categories	NNSA		Non-NNSA		Maximum potentially repositioned FTE	Maximum required FTE for 50 ppy	% of potentially repositioned FTE
	Handles Fissile Material	Does Not Handle Fissile Material	Handles Fissile Material	Does Not Handle Fissile Material			
(b)(4)							

Source: SRS data.

Given these data, it appears for SRS (b)(4) categories have the most employees available to be potentially repositioned to pit production. For example, SRS has (b)(4) required for 50 ppy, which represents only 8 percent of potentially available FTE. However, most of the available employees support programs that do not require them to handle fissile materials, and even fissile handlers require OJT. Therefore, any employee repositioned to pit production would still require significant onboarding and training. Table 4-5 contains data on current LANL employees.

Table 4-5. Current LANL Employees Who Could Be Repositioned

Role Categories*	NNSA		Non-NNSA		Maximum potentially repositioned FTE	Maximum required FTE for 30 ppy	% of potentially repositioned FTE	Maximum required FTE for 80 ppy	% of potentially repositioned FTE
	Handles Fissile Material	Does Not Handle Fissile Material	Handles Fissile Material	Does Not Handle Fissile Material					
(b)(4)									

Source: LANL data.

For LANL, it appears that employees across all five role categories may be available to be repositioned to pit production. As indicated by the percentages in the final column, (b)(4) appear have the greatest capacity. As with SRS, most available workers are employees who do not handle fissile materials and all repositioned employees would require significant onboarding and training.

For both sites, it is also important to consider the potential impacts of staff members transferring between programs. We understand that transfers are unlikely to reduce the total number of hires required for each site, as their previous position would need to be backfilled.²²

Internal Training Capability

Both sites have robust training programs to prepare employees for working safely and effectively with highly radioactive materials.²³ The primary difference between the sites is in their ability to provide training and experience in the formation of plutonium pits. LANL has employees who are experienced in pit production. However, SRS may not have experienced pit production employees in place to oversee the first wave of new hires. While exact training requirements are beyond the primary focus of our analysis, there are important implications for future staffing:

- *On-the-job Training.* We understand that new or repositioned pit production staff members will require training. For LANL, we expect future staff members to follow training and development procedures that exist at the site. For SRS, training is complicated, as pit production does not exist onsite. Key questions include the following:
 - a. *What positions require OJT at a plutonium pit production facility?* We understand that every future staff member requires OJT, but we do not know which positions require hands-on training at a pit production facility. Will this training have to take place at LANL until the pit production facilities at SRS are operational, or are there alternatives?

²² Based on a working session with NNSA on February 5, 2018, which included SME insight into operations at LANL.

²³ Ibid.

- b. *Who would train potential future SRS staff members? With current pit production taking place at only LANL, NNSA must consider who will train future SRS staff members. Will experts from LANL train them? If not, who else is qualified to provide OJT?*
- *Availability of Pit Production Facilities.* Currently, PF-4 at LANL is the only facility in the United States producing plutonium pits. It is our understanding that future pit production facilities at LANL and SRS are not expected to be operational until the late 2020s to early 2030s.²⁴ Here are key questions for consideration:
 - a. *Does LANL have the space to train future staff members? It is our understanding that PF-4 is used for pit production as well as other programs.²⁵ If LANL were responsible for the full 80 WR ppy requirement, would current pit production facilities have enough space to train new or repositioned staff members prior to the new facilities coming online?*
 - b. *How would SRS train potential future staff members without pit production facilities? Given the 3–5 years required to hire and train staff members to be fully operational, we understand that SRS needs to hire or reposition staff members for future pit production prior to when facilities are expected to be operational. How then will SRS train future staff members while pit production facilities are under construction? Will SRS staff members need to travel or temporarily relocate to LANL for OJT? Will LANL experts travel or temporarily relocate to SRS to train staff members at SRS, and if so, where and how will SRS staff members receive OJT?*

Therefore, it appears that experienced LANL workers need to travel to SRS or new SRS workers need to travel to LANL to receive OJT. Either approach presents challenges and requires further study if NNSA feels this level of training will prepare workers for producing pits safely and effectively.

Ability of the Local Labor Force to Satisfy Staffing Requirements

After analyzing the workforce in both localities, the research team turned its attention to the local labor forces surrounding LANL and SRS to determine whether the right type of workers live in each area.

Summary of Findings

- There are more workers available in the SRS locality but higher wages in the LANL locality.
- Compared with the SRS locality, the LANL locality experienced lower rates of unemployment between 2007 and 2016.

²⁴ NNSA, Analysis of Alternatives, 2017.

²⁵ Based on a working session with NNSA on February 5, 2018, which included SME insight into operations at LANL.

- The population in the LANL locality is generally older than both the national average and those who live in SRS, while SRS trends closer to the national average.
- Workers in the LANL locality have a higher level of educational attainment than both the national average and those around SRS, who are closer to the national average.

Background

In 2013, LMI and TechSource assessed skilled staffing capabilities in support of weapons programs at all NNSA localities.²⁶ The report determined that each locality had sufficient mechanisms in place to source talent in its area but acknowledged the extensive time needed to integrate external hires into the weapons program. Required security clearances, onsite technical training, and development processes to adequately train new hires in skills not available through academia are necessary to meet the unique demands of the nuclear weapons program.²⁷ This time to clear and train new pit production personnel is an inherent risk to programmatic operations even when qualified candidates are available.

Approach

To determine whether the right type of workers live in the areas surrounding the two localities, (b)(4)

general occupational categories were subsequently defined as follows:

- 11-0000—Management
- 17-0000—Architecture and Engineering
- 19-0000—Life, Physical, and Social Science
- 47-0000—Construction and Extraction
- 51-0000—Production.

Looking at the BLS description for each SOC title, along with other titles within the general occupational categories, the research team compiled profiles for each of the general occupations, similar to those created for the role categories during the pit production staffing profile.²⁸ Figure 4-1 shows this relationship. While the link between the role categories required for pit production (the demand side) and the occupational categories based on the SOC (the supply side) is not exact, (b)(4)

²⁶ LMI and TechSource, *DOE NNSA M&O Contractor Essential Skill Workforce: Assessment of Essential Skill Staffing Capabilities of NSE Sites to Support NNSA Weapons Programs*, Report ME301T1 (Tysons, VA: LMI, September 2013).

²⁷ *Ibid.*, p. iv.

²⁸ These five general occupations do not translate on a one-to-one basis back to the five pit production role categories. Much like the role categories represent individuals who work within the 14 pit production competencies, workers in the five general occupations represent specific SOC system job titles in each of the five role categories. Appendices C and D provide the profiles and mapping in greater detail.

Figure 4-1. Linking Role Categories to Occupational Categories



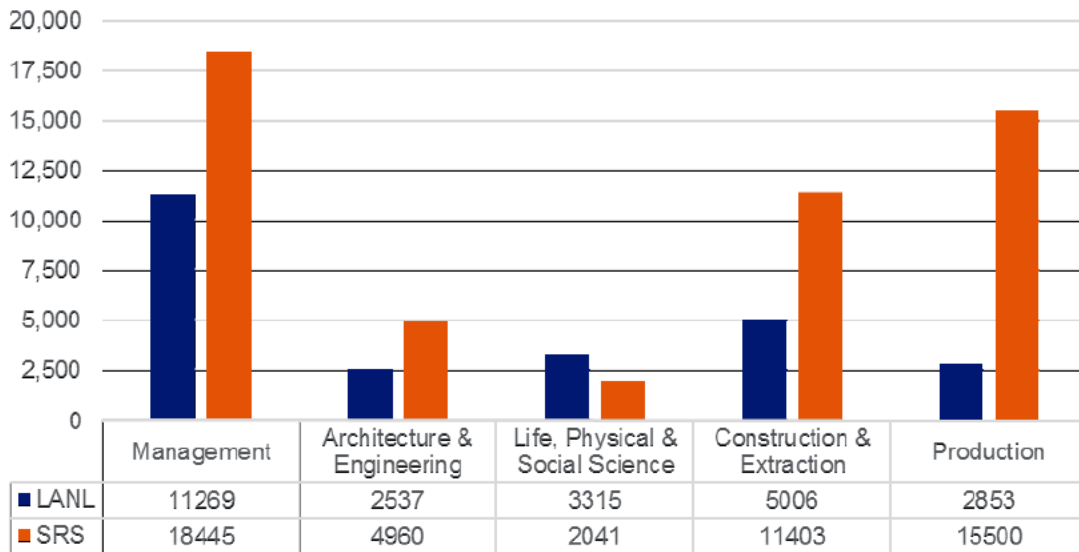
Analysis

By creating the link between demand and supply and by defining the localities, we are able to examine characteristics of the local labor force.

Number of Workers

Based on 2016 U.S. Census data, Figure 4-2 shows that the SRS locality has more workers in four of the five occupations than the LANL locality. The exception is the Life, Physical, and Social Science occupational category, with more workers in the region around LANL than SRS.

Figure 4-2. Labor Force by SOC Category

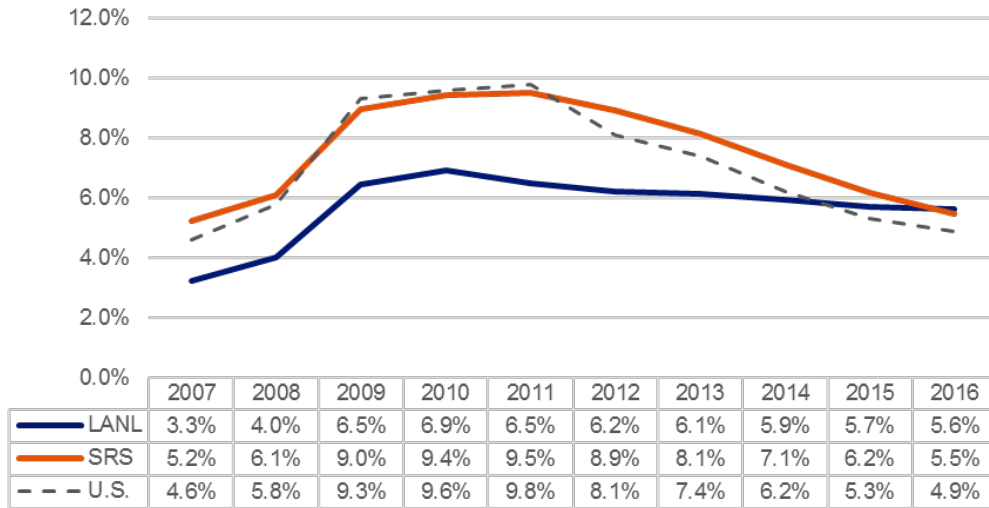


Source: U.S. Census 2016 American Community Survey.

Local Employment

Compared with the SRS locality, the LANL locality experienced lower rates of unemployment between 2007 and 2016, as shown in Figure 4-3.

Figure 4-3. Local and National Unemployment Rates, 2007–2016

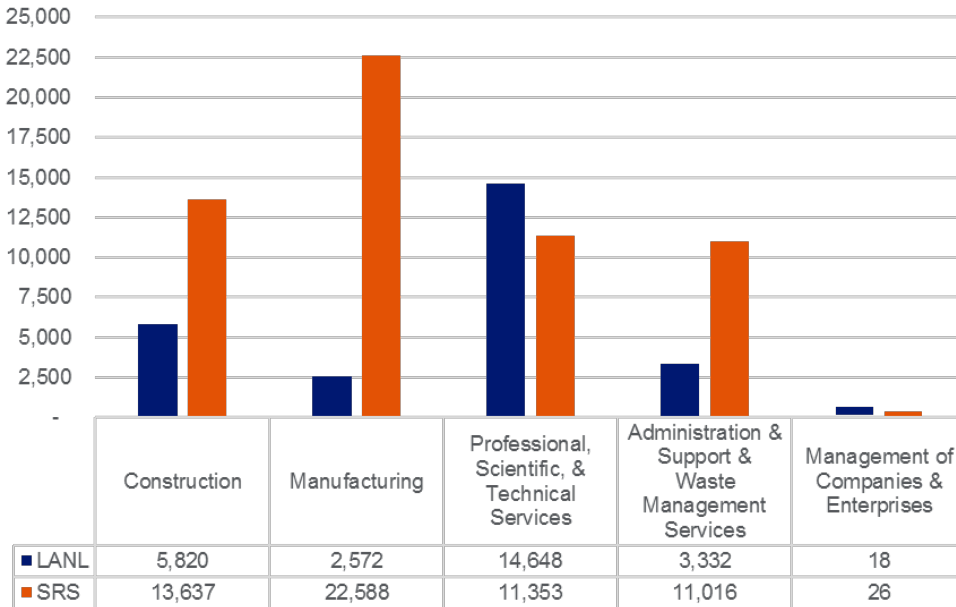


Source: BLS Local Area Unemployment Statistics via the U.S. Department of Agriculture.

In both areas, unemployment peaked in 2009. Since 2010, unemployment in LANL has plateaued around 6 percent. Comparatively, unemployment in the SRS locality peaked at 9.5 percent in 2011 but has since declined by 4 percentage points. In 2016, the LANL and SRS localities had unemployment rates higher than the national average, at 5.6 percent and 5.5 percent, respectively.

Figure 4-4 depicts local employment in the industries relevant to pit production. Employment in the LANL locality is primarily in the professional, scientific, and technical services industries; employment in the SRS locality is concentrated in manufacturing.

Figure 4-4. Local Employment in Relevant Industries, 2016

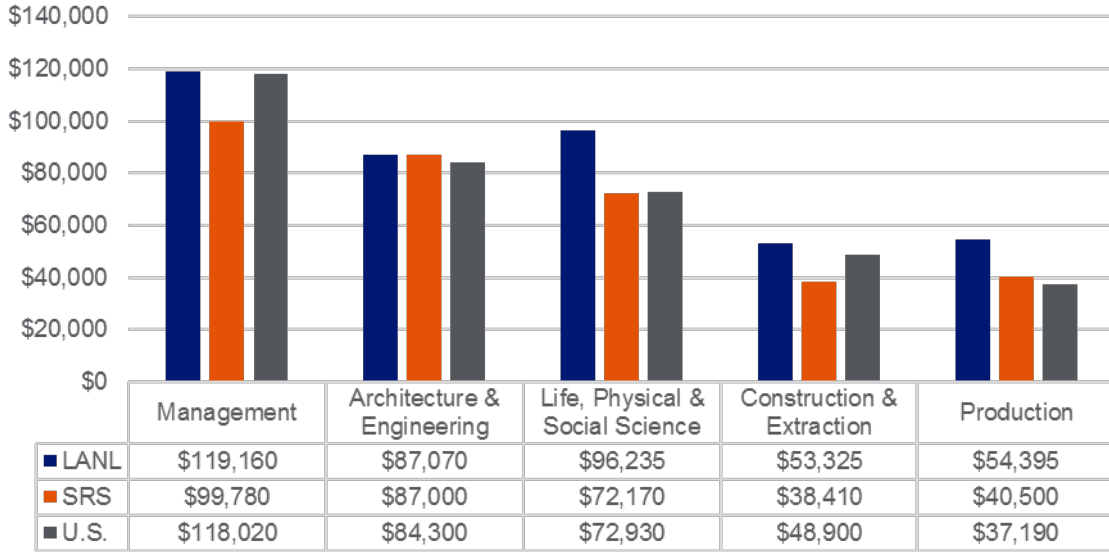


Source: U.S. Census 2016 American Community Survey.

Average Wages

Figure 4-5 shows that workers in the LANL locality earn more than those around SRS, except for workers in the Architecture and Engineering category who are paid almost the same in both locations.²⁹ Workers in the LANL area also earn more than the national average in each occupation. The SRS locality is less consistent. Management, sciences, and construction and extraction occupations earn less than the national average, while architecture and engineering and production earn more.

Figure 4-5. Average Wage by SOC Category



Source: BLS, segmented by MSA or BOS area.³⁰

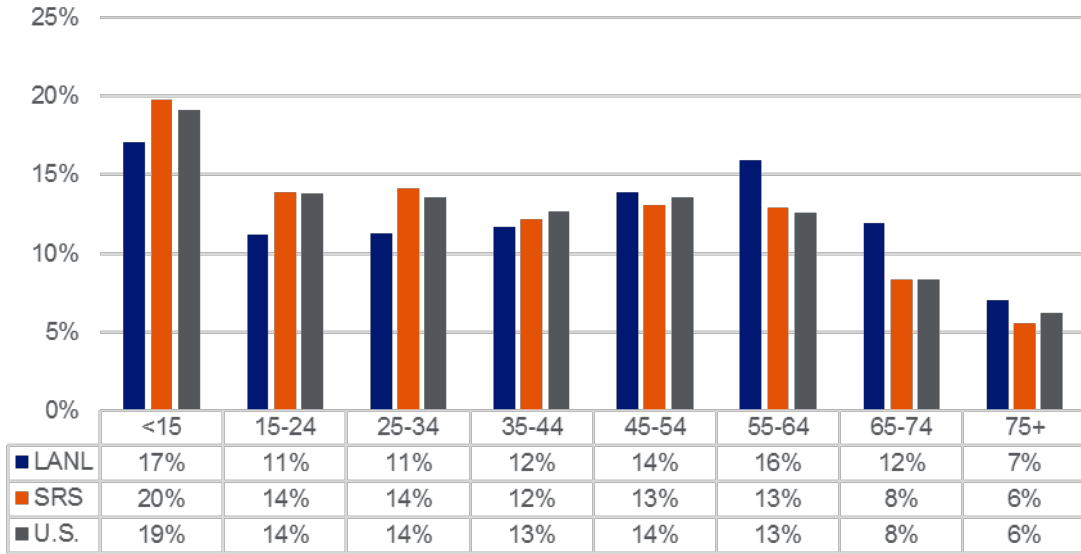
Population Age

There are distinctions between the two sites with respect to population age. Figure 4-6 displays eight age brackets as a percentage of total locality population. People who live around LANL are generally older than both the national average and those who live in SRS, while SRS trends closer to the national average.

²⁹ We compiled average wages using BLS data. In this case, the information was segmented by metropolitan statistical area (MSA) and balance-of-state (BOS) area. The LANL locality focuses on the BOS areas of Los Alamos and Santa Fe, New Mexico; SRS focuses on the MSA of Augusta-Richmond County, GA-SC.

³⁰ MSA and BOS area are determined by the Office of Management and Budget and represent geographical regions with a specific population at their core that has close economic ties throughout the area.

Figure 4-6. Age Brackets by Locality

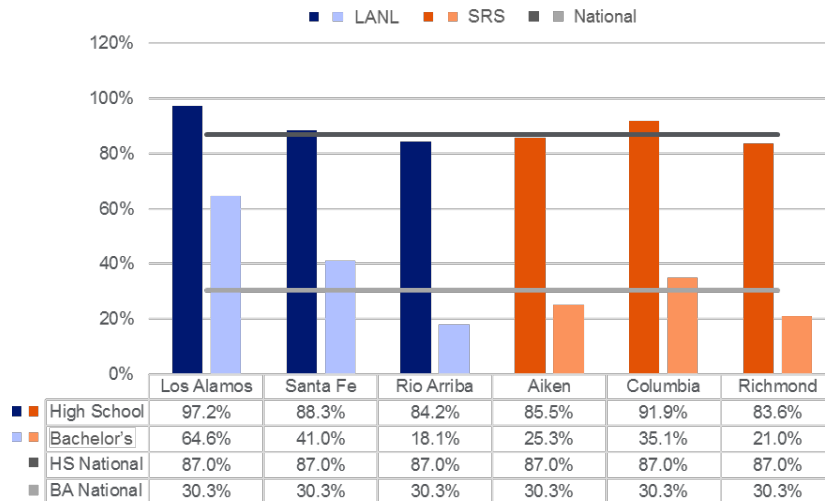


Source: U.S. Census 2016 American Community Survey.

Educational Attainment

Figure 4-7 shows that the population in the LANL locality has a higher level of educational attainment than both the national average and those around SRS, who are closer to the national average. As the figure shows, LANL’s Los Alamos County is especially well educated, with 97 percent of the population age 25 and above having attained a high school diploma, and 65 percent having attained a bachelor’s degree, both well above the national average. Santa Fe’s population also has high bachelor’s degree attainment at 41 percent, while Rio Arriba falls below average in both categories. For the SRS locality, Columbia rates above average in both the high school diploma and bachelor’s degree categories, but Aiken and Richmond fall short, especially in bachelor’s degree attainment.

Figure 4-7. Educational Attainment, Age 25+



Source: U.S. Census 2016 American Community Survey.

Ability of the Site to Attract Additional Workers to Satisfy Staffing Requirements

This section describes the local amenities and attractions that could enable LANL and SRS to draw the needed workers to satisfy staffing requirements.

Summary of Findings

- Homes prices in the region surrounding LANL are higher on average than those in the area surrounding SRS. Median home values near Los Alamos and Santa Fe are above \$250,000 while those in SRS are generally \$100,000–\$175,000. Rental prices have a smaller spread but are still more expensive around LANL.
- About 90 percent of workers at both sites drive to work, alone or as part of a carpool. Our analysis found that commuting times at the two sites are about the same.
- Based on Niche rankings, school districts in the areas surrounding LANL generally rank higher than the districts surrounding SRS. Both sites have strong individual schools within their areas.
- LANL has recruiting connections with local southwestern universities and technical colleges, as well as dozens of nationally recognized programs. SRS tends to recruit more locally, employing numerous graduates from strong regional universities. These varied recruitment strategies are likely driven by differences in program missions.
- Although measures of healthcare vary significantly between the LANL and SRS localities, LANL appears to have better availability of care. However, the quality of care appears to be below the national average for both localities.
- Crime appears to be higher in the counties around SRS than in those around LANL.
- The cost of living in the area around LANL is slightly higher than the national average, while it is lower in the area around SRS. The relative cost of housing is a major factor in this difference.
- While both localities offer outstanding cultural and entertainment activities, LANL's attractions emphasize outdoor activities while communities near SRS, particularly Augusta and Columbia, are rated high on nightlife.

Background

To hire the number of new workers necessary to meet the expanding requirement for pit production, LANL and SRS are equally likely to need to attract workers from outside their local geographical areas. In addition to the job itself, characteristics of the surrounding communities can have a significant impact on the decision to accept an employment opportunity. Therefore, we examined a variety of factors affecting that decision. We also looked at each site's established connections with academic partners that could be used to identify and recruit qualified workers.

Approach

This section analyzes factors that influence the ability of a geographic area to attract new workers by using data obtained from publicly available sources. These factors include the following:

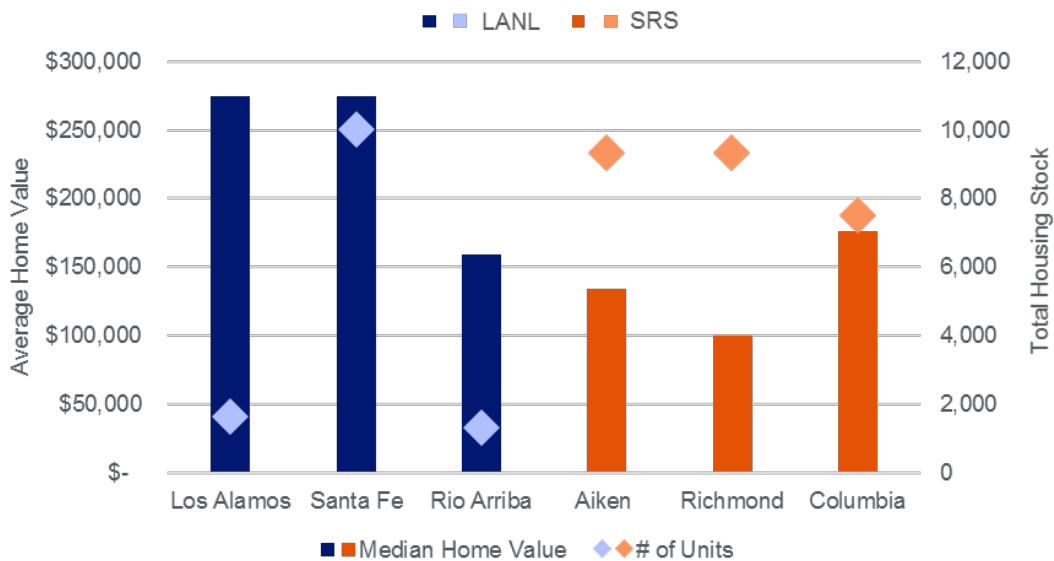
- Supply and cost of housing
- Local commuting
- Public school districts
- Academic partnerships
- Healthcare
- Crime rate
- Cost of living
- Cultural amenities.

Analysis

Supply and Cost of Housing

Homes prices in the region surrounding LANL are higher on average than those in the area surrounding SRS. One of the contributing factors is the housing supply in the region: compared with SRS, the total housing supply is lower in the area surrounding LANL. Figure 4-8 provides an overview of the average home values and the total housing stock for each proximate county surrounding LANL and SRS. The housing count in Rio Arriba County is likely overestimated (and housing cost likely underestimated), as mobile homes account for 38.5 percent of housing. The same is true for Aiken County, where 21.9 percent of housing is mobile homes.

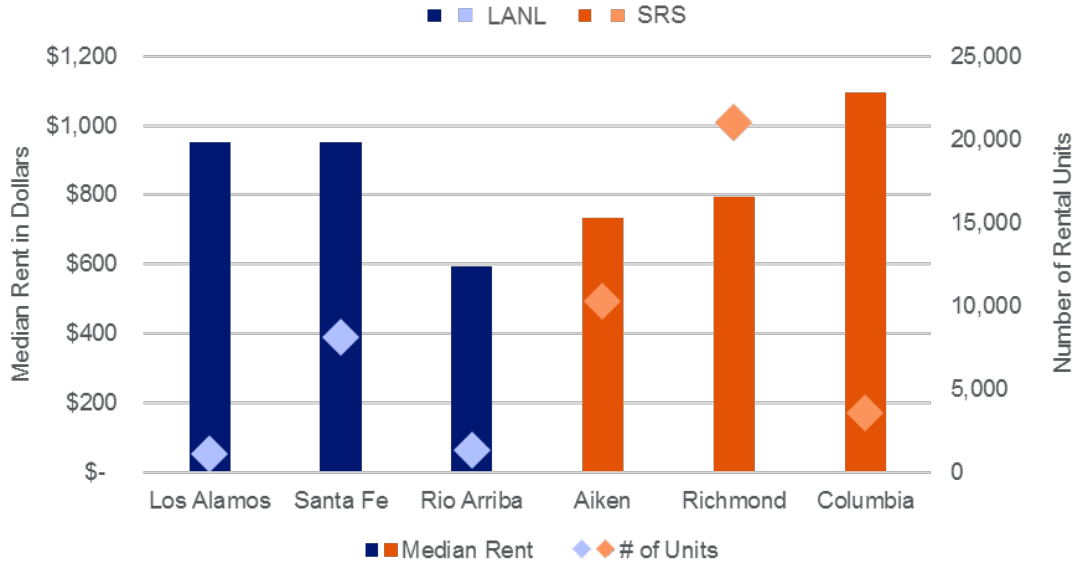
Figure 4-8. Home Value and Stock by County, 2016



Source: U.S. Census 2016 American Community Survey.

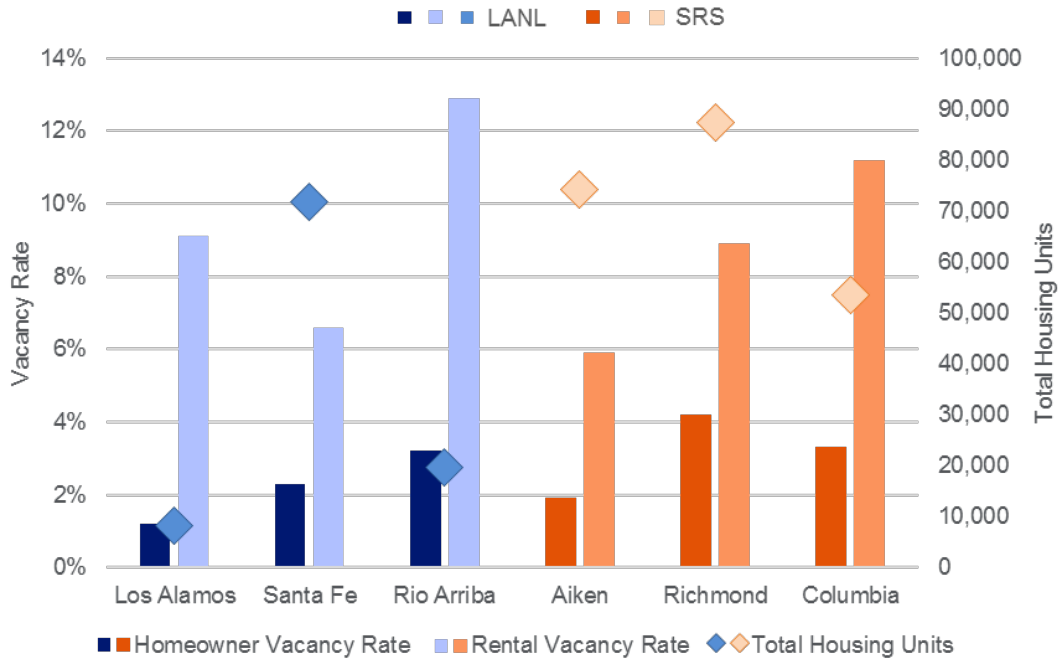
Compared with this housing market analysis, there is much less disparity between the rental markets around each site. Figure 4-9 provides an overview of the median rent and availability by county, and Figure 4-10 shows vacancy rates and total housing units.

Figure 4-9. Median Rent and Stock by County, 2016



Source: U.S. Census 2016 American Community Survey.

Figure 4-10. Vacancy Rates and Total Housing Units by County, 2016



Source: U.S. Census 2016 American Community Survey.

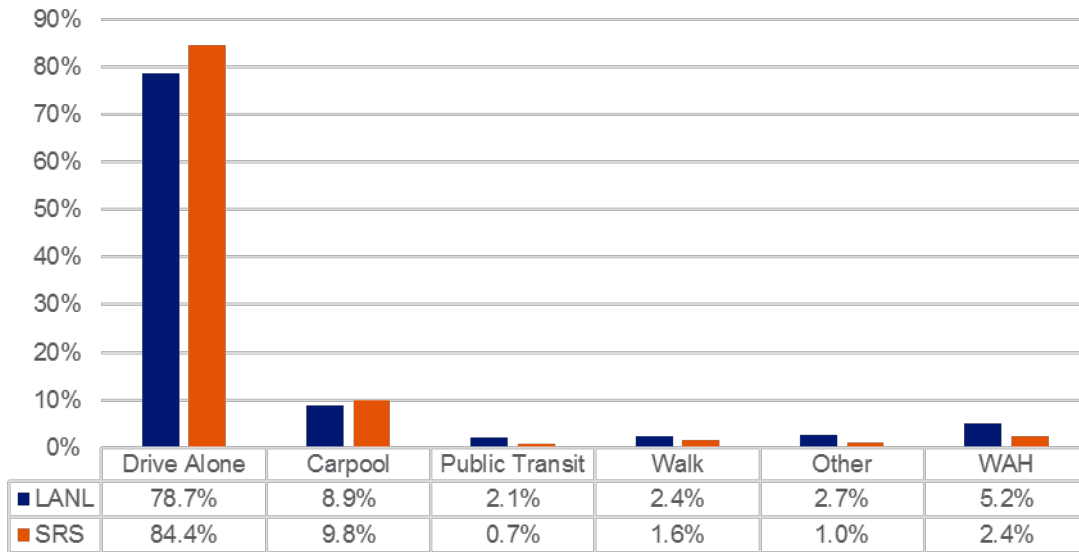
The supply and cost of rental units is similar to the pattern seen in housing, with the exception of Columbia County, whose median rent is the highest of the six counties analyzed and whose total supply of rental units is lower than Santa Fe's.

Local Commuting

Based on U.S. Census 2016 American Community Survey data, our analysis found that average commuting times at LANL and SRS are approximately 23 minutes, and nearly 90 percent of workers at both sites drive to work, either alone or as part of a carpool.³¹ Specifically, workers in the LANL area travel an average of 21.9 minutes to work from door to door, while those around SRS take roughly 23.4 minutes—a difference of less than two minutes.

Figure 4-11 lays out the modes by which workers in each locality get to work. The vast majority of workers in both localities drive alone (84 percent in SRS’s locality and 79 percent in LANL’s locality). Less than 10 percent carpool in both localities, and even fewer use public transit, walk, take a taxi or ride a motorcycle (other), or work at home (WAH).

Figure 4-11. Method of Commute by Locality



Source: U.S. Census 2016 American Community Survey.

Public School Districts

We used Niche rankings and grades as a standardized measure of rating school districts germane to the LANL and SRS localities.³² School districts in the areas surrounding LANL generally rank higher than the districts surrounding SRS. Table 4-6 highlights Niche ranks as a percentile for each state and provides the Niche grades for each school district within the LANL and SRS localities.³³

³¹ We weighted the average commute time in minutes for each county by the respective county’s percentage of the total civilian labor force for each locality to arrive at an average commute time.

³² Comparing schools and school districts from different states is a challenge because of the varying data elements reported by each state’s department of education. We have therefore based our analysis on the ratings provided by a third-party site, Niche.com. Niche rates schools and districts on factors including academics (50 percent), teacher quality (15 percent), culture and diversity (10 percent), and the remaining 25 percent from areas such as health and safety, resources and facilities, clubs and activities, and parent–student surveys. Data come from the U.S. Department of Education and over 100 million reviews and survey responses.

³³ Because of the size of New Mexico’s counties, we excluded some smaller districts within the counties beyond 50 miles from LANL or SRS. As part of our sensitivity analysis, we looked at districts within 50 miles of the sites, some of which extend to other counties.

Table 4-6. School District Rankings

District	State	Niche percentile	Niche grade	# of schools	# of students
LANL locality					
Los Alamos Public Schools	NM	100	B+	7	3,509
Santa Fe Public Schools	NM	73	C	33	14,752
Pojoaque Valley Public Schools	NM	29	C	5	1,977
Espanola Public Schools	NM	14	D	15	4,017
SRS locality					
Columbia County Schools	GA	89	B+	30	25,532
Aiken County Public Schools	SC	38	C+	40	24,534
Richmond County Schools	GA	27	C	61	31,823

Source: Niche.com.

As the table shows, the LANL and SRS localities have public school districts in the top 15th percentile of their states, with national grades of B+. However, each locality also includes schools that fall below the 40th percentile, with average or below-average grades, including the Espanola Public Schools, which received a D grade. The number of schools and students in each school district reflects the larger population around SRS.

Academic Partnerships

To assess the recruiting ability of both sites, we reviewed LANL and SRS websites and other publicly available information to compile a list of recruiting methods for each site.³⁴ LANL recruits candidates from the southwestern United States and across the country, while SRS employees tend to come mostly from the Southeast.

LANL representatives conduct nearly 100 recruiting trips per year, traveling to local southwestern universities and technical colleges as well as dozens of nationally recognized programs such as Harvard, MIT, Stanford, Georgia Tech, and Carnegie Mellon. LANL also recruits at military career fairs and major scientific conferences. Interviews with LANL officials confirm that employees at the staff level are recruited from university master’s and doctorate degree programs, as well as technical schools.

While SRS has research relationships with nationally known institutions such as MIT, Johns Hopkins, and Virginia Tech, as well as many local universities, few SRS employees come from major universities outside the Southeast; many are graduates of strong regional universities such as Georgia Tech, Clemson, and South Carolina or local universities such as Aiken Technical College and Augusta University. Most SRS summer interns hail from southeastern schools. In addition, SRS recruits veterans in the Central

³⁴ Specifically, we reviewed these online sources: DOE Savannah River National Laboratory, “Working with SRNL University Programs,” https://srnl.doe.gov/university_programs/index.htm; DOE LANL, “Recruiting Events,” <https://www.lanl.gov/careers/career-options/jobs/recruiting-events.php>; Savannah River Nuclear Solutions, “Degree of Success: Graduates of Aiken Tech’s Radiation Protection Program Find Opportunities at SRNS,” SRNS Today, November 2017, p. 7, https://www.savannahrivernuclearsolutions.com/docs/srns_today_1117.pdf; SRNS, “Big Internship Program Leading to Full-Time SRNS Jobs,” The Times and Democrat, July 19, 2015, http://thetandd.com/business/big-internship-program-leading-to-full-time-srns-jobs/article_67451506-1193-5035-978a-fdac6778ed2f.html.

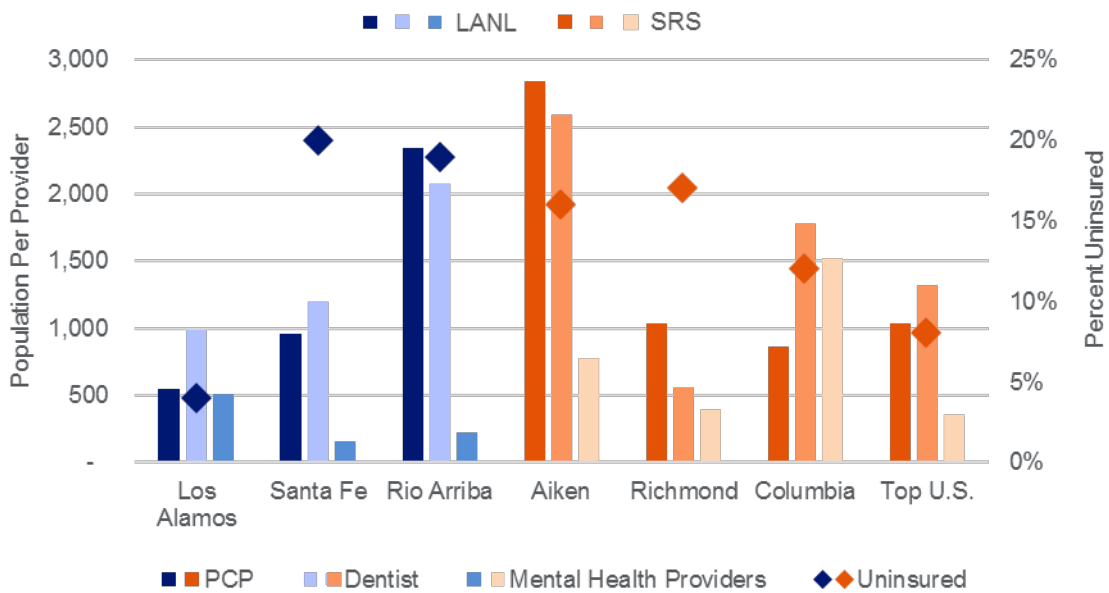
Savannah River Area. SRS begins its recruitment locally, expanding to a handful of national universities such as the Tennessee and Worcester Polytechnic Institute.

Healthcare

To assess healthcare across the LANL and SRS localities, we assessed the availability and quality of care. Given data from County Health Rankings, LANL appears to have better availability of care, as measured by population per clinical care provider and percent uninsured.³⁵ Based on data from Medicare Geographic Variation, however, the quality of care appears to be below national average for both localities.³⁶

Measures of healthcare availability vary significantly between the counties within each site's area. Figure 4-12 summarizes the availability of healthcare across both localities.

Figure 4-12. Clinical Care and Percent Uninsured by County, 2017



Source: County Health Rankings.org.³⁷

Overall, Los Alamos appears to have both high availability of healthcare and a low proportion of uninsured individuals; Santa Fe has nearly as good availability but a much higher percentage of uninsured. Near SRS, Aiken has lower availability than any other community at either site, while Richmond's is near that of Los Alamos and Santa Fe; Columbia falls in between.

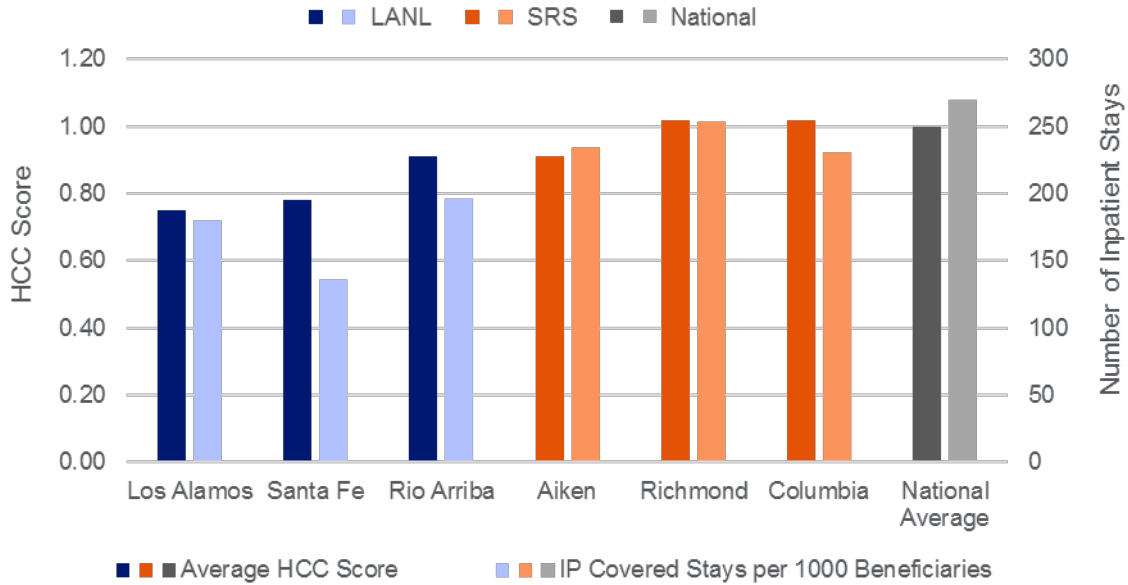
³⁵ Countyhealthrankings.org is a collaboration between the Robert Wood Johnson Foundation and the University of Wisconsin Population Health Institute.

³⁶ Information about Medicare Geographic Variation files for public use is available via the U.S. Department of Health and Human Services, Centers for Medicare & Medicaid Services, <https://www.cms.gov/Research-Statistics-Data-and-Systems/Statistics-Trends-and-Reports/Medicare-Geographic-Variation/index.html>.

³⁷ The bars in this figure represent county population per healthcare provider: blue for primary care physician, orange for dentist, and gold for mental health. For this measure, lower is better. The bars at the far right indicate the 90th percentile for the United States. The green diamonds indicate the percent of the population that is uninsured (measured on the right-hand scale); again, lower is better, and the overall U.S. percentage is shown at far right.

In terms of healthcare quality, Figure 4-13 provides an overview of data from Medicare Geographic Variation for average hierarchical condition category (HCC) score and inpatient covered stays.³⁸

Figure 4-13. Average HCC Score and Inpatient Covered Stays, 2015



Source: Medicare Geographic Variation

In the above figure, the inpatient covered stays per 1,000 beneficiaries metric shows how often, on average, people require inpatient care. Overall, the area around LANL tends to require inpatient care slightly less often than the area around SRS. All surveyed counties fall below the national average. The average HCC score (orange bar) approximates the overall health of a population; a lower HCC score indicates a healthier population.³⁹

Because the HCC includes age as a risk factor, older populations will score higher if all other factors are equal. In this case, Los Alamos has the highest average age yet the lowest average HCC score. This indicates that the Los Alamos population is generally healthier than the populations of the other counties in the analysis, even when accounting for the population’s higher average age. Overall, the average HCC score tends to be slightly lower around LANL than SRS. Only Richmond and Columbia counties exceed the national average HCC score, and they do so only slightly.

Crime Rates

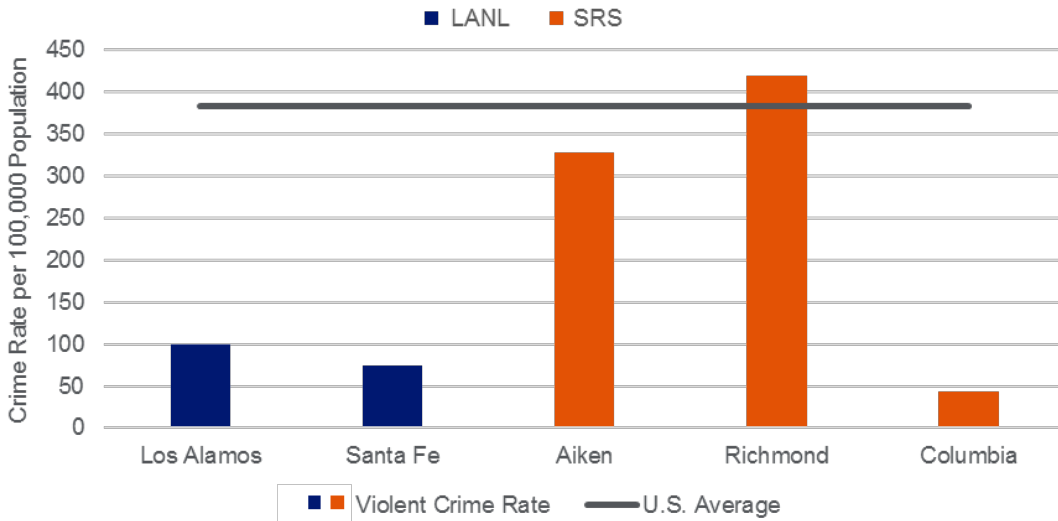
Comparatively speaking, crime is generally higher in the counties around SRS than around LANL. To assess crime between localities, we used Federal Bureau of Investigation (FBI) data on violent and property crime rates for each locality, the two main sources of crime data collected by the FBI. As the counties under review have vastly different

³⁸ Quality metrics drawn from the Medicare Geographic Variation data set. While using this Medicare data makes comparison across states and regions possible, it applies only to users of Medicare.

³⁹ The HCC applies to those who qualify for Medicare.

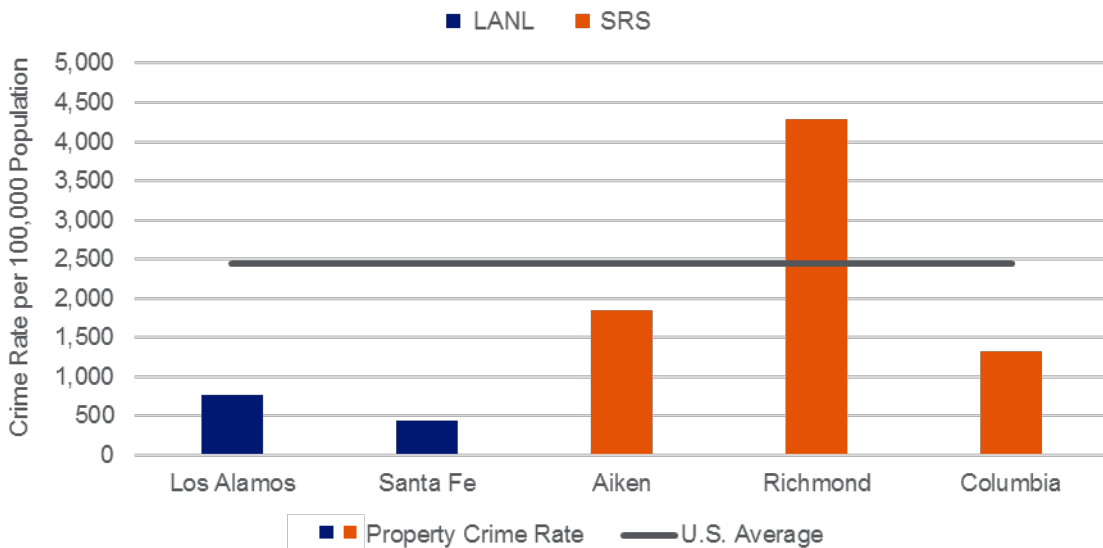
populations, using the crime rate per 100,000 made the counties comparable in our analysis.⁴⁰ Figure 4-14 and Figure 4-15 show the results.

Figure 4-14. Violent Crime Rate by County, 2016



Source: FBI crime data.

Figure 4-15. Property Crime Rate by County, 2016



Source: FBI crime data.

⁴⁰ The data shown in the figures are county level, except for Los Alamos, for which county-level data are not available. The city of Los Alamos reported data, as shown in the table. Rio Arriba County did not report crime data to the FBI.

Cost of Living

To compare the cost of living in each locality, the research team used Sperling's BestPlaces Cost of Living index for the two most populated cities.⁴¹ Table 4-7 provides results for Los Alamos and Santa Fe, New Mexico, for LANL, as well as Aiken in South Carolina and Richmond County in Georgia for SRS. The numbers in each column represent the cost as a percentage of the national average. These data show the overall cost of living around LANL as above the national average and below for SRS. The difference in living costs between localities is primarily driven by housing costs. When cost-of-living factors are compared without housing, the difference between the two localities is not as pronounced.

Table 4-7. Cost of Living Comparison

Cost of living	Los Alamos, NM	Santa Fe, NM	Aiken, SC	Richmond County, GA	United States
Overall	112	117	85	78	100
Grocery	97	92	94	95	100
Health	98	96	86	89	100
Housing	135	164	64	42	100
Utilities	89	92	95	98	100
Transportation	107	97	93	93	100
Miscellaneous	102	95	98	98	100

Source: Sperling's BestPlaces Cost of Living, 2016 data.

Transportation and especially housing are what skew the overall findings toward the SRS locality. LANL-area housing is 12 percent above the national average in Los Alamos and 17 percent above in Santa Fe. In comparison, SRS-area housing is just 64 percent of the national average in Aiken and 42 percent in Augusta.

Cultural Amenities

Table 4-8 compares the cultural amenities in each locality using Niche's Nightlife Grade Index and Outdoor Activities Grade Index.⁴² These indexes help assess the quality of life in terms of activities outside of the workplace; the type of amenities that might attract workers to the local area. According to the 2010 Knight Foundation's Soul of the Community Study, living in a community you love is just as important as loving your home or your job.⁴³ Outstanding schools, affordable healthcare, and safe streets are pluses, but the Foundation dug deeper to determine what makes people want to put down roots and establish a life in a particular area.

In collaboration with Gallup, the Foundation interviewed over 14,000 adults in 26 communities across the U.S. to determine the emotional factors that attach residents to their

⁴¹ Sperling's BestPlaces Cost of Living index assumes that the overall cost of living can be comprehensively calculated based on the following factors and weights: housing (30 percent), food and groceries (15 percent), transportation (10 percent), utilities (6 percent), healthcare (7 percent), and miscellaneous expenses (32 percent). Appendix G of this report and <https://www.bestplaces.net/cost-of-living/> contain more details.

⁴² Niche.com Inc., "2017 Best Places for Outdoor Activities Methodology," accessed March 1, 2018, <https://about.niche.com/methodology/best-outdoors>; Niche.com Inc., "2017 Places with the Most Nightlife," accessed March 1, 2018, <https://about.niche.com/methodology/nightlife>. Appendix H of this report contains more details.

⁴³ Knight Foundation, "Soul of the Community," <https://knightfoundation.org/sotc/>.

communities and the role of community attachment on an area’s economic growth and well-being. The three most important elements are:

1. An inclusive atmosphere in which people feel like an equal part of the community
2. A healthy social environment, with opportunities for social interaction and citizen sharing, including a vibrant nightlife and the availability of events and cultural opportunities
3. A physically beautiful space, including the availability of parks and green spaces, views and vistas.



The LANL and SRS localities possess unique cultural amenities for residents. Whereas Niche gave LANL’s nearby cities higher outdoor activity grades, SRS’s closest metropolitan areas received higher nightlife ratings. Table 4-9 highlights unique amenities in both localities.

Table 4-8. LANL and SRS Amenity Index Grades

City	State	Nightlife grade	Outdoor activities grade
Los Alamos	NM	C+	A
Santa Fe	NM	B+	A
Aiken	SC	C	B+
Augusta	GA	A-	C+
Columbia	SC	A	B+

Source: Niche.com data.

Table 4-9. Cultural Amenity Highlights

LANL highlight	SRS highlight
<p>One popular outdoor attraction is Bandelier National Monument, which contains roughly 33,000 acres of canyon wilderness and ancient archaeological sites, attracting 200,000 visitors each year.</p>  <p>Source: Greg Willis, “Alcove House Kiva, Bandelier Nat’l Monument,” Flickr.⁴⁴</p>	<p>The Masters Tournament is golf’s first and most widely viewed major championship of the year, held annually at Augusta National Golf Club since 1934.</p>  <p>Source: Mbrooks, “Augusta National Golf Club, Hole 10 ‘Camellia,’” Wikimedia.⁴⁵</p>

⁴⁴ Greg Willis, “Alcove House Kiva, Bandelier Nat’l Monument,” image taken November 2, 2010, available via Flickr, <https://www.flickr.com/photos/gregw66/5404807438/>. Creative Commons License (CC BY-SA 2.0), <https://creativecommons.org/licenses/by-sa/2.0/>.

⁴⁵ User Mbrooks, “Augusta National Golf Club, Hole 10 ‘Camellia,’” image, April 5, 2006, available via [https://commons.wikimedia.org/wiki/File:Augusta_National_Golf_Club,_Hole_10_\(Camellia\).jpg](https://commons.wikimedia.org/wiki/File:Augusta_National_Golf_Club,_Hole_10_(Camellia).jpg). Public Domain License.

Chapter 5

Additional Considerations

This chapter outlines high-level risks and other considerations that affect pit production staffing. Although these elements are beyond the primary focus of our analysis, they could equip NNSA with a more robust understanding of the factors affecting future pit production.

Ramp-up in Hiring and Training for Pit Production

Decision-makers considering future pit production at LANL and SRS would benefit from a closer examination of how dedicated pit production staff members will be hired or repositioned and trained, particularly for production staff. Plutonium pit production workers require approximately 3–5 years from the hiring to ready-to-work phases, (b)(4)

These requirements raise important questions and considerations for hiring and training at LANL and SRS:

- **Hiring targets and timing.** Throughout this report, we assume that staffing requirements are for fully operational staff members. Given the 3–5 years of time required to hire and fully train staff members, further examination on how this will affect the timing of hiring and exact hiring targets is necessary to ensure that staff members are fully operational in line with production targets and milestones.
- **On-the-job training.** We understand that new or repositioned pit production staff members require OJT. For LANL, we expect future staff members to follow training and development procedures that exist at the site; for SRS, training is complicated because pit production does not exist onsite. As current pit production occurs only at LANL, OJT appears to require sending experienced LANL workers to SRS or sending new SRS workers to LANL. There are challenges with either approach.
- **Availability of pit production facilities.** PF-4 at LANL is the only pit production facility in the United States. We understand that potential future pit production facilities at either LANL or SRS are not expected to be operational until the late 2020s to early 2030s.⁴⁷ As such, decision-makers should consider how SRS will train future staff members while facilities are under construction, if this option is pursued.

Variety of Operating Models Available

LANL and SRS are government-owned, contractor-operated facilities under separate management. All assumptions throughout this report are based on LANL's operations, but the operating model for future pit production at both sites may change based on the

⁴⁶

(b)(4)

⁴⁷ NNSA, Analysis of Alternatives, 2017.

contractors charged with future management of operations. Potential considerations include the following:

- **Variety of operating models.** For this report, we base all staffing requirements on single- and double-shift operations. Further examination of operating models, including the differences between support staff and security staff for double-shifts, would help inform decision-makers on all operating options available.
- **Shared services and operating innovations between LANL and SRS.** If NNSA decides to split production between LANL and SRS, decision-makers would benefit from considering whether there are services or support staff members who may be shared across both sites. For this report, we assume that operations will continue under current operating models and technology; additional consideration on how best to efficiently manage and operate pit production across sites would be informative.
- **Flexibility afforded by multiple locations.** Having pit production at multiple locations protects NNSA against possible localized disruptions. Catastrophic local events or work stoppages could cause a total halt to U.S. pit production if all work is performed in one location.

Leveraging Existing Staff Members and Capabilities

LANL and SRS have existing staff members who may be repositioned for future pit production. However, both sites may also have existing staff members and capabilities in other programs for consideration:

- **Repositioning existing staff members.** LANL and SRS have provided figures outlining the number of staff at each site that may be repositioned for future pit production. NNSA decision-makers and senior M&O managers will need to consider whether to use these resources, how best to potentially reposition staff, and what impact this may have on other programs.
- **Leveraging capabilities of other programs and experts at both sites.** Decision-makers should consider the impact of other programs at both sites. Are there experts or capabilities at each site to leverage in support of future pit production? Will those programs compete with pit production for staffing requirements, potentially affecting attrition rates?
- **Required facility, security, and other administrative staff members for future pit production.** In addition to dedicated pit production staff members, decision-makers should consider the administrative staff members required for future pit production. Further examination of what support staff is required will help equip decision-makers with a more robust understanding of the factors affecting future pit production.

Appendix A

Site Profiles

This section provides a high-level overview of the LANL and SRS sites and the key characteristics by which they can be compared.

LANL Overview

Founded in 1943 as site Y of the Manhattan project, LANL is a senior laboratory in the DOE system whose mission is “to solve national security challenges through scientific excellence.”⁴⁸ LANL executes all components of DOE’s mission, including national security, science, energy, and environmental management. In 1993, 4 years after the closure of the Rocky Flats plants, NNSA tasked LANL with re-establishing the U.S.’ capability to manufacture plutonium pits for stockpile. LANL delivered its first stockpile pit in 2007. Nearly all plutonium-related operations occur at LANL’s full-capability production facility, the only existing facility in the nation. Table A-1 summarizes key characteristics of LANL.

Table A-1 LANL Overview Facts

Characteristics	Statistics
(b)(4)	
Total acreage of LANL footprint	23,680

Source: LANL and NNSA.⁴⁹

SRS Overview

The mission of SRS is “to safely and efficiently operate the site to protect the public health and environment while supporting the nation’s nuclear deterrent and transformation of the site for future use.”⁵⁰ Founded in 1950 to support the development of nuclear weapons during the Cold War, SRS supports DOE’s Office of Environmental Management and NNSA through three primary focus areas: environmental stewardship, clean energy, and national security. SRS contains the country’s only tritium extracting, recycling, purifying, and reloading facility. SRS also manages plutonium as a part of the disposition of nuclear materials. This includes safely receiving and storing excess plutonium produced at other sites, including LANL. Table A-2 summarizes key characteristics of SRS. Pit production would be a new capability at SRS.

⁴⁸ LANL, “Mission, Vision, Values,” <https://www.lanl.gov/mission/mission.php>.

⁴⁹ LANL, “Economic Impact on New Mexico,” <http://www.lanl.gov/community/economic/index.php>; NNSA, *Surplus Plutonium Disposition Supplemental Environmental Impact Statement: Los Alamos National Laboratory*, available via <https://nnsa.energy.gov/sites/default/files/nnsa/01-12-inlinefiles/LANL%20Factsheet%20Draft%209.pdf>.

⁵⁰ SRS, “Team SRS Mission Statement,” <https://www.srs.gov/general/about/mission.htm>.

Table A-2. SRS Overview Facts

SRS characteristics	Statistics
(b)(4)	
Total acreage of SRS footprint	198,344

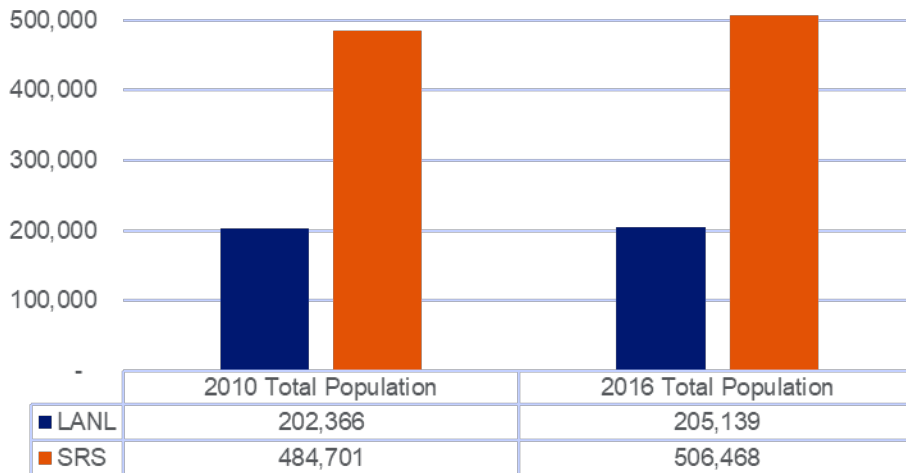
Source: SRS and the SRS Community Reuse Organization.⁵¹

Comparative Characteristics

The charts and tables in this section present economic and demographic characteristics describing the localities surrounding LANL and SRS.

With respect to total population, the SRS locality has over 2.5 times the population of the LANL locality, as shown in Figure A-1. Between 2010 and 2016, the SRS locality’s population increased by 4.5 percent while the population in the LANL locality increased by 1.4 percent.

Figure A-1. Total Population of the LANL and SRS Localities

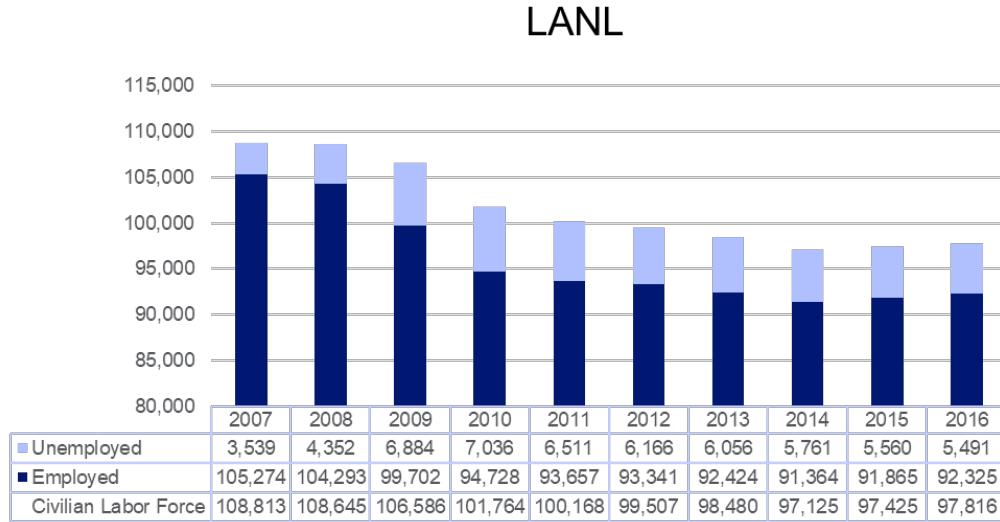


Sources: U.S. Census 2010 and American Community Survey 2016 data.

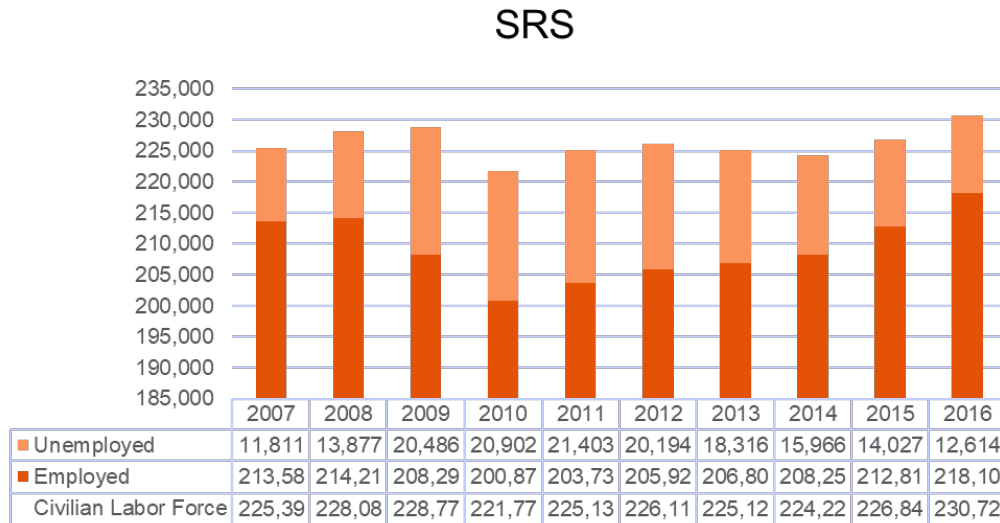
As highlighted in Figure A-2, between 2007 and 2016, the total civilian labor force in the LANL locality declined by 10.1 percent. During this same 10-year period, the civilian workforce in the SRS locality increased by 2.4 percent.

⁵¹ SRS Community Reuse Organization, *The Savannah River Site: Economic Impact and Workforce Transition*, August 2017, available at <http://www.srsco.org/wp-content/uploads/2017/08/2017-08-21-SRS-Consequences-Analysis-FINAL.pdf>; SRS factsheet, https://www.srs.gov/general/news/factsheets/srs_esrs.pdf.

Figure A-2. Total Local Civilian Labor Force, Employed and Unemployed



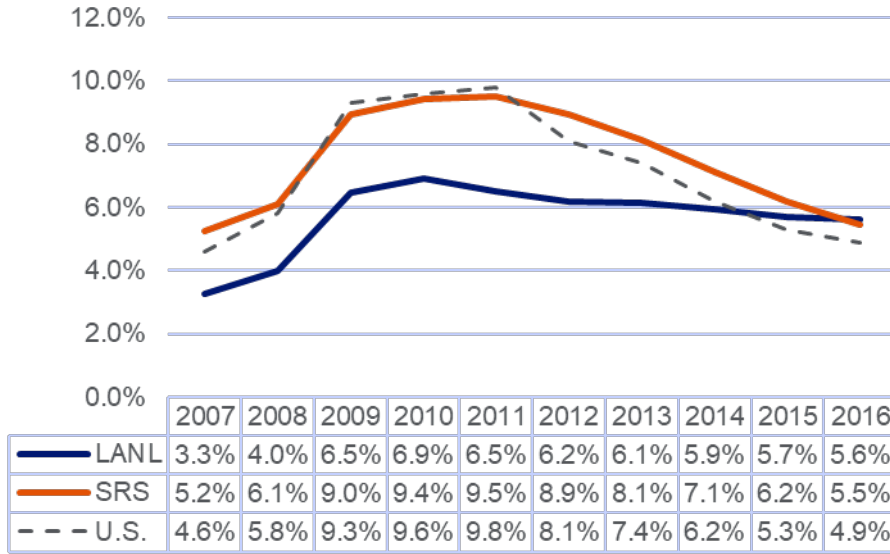
Source: BLS Local Area Unemployment Statistics via the U.S. Department of Agriculture.



Source: BLS Local Area Unemployment Statistics via the U.S. Department of Agriculture.

Compared with the SRS locality, the LANL locality experienced lower rates of unemployment between 2007 and 2016. In both areas, unemployment peaked in 2009. Since 2010, unemployment in LANL has plateaued around 6 percent. Comparatively, unemployment in the SRS locality peaked at 9.5 percent in 2011 but has since declined by 4 percentage points. In 2016, the LANL and SRS localities had unemployment rates higher than the national average, at 5.6 percent and 5.5 percent, respectively (see Figure A-3).

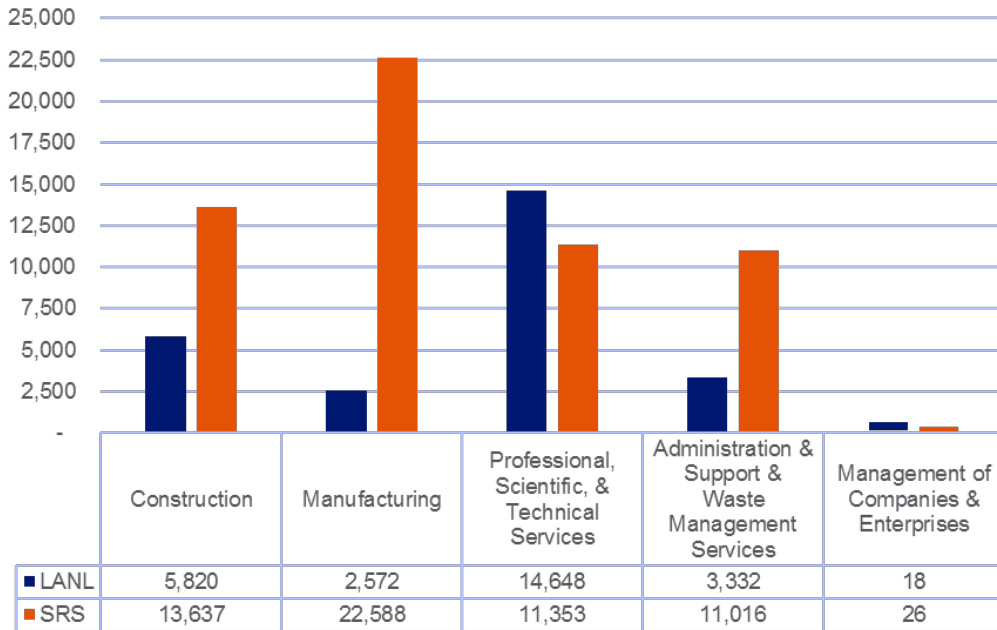
Figure A-3. Local and National Unemployment Rates, 2007–2016



Source: BLS Local Area Unemployment Statistics via the U.S. Department of Agriculture.

Figure A-4 depicts local employment in the industries relevant to pit production. Employment in the LANL locality is primarily situated in the professional, scientific, and technical services industries; employment in the SRS locality is concentrated in manufacturing.

Figure A-4. Local Employment in Relevant Industries, 2016



Source: U.S. Census 2016 American Community Survey.

New Mexico and South Carolina expect employment gains in fields pertinent to plutonium pit production, as shown in Table A-3. In each state, employment in construction is projected to increase by 2024, at rates of 7.7 percent and 13.8 percent, respectively.

South Carolina also expects large employment gains in the professional, scientific, and technical services industry (12.5 percent) and the administration and support and waste management and remediation services industry (17.4 percent).

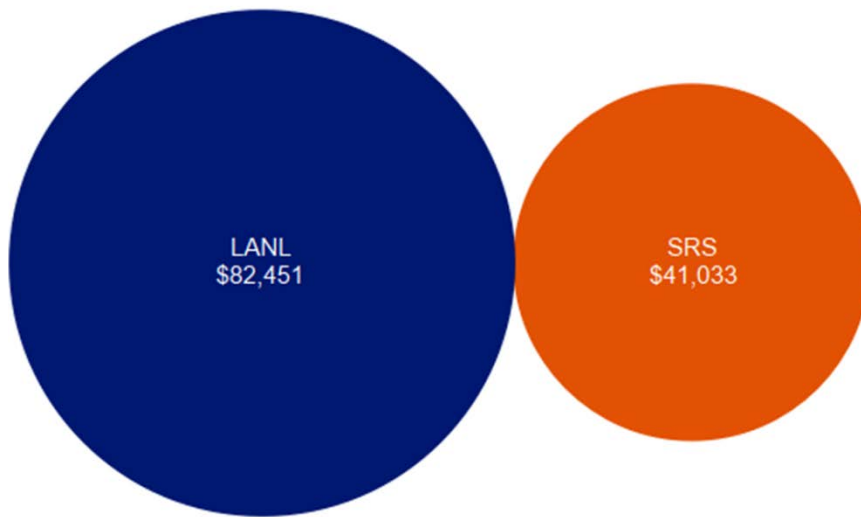
Table A-3. Projected Percent Changes in Industry Employment, 2014–2024

	Construction	Manufacturing	Professional, scientific, and technical services	Administration and support and waste management and remediation services	Management of companies and enterprises
New Mexico	7.7	-3.4	4.6	1.1	0.8
South Carolina	13.8	-	12.5	17.4	4.5

Source: New Mexico Department of Workforce Solutions, Employment Projections Program, and South Carolina Department of Employment and Workforce.

Figure A-5 compares the mean household income of the localities surrounding LANL and SRS. The average LANL household earns twice as much as the average SRS household.

Figure A-5. Local Mean Household Income, 2016



Source: U.S. Census 2016 American Census Survey.

Appendix B

Sample LANL Job Posting

Titles in parentheses are those used in the Position Description Library, and the numbers after each title represent the range of technical levels used in pit production.⁵² Technical levels range from 1 (Journeyman) to 5–6 (Expert).

Table B-1. Sample LANL Job Titles and Hiring Levels

CSE/Maint.	Engineer	Sr. Tech	Tech/SSM	MGMT
(b)(4)				

⁵² Titles in parentheses are added only if different from what is colloquially used at LANL.

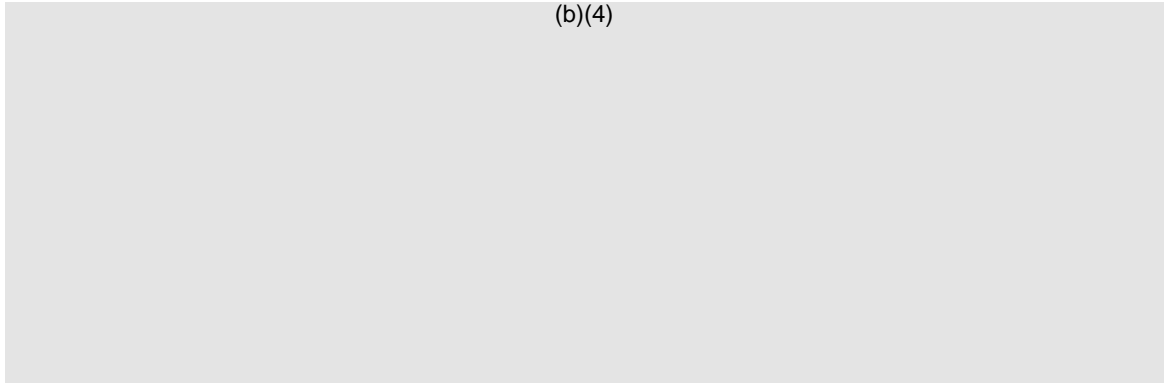
⁵³ "Level" refers to the technical or hiring level required for pit production.

Appendix C

General Occupational Categories

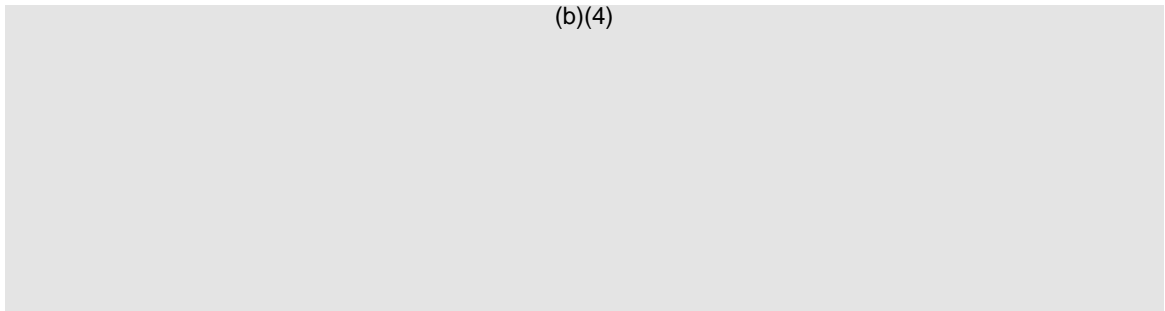
The 16 sample LANL pit production titles and their relevant SOC are mapped in the following tables, segmented by role category.

(b)(4)



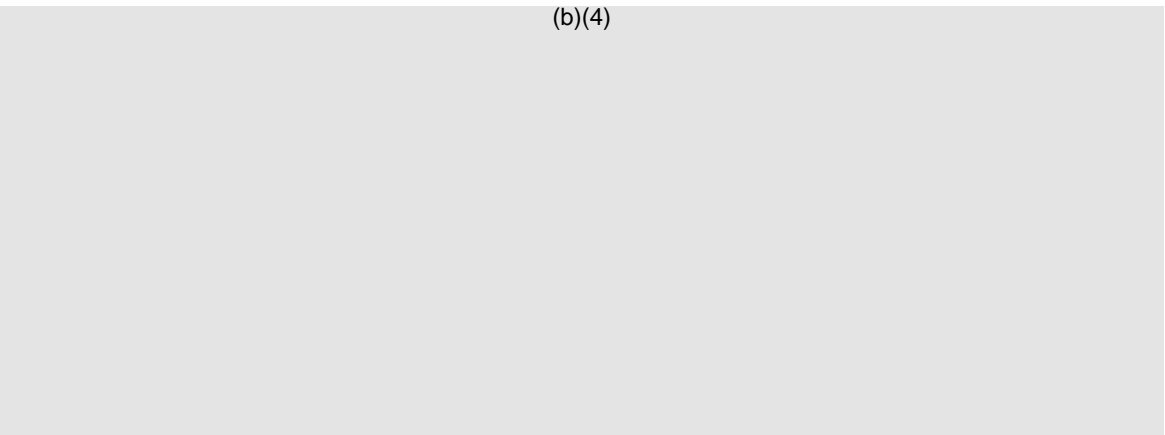
Source: LANL Position Description Library, BLS SOC systems, and sample job postings.

(b)(4)



Source: LANL Position Description Library, BLS SOC systems, and sample job postings.

(b)(4)



Source: LANL Position Description Library, BLS SOC systems, and sample job postings.

(b)(4)



Source: LANL Position Description Library, BLS SOC systems, and sample job postings.

(b)(4)



Source: LANL Position Description Library, BLS SOC systems, and sample job postings.

Appendix D

General Occupational Profile

Looking at the BLS description for each SOC, along with other SOCs within the occupational categories, the research team compiled profiles for each general occupations, similar to those created for the role categories during the pit production staffing profile effort.

Table D-1. General Occupational Profiles

SOC	Occupation	Description	Education	Experience
11-0000	Management	Plan, direct, or coordinate the operations of public- or private-sector organizations	Bachelor's degree	Considerable work-related skill, knowledge, or experience
17-0000	Architecture and Engineering	Design, integrate, or improve processes or products	Bachelor's degree	Considerable work-related skill, knowledge, or experience
19-0000	Life, Physical, and Social Science	Conduct analysis and testing involving the experimental, theoretical, or practical application of related sciences	Master's or doctorate degree	Considerable work-related skill, knowledge, or experience
47-0000	Construction and Extraction	Perform physical labor using tools and heavy machinery for construction or material removal	High school diploma, although an associate's degree may be required for some roles	Previous work-related skills, knowledge, or experience
51-0000	Production	Form materials or fabricate parts and tools used in precision machinery and or technical processes	High school and or vocational school diploma	Previous work-related skills, knowledge, or experience

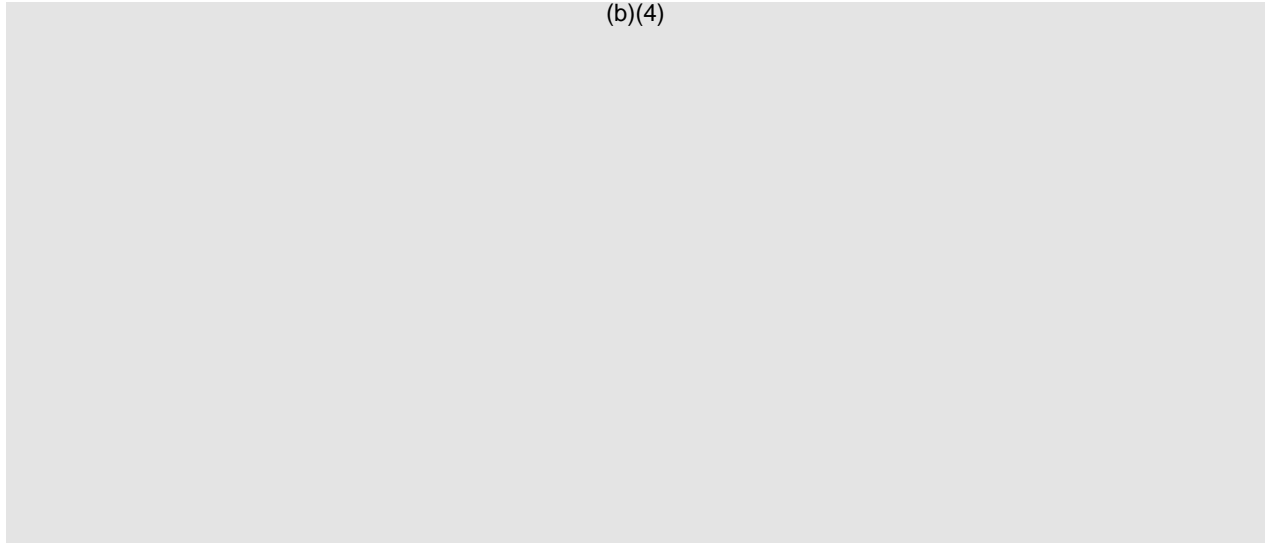
Source: BLS and SOC data.

Appendix E

LANL Staffing with Attrition

These tables show the effect of attrition on staffing requirements for each of the five roles from base case to 30 ppy and then 80 ppy, should LANL be tasked with further expanding its pit production capability. The bolded number range in each column indicates the number of new pit production workers needed each year. Attrition is calculated at 7.9 percent for existing employees and 3.6 percent for new hires.

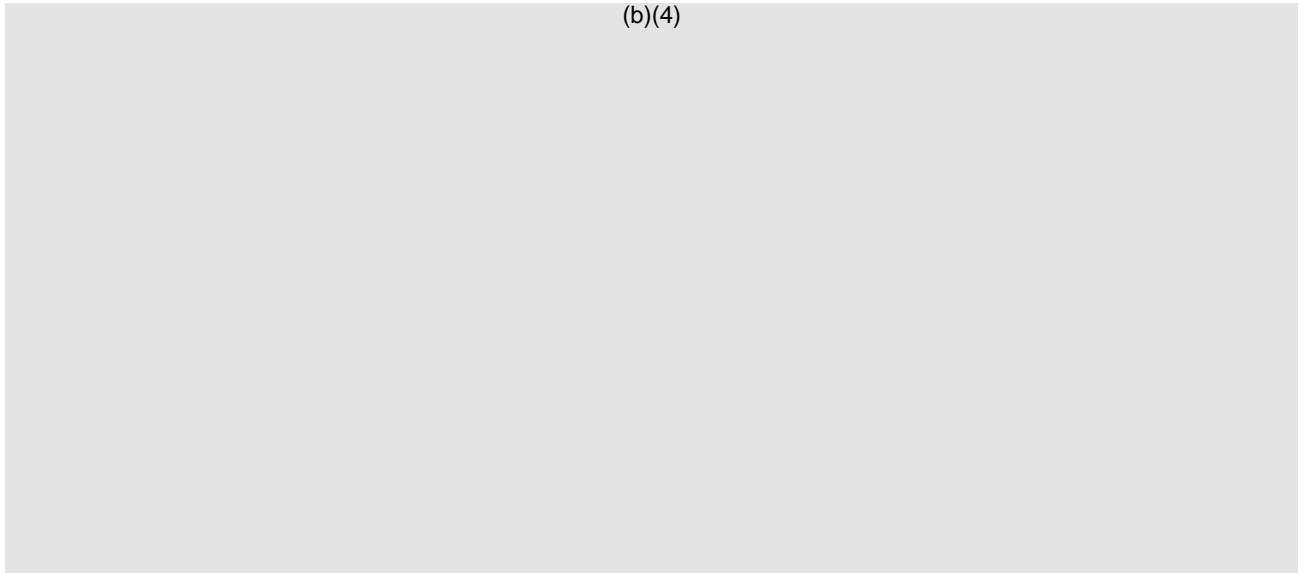
(b)(4)



Source: NNSA's FY18 SSMP and LANL attrition rates.

Note: Due to decimal-point rounding, the total row may have a +/- error of 1-2 workers.

(b)(4)



Source: NNSA's FY18 SSMP and LANL attrition rates.

Note: Due to decimal-point rounding, the total row may have a +/- error of 1-2 workers.

(b)(4)



Source: NNSA's FY18 SSMP and LANL attrition rates.

Note: Due to decimal-point rounding, the total row may have a +/- error of 1-2 workers.

(b)(4)



Source: NNSA's FY18 SSMP and LANL attrition rates.

Note: Due to decimal-point rounding, the total row may have a +/- error of 1-2 workers.

(b)(4)



Source: NNSA's FY18 SSMP and LANL attrition rates.

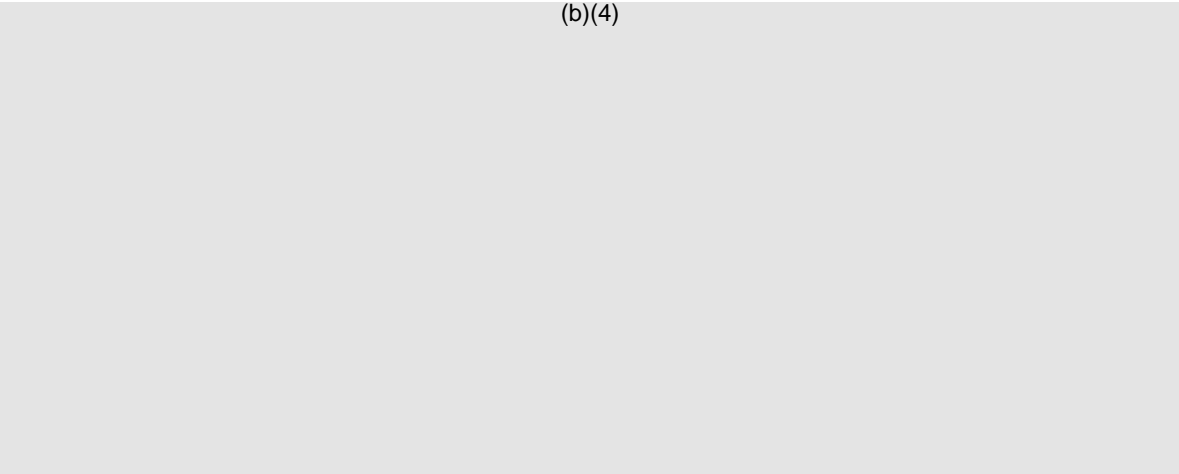
Note: Due to decimal-point rounding, the total row may have a +/- error of 1-2 workers.

Appendix F

SRS Requirements with Attrition

For SRS, we received total attrition data by job group but did not receive attrition data by retirement and non-retirement status. Therefore, we assumed the same ratio of non-retirement attrition rate to total attrition rate that we found for LANL. The results are shown in the table below.

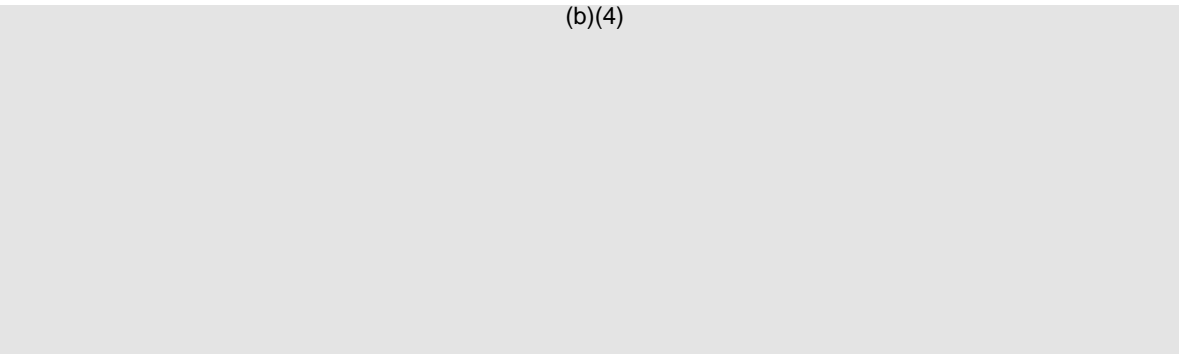
(b)(4)



Source: SRS data.

The rest of the tables in this appendix show the effect of attrition on staffing requirements for each of the five roles across a 4-year period, should SRS be tasked with building up pit production to 50 ppy. The bolded number range in each column indicates the number of new pit production workers needed each year.

(b)(4)



Source: NNSA's FY18 SSMP and SRS attrition rates.

Note: Due to decimal-point rounding, the total row may have a +/- error of 1-2 workers.

(b)(4)



Source: NNSA's FY18 SSMP and SRS attrition rates.

Note: Due to decimal-point rounding, the total row may have a +/- error of 1-2 workers.

Appendix G

Cost of Living Factor Descriptions

Table G-1. Sperling's BestPlaces Cost of Living Factor Descriptions

Factor	Description
Grocery	Average cost of food in grocery stores in an area
Health	Average cost of healthcare calculated using the standard daily rate for a hospital room, and the costs of a doctor's office visit and a dental checkup
Housing	Average cost of an area's housing, which includes mortgage payments, apartment rents, and property tax
Utilities	Average cost of heating or cooling a typical residence for the area, including electricity and natural gas
Transportation	Average cost of gasoline, car insurance and maintenance expenses, and mass transit fare for the area; the cost of the vehicle and any vehicle registration and license taxes are not included
Miscellaneous	Cost index of those goods and services not included in the other cost of living categories, including clothing, restaurants, repairs, entertainment, and others services

Source: Factors and descriptions from Sperling's BestPlaces 2016 data.

Appendix H

Niche's Grade Indices

We used two of Niche's indices to evaluate residential amenities of cities within the LANL and SRS localities: the Nightlife Grade Index and the Outdoor Activities Grade Index. The nightlife grade assesses things to do in an area, as shown in Table H-1.

Table H-1. Niche's Nightlife Grade Index

Factor	Description	Source	Weight (%)
Access to bars	A measure of both the proximity (per square mile) and the availability (per capita) of bars and similar establishments	Niche	30
Access to restaurants	A measure of both the proximity (per square mile) and the availability (per capita) of full-service restaurants	Niche	30
Residents 18–34 years old	Percentage of residents between the ages of 18 and 34	U.S. Census	20
Millennial newcomers	The percent of residents between the ages of 25 and 34 who moved into the area within the last year	U.S. Census	10
Access to movie theaters	A measure of both the proximity (per square mile) and the availability (per capita) of movie theaters	Niche	5
Access to theaters	A measure of both the proximity (per square mile) and the availability (per capita) of theaters	Niche	5

Source: Niche.com Inc., "2017 Places with the Most Nightlife."⁵⁵

Similarly, a region's outdoor activities grade offers an assessment of accessibility to outdoor spaces and activities, as outlined in Table H-2.

⁵⁵ Niche.com Inc., "2017 Places with the Most Nightlife," accessed March 1, 2018, <https://about.niche.com/methodology/nightlife/>.

Table H-2. Niche’s Outdoor Activities Grade Index

Factor	Description	Source	Weight (%)
Nearby national parks and forests	The number of national parks and forests within 200 miles. Parks were assigned to their primary state.	U.S. National Park Service	20
Parks	A measure of the availability of parks.	OpenStreetMap	20
Nearby state parks and forests	The number of state parks and forests within 100 miles.	U.S. Geological Survey	15
Physical inactivity	The rate of adults (at the county level) who do not report any leisure-time physical activity.	Centers for Disease Control and Prevention	10
Weather grade	Based on number of sunny days, precipitation, and average temperatures in an area.	Niche.com	10
Access to recreational goods rentals	A measure of both the proximity (per square mile) and the availability (per capita) of recreational goods rentals.	Niche.com	5
Air quality index 90th percentile	A daily measure of the air quality (lower is better). This factor uses the 90th percentile value (i.e., 90 percent of recorded days had this value or less).	U.S. Environmental Protection Agency	5
Nearby beaches	The number of beaches within 100 miles.	U.S. Census	5
Nearby campgrounds	The number of campgrounds within 50 miles.	FBI Uniform Crime Report	5
Nearby skiing facilities	The number of ski facilities within 50 miles.	U.S. Census	5

Source: Niche.com Inc., “2017 Best Places for Outdoor Activities Methodology.”⁵⁶

Niche assigned a grade between A+ and D– for the above indices in each place. The cumulative score of each index’s factors was converted into a standardized z-score in relationship to an average (0). Possible z-scores were categorized in 12 ranges, each represented by a grade of A+ to D–. Grades of B or higher indicate a ranking above the national average (a z-score of 0 or higher).

⁵⁶ Niche.com Inc., “2017 Best Places for Outdoor Activities Methodology,” accessed March 1, 2018, <https://about.niche.com/methodology/best-outdoors/>.

Appendix I

Abbreviations

BLS	Bureau of Labor Statistics
BOS	balance of state
(b)(4)	
DOE	Department of Energy
FBI	Federal Bureau of Investigation
FTE	full-time equivalent
FY	fiscal year
HCC	hierarchical condition category
(b)(4)	
MC&A	material control and accountability
MGMT	Management
MIT	Massachusetts Institute of Technology
MSA	metropolitan statistical area
NNSA	National Nuclear Security Administration
OJT	on-the-job training
PCP	primary care physician
ppy	pits per year
(b)(4)	
SME	subject matter expert
SOC	Standard Occupational Classification
(b)(4)	
SRNS	Savannah River Nuclear Solutions, LLC
SRS	Savannah River Site
SSMP	FY18 Stockpile Stewardship and Management Plan
(b)(4)	
WAH	work at home
WR	war reserve