Final Report for the Plutonium Pit Production Analysis of Alternatives

Appendix B. Infrastructure Siting Analysis

	Capital Items and Functions												
Site	Low-level liquid rad waste treatment	TRU liquid waste treatment	PIDADS/Access control	Classified beryllium machining	Classified stainless steel machining	Classified uranium machining	Classified graphite machining	Graphite coating capability/capacity	low-level solid waste storage and shipping	TRU solid waste management	Analytical chemistry and materials characterization	Standards and calibration lab	Cold Machine and tooling shop
LANL	V	V	V	V	V	V	V	V	V	V	V	٧	V
SRS	V	V	V		V	V	V		V	V	V	V	V
Pantex			V		V		V		V	1		V	V
NNSS			V	1	V		V		V	V		V	V
LLNL	V	V			V	V	V	V	V	V	V	V	٧
Y12/ORNL			V	V	V	V	V	V	٧	$\sqrt{1}$	V	V	V
WIPP ¹								1	V	V			L
Hanford/PNNL	V		V						V	V	L ²]
INL	V	V	٧		V	V		1	٧	V	V	V	V
BNL ³	1								V	1	L L	-1	
KCNSC					V		[]	1					V
SNL-Albuquerque			٧					1	V		L	V	
Greenfield							()						

Table B-2. Availability of capital items and functions at each candidate site

Site has limited capability

L

Hanford utilizes PNNL capability per Bob Putnam (LANL).

3. The Infrastructure Sub-team received no written response for BNL.

PIDADS = Perimeter Intrusion, Detection, Assessment, and Delay System; TRU = transuranic.

Final Report for the Plutonium Pit Production Analysis of Alternatives Appendix B. Infrastructure Siting Analysis

B.2.1.2 **Operating Infrastructure**

The IST determined whether each of the candidate sites has operating infrastructure (defined by the following list):

- Production control systems .
- Manufacturing policies, procedures, and training system (quality)
- Materials control systems
- Safeguards and accountability systems
- Qualified operators and technicians .
- NAP-24 Weapon Quality Policy .
- Certified materials (e.g., gasses, in-process supplies) .

As was done for capital items and functions, this information was obtained by sending a questionnaire to each site. For LANL, SRS, and INL, infrastructure information was also obtained by visiting the site. The results are shown on Table B-3.

		Operating Infrastructure							
Site	Production control system	Manufacturing policies, procedures and training system (quality)	Materials control system	Safeguards and accountability systems	Qualified operators and technicians	NAP-24, Weapon Quality Policy, certified materials (gases, in process supplies, etc.)			
LANL	V	V	٧	V	V	٧			
SRS	V	V	V	V	V	٧			
Pantex	V	V	٧	V	V				
NNSS		V	٧	V	L				
LLNL			٧	V	V	V			
Y12/ORNL	V	V	٧	V	V	v			
WIPP ¹	V	L			V				
Hanford/PNNL	-		٧	V					
INL	V	V	v	V	V				
BNL									
KCNSC	V	V	V	٧	V	V			
SNL-Albuquerque	V	V	٧	V	V	V			
Greenfield		8/							

Table B–3. Availability of operating infrastructure at each candidate site

capability

Site has

limited capability 1. DOE's Office of Environmental Management submitted that WIPP has no capabilities in this area. The chart reflects the Infrastructure Sub-team's independent knowledge of WIPP.



Final Report for the Plutonium Pit Production Analysis of Alternatives Appendix B. Infrastructure Siting Analysis

B.2.1.3 Plant Core Infrastructure

The IST determined whether each of the candidate sites has plant core infrastructure I (defined by the following list):

- Security Category I facility support
- Normal and off-normal power systems and supply, including a redundant power source
- Normal utility support i.e., gas and water
- Medical facilities capable of handling alpha-contamination
- On-site and off-site environmental monitoring
- A sanitary wastewater facility

As was the case for the capital items and functions and the operating infrastructure, this information was obtained by sending a questionnaire to each site. The results are shown on Table B–4.

		Plant Core Infrastructure								
Site	Security Category 1 facility support	Normal and off-normal power systems and supply	Normal utility support gas, water supply, redundant source for electrical power	Medical facilities (capable of dealing with alpha contaminated individuals)	Environmental monitoring (on-site and off-site)	Sanitary wastewater facility				
LANL	V	V	V	V	٧	V				
SRS	V	V	V	V	٧	V				
Pantex	V	٧	V	V	٧	V				
NNSS	V	٧	V	V	V	V				
LLNL		٧	V	V	V					
Y12/ORNL	V	٧	V	V	٧	V				
WIPP ¹		٧	٧	V	٧	V				
Hanford/PNNL	V		V	V	٧	V				
INL	V	٧	V	V	٧	V				
BNL			V		٧	1				
KCNSC		٧	V	1	٧	V				
SNL-Albuquerque	V (?)	٧	V	٧	V					
Greenfield										

Table B-4. Availability of plant core infrastructure at each candidate site

capability Site has limited

capability

L

 DOE Office of Environmental Management submitted that WIPP has no capabilities in this area. The chart reflects the Infrastructure Sub-team's independent knowledge of WIPP.

Final Report for the Plutonium Pit Production Analysis of AlternativesAppendix B. Infrastructure Siting Analysis

At this stage, it is possible to develop a simplified listing of the desirability of sites based solely on the number of green boxes along each row, summed across all three tables, as follows:

- **Favorable:** LANL, SRS, Y-12/ORNL,¹ and INL
- Neutral: Pantex, NNSS, LLNL, and SNL
- Unfavorable: Hanford, WIPP, BNL, KCNSC, SNL-Albuquerque

B.3 Siting Risk Analysis

This section describes the criteria selected to determine the siting risk (*i.e.*, characteristics of the site that tend to increase the societal, individual, and/or environmental risk). Risk determinations are subjective and could in theory be changed as a result of further discussion or the availability of additional data. The description of risk criteria is followed by a description of the sources consulted to obtain data pertinent to each criterion. Finally, the results of the subjective risk analysis are presented in tabular form.

B.3.1 Factors Considered

The following factors were considered in making a subjective evaluation of the risk associated with siting the pit manufacturing capability (or parts thereof) at each of the candidate sites.

- Area of the site: Site size is important because if the site is small, the manufacturing facility cannot be placed far away from the site boundary. This would tend to contribute a relatively large amount to site risk should there be people living at or near the site boundary. The arbitrary criteria chosen for this analysis are that a small site, with relatively high risk, has an area of less than 10 square miles. A large site, with a relatively low risk, has an area exceeding 100 square miles. Any site with an area in the range 10-100 square miles will be characterized by the rather imprecise term "moderate," i.e., it makes a moderate contribution to site risk.
- Relevant site information within five miles: Miscellaneous items of information are collected under this heading, including population within that radius, distance to the nearest resident, nature of the countryside (e.g., farming, forested, unpopulated, industrial), and any environmental factor deemed relevant (e.g., a major river flows through it or there is a lake or other sensitive environmental area). On the basis of these considerations, a purely subjective judgement is made as to whether the factors within five miles make a low, moderate, or high contribution to siting risk.
- **Nearby centers of population:** A few representative cities or towns are chosen and their population, distance, and direction are tabulated. Again, a subjective assessment is made of whether these are potentially low, moderate, or high contributors to siting risk.
- **Population within 50 miles:** Population within 50 miles is estimated because, in environmental impact statements and other siting analyses, this population is often used as the basis for estimates of population radiation dose, either for routine operation or hypothetical accident scenarios. Again, an arbitrary range is chosen: the potential contribution to overall site risk is low if the 50-mile population is less than 500,000, high if it is more than 2,000,000, and moderate if it is in between.
- **Predominant wind direction:** The wind rose(s) for each site are obtained. If the predominant wind direction is towards nearby residents and/or major centers of population this is viewed as

¹Y-12 and ORNL are combined on the grounds that, if pit manufacturing were to be sent to Oak Ridge, capabilities at both facilities would be used.

Final Report for the Plutonium Pit Production Analysis of AlternativesAppendix B. Infrastructure Siting Analysis

increasing overall site risk. If it blows away from populated areas, it is regarded as a relatively low contributor to site risk.

B.3.1.1 Sources of Site Risk Data

The principal sources of data were:

- Site fact sheets: found on the Department of Energy's web site, energy.gov. This proved to be a particularly reliable source for site areas.
- The Missouri Census Data Center: http://mcdc.missouri.edu/websas/caps10c.html. This is a free source for the population in circles with user-chosen radii for any site in the country, based on 2010 census data.
- **"Suburban Stats:"** at https://suburbanstats.org/population/ provides the population of any city in the country, also based on 2010 census data.
- **NEPA documents:** Environmental impact statements, Environmental Assessments, and Annual Site Reports. These are good sources for wind roses, some maps, some population data, and where candidate buildings for the pit manufacturing capability (if any) are located.
- **Google Maps and satellite imagery:** useful for estimating as-the-crow-flies distances and assessing the nature of the surroundings (e.g., farming, forested, urban, industrialized).

Based solely on the number of red or green cells in each row of Table B–5 one can make a rough ranking of the sites:

- Favorable: SRS, Nevada, Hanford, INL, WIPP.
- Neutral/moderate: LANL, ORNL, and SNL.
- Unfavorable: LLNL, Y-12, BNL, and KCNSC.

A couple of observations are pertinent. First, Y-12 shows a higher siting risk than does ORNL because the former is at the Northeast corner of the Oak Ridge Reservation (ORR) a short distance from the city of Oak Ridge, whereas the latter is in the center of ORR some four miles from the nearest residents. Second, the relative ranking of LANL is moot because, since it is the only site at which it is currently possible to manufacture a pit, it has been "grandfathered" in.

Final Report for the Plutonium Pit Production Analysis of Alternatives

Appendix B. Infrastructure Siting Analysis

B.3.2 Results of the Siting Risk Analysis

	Site Factors								
				Nearby Ci	ties		Population		Assessment of
Site	Area (square miles)/acres	Relevant Site Information Within 5 Miles	Name	Distance Population Direction (miles) within Direction Predominant Wind Direction (from) Rel fr IM 12 000 1.3 (southern N N S (dautimo) = i.o.		Relative Risks Arising from Siting Issues			
LANL	36/23,000	From PF-A, the dig of Las Alamias lies allout A.3 milias Nue N. In other directions. spacedy population.	Los Alamos, NM White Rock, NM Santa Fe, NM	12,000 5,800 68,000	1.3 (southern edge) 5 24	N SE SE	378,000	S (daytime) – i.e., towards Los Alamos NW-SW (night)	Moderate
SRS	310/200,000	Within site (measured from F-Area, site of Mixed Fuel Fabrication Facility)	Jackson, SC Augusta, GA Aiken, SC	1,700 196,000 30,000	7 20 18	NW NW N	790,000	W Not towards cities listed to left	Low
Pantex	28/18,000	Predominantly farming, sparsely populated Only 2 people within 2 miles, ~360 within 5 miles), some unpopulated hill country to NW	Panhandle, TX Amarillo, TX	2,500 190,000	10 10	NE SW	316,000	S-SW, away from Amarillo	Low
NNSS	1,360/870,000	No people within 5 miles of DAF	North Las Vegas	217,000	90	SE	42,000	sw	Low
LLNL	17640	The rily of Everyone about the western boundary of the cire. There are some tens of thousands of people within Smites, mostly to the west.	Livermore, CA Pleasanton, CA Dublin, CA	81,000 70,000 46,000	2 (rity center) 9 14	E ESE E	7,760,000	W, WSW, SW, SSW Away from cities listed to left	High
Y-12	1.35/811 at 48 stormer of ORP (62/33,500)	Nearest houses "1, 500" M of PIDAOS: entire city of Dak things within 5 miles.	Oak Ridge, TN Knoxville, TN	29,000 180,000	2 (center) 20 (center) 8 (clorest semmach)	N Slightly S of E SE	1,200,000	About equally from SW-SSW/NE-NNE	High
ORNL	6.9/4,400 towards center of ORR (52/33,500)	Nearest houses ~ 4 miles E and S. Most of circle of radius 5 miles within ORR.	Oak Ridge, TN Knoxville, TN	29,000 180,000	6 (center) 22 (center) 11 (closest approach)	NE Slightly N of E ESE	1,200,000	About equally from SW-SSW/NE-NNE	Moderate
WIPP	16/10,000	Very sparsely populated, numerous oil and natural gas wells.	Loving, NM Carlsbad, NM No other city within 30 miles	1,400 26,000	17 24	WSW WNW	113,000	SE, passing N of Carlsbad	Low
Hanford	586/375,000	Within site (e.g., measured from Area 200E or 200W)	Richland WA Kennewick WA Pasco WA	48,000 74,000 60,000	17 30 30	SE SE SE	560,000	NW, WNW, W Mostly not directly towards nearby cities	Low

Table B-5. Summary of siting risk analysis

Final Report for the Plutonium Pit Production Analysis of Alternatives

Appendix B. Infrastructure Siting Analysis

	10			Site Factors					Subjective Assessment of	
				Nearby Cit	ties		Population			
Site	Area (square miles)/acres	Relevant Site Information Within 5 Miles	Name	Population	Distance (miles)	Direction	within 50 miles	Predominant Wind Direction (from)	Relative Risks Arising from Siting Issues	
INL	890/570,000	Within site (depending on where pit production facility would be sited), very sparse just outside site boundary	Arco/Butte City ID Blackfoot, ID Idaho Falls, ID	1,000 12,000 57,000	20 40 50	WNW SE E	179,000	SW, not towards nearby cities	Low	
BNL	8/5,000	°13 till) people within one mile of site koundary. population within 5 miles ~67,000	Brookhaven Township	*486.1009	Occupies ~530 mi ² around site	Surrounds site	6,200,000	Westerly	High	
KCNSC	n.29/56e	Nearest houses * 0.3 mi NE *98,000 people within 5 miles	Grandview, MO Belton City, MO Kansas City, MO	2 5 20	24,400 23,000 460,000	NNE SSE N	2,200,000	From 5 towards Kansas City	High	
SNL	13.4/8,600 within Kirkland Air Force Base (80/51,000)	Mostly empty except to N in Albuquerque. 25,000 people within 5 miles, nearest houses at ~3 miles.	Albuquerque, NM South Valley, NM	7 8	546,000 41,000	NNW W	910,000	From E to SE, towards Rio Grande Valley and SW Albuquerque metropolitan area.	moderate	

Final Report for the Plutonium Pit Production Analysis of Alternatives Appendix B. Infrastructure Siting Analysis

B.4 Political Risk Assessment

The AoA team also considered political risk. This, of course, is highly subjective. In assessing whether political risk is high, moderate, or low the team asked whether there was a history of political protest or interference at or near a site. A specific example of a site that ultimately did not make the short list is Brookhaven., There was significant public and legislative resistance to the proposed Shoreham nuclear reactor (which was located not far from Brookhaven) and the reactor was abandoned even though it was essentially complete, had many safety features, and had already cost several billion dollars. In that case, it is clear that the political risk is high or even very high. Other relevant information, where pertinent, might include the presence of nearby national parks or other sensitive environmental receptors, or Native American reservations. The findings of the subjective risk analysis are displayed in Table B–6.

Site	Severity of Political Risk	Comments/Explanation						
LANL	Moderate	The city of Los Alamos is only 1.3 miles to the north of PF-4 and there has been considerable controversy in the past about changes in mission. In addition, there are many Native American reservations within 50 miles of the site, and the Bandelier National Forest is nearby (a few years ago a fire there almost encroached upon Technical Area 55). On the other hand, one would expect many members of the local population to welcome new jobs and expenditures. On balance, the political risk is moderate.						
SRS	Moderate	There has been considerable controversy, including law suits, over the Mixed Fuel Fabrication Facility. However, this is also another site where one would expect many members of the local population to welcome new jobs and expenditures. On balance, the political risk is moderate.						
Pantex	Low	There is little history of conflict with neighbors. Pantex already handles pits.						
NNSS	Low	Remoteness and size of site are considerable plusses. However, the low severity of political risk could be revised upwards if, for example, there is any residual conflict arising from the Yucca Mountain controversy.						
LLNL	High	Large numbers of people live nearby. There has been intentional reduction of the amount of plutonium at LLNL, and the local population is not likely to want to see that reversed.						
Y-12	Moderate	The northern boundary of Y-12 adjacent to the PIDADS is very close to the city of Oak Ridge.						
ORNL	Moderate	Likely to be lower than Y-12 because ORNL is in the middle of the Oak Ridge Reservation, a considerable distance from the closest houses. However, should pit manufacturing be established in Oak Ridge, use would likely be made of both Y-12 and ORNL and it would be difficult to disentangle the political risk associated with what would not really be separate sites.						
WIPP	Low	Extremely remote location, but would possibly require either revision of the Land Withdrawal Act or a new act to be passed.						
Hanford	High	Much previous controversy (e.g., about tanks) and great local concern about potential contamination of the Columbia River.						
INL	Moderate	Extreme remoteness and a large site should mitigate public concerns. However, INL is currently operating under a consent decree with the State of Idaho that might make it difficult to establish new activities that require bringing plutonium onsite. On balance, the political risk is moderate.						
BNL	High	In a very populated area. There is a history of hostility to nuclear power – the nearby Shoreham Nuclear Power Plant was abandoned after it had been completed because of local opposition. There is likely to be an outcry over the possibility of bringing plutonium to the site.						
KCNSC	High	The site is dedicated to non-nuclear components. It is also very small and close to large concentrations of population.						
SNL	Moderate	The amount of special nuclear material held at SNL has been considerably reduced and there would likely be concern if it were proposed to reverse that trend.						

Table B-6. Subjective political risk analysis

Final Report for the Plutonium Pit Production Analysis of Alternatives Appendix B. Infrastructure Siting Analysis

In a way similar to that already done for the site infrastructure and the siting risk analysis, it is possible to develop a rough ranking of the sites from Table B–6.

- Favorable: Pantex, NNSS, and WIPP
- Neutral: LANL, SRS, Y-12/ORNL, INL, and SNL
- Unfavorable: LLNL, Hanford, BNL, and KCNSC

B.5 Summary and Conclusions

In this section, the results are summarized and an assessment of site suitability is made in two ways: a) from a high level, by simply a visual assessment of a composite table that summarizes infrastructure, siting risk, and political risk; and b) by adopting two simple, semi-quantitative ranking processes.

B.5.1 High Level Assessment

As noted above, each of the candidate sites was evaluated from the three perspectives of support infrastructure, siting risk, and political risk. For the siting risk and political risk, each site is assigned to the low, moderate, or high category using the results in Tables B–5 and B–6. For the support infrastructure, in order to be consistent with the risk rankings (so that the least favorable sites are ranked "high" and the most favorable are ranked "low"), the authors used an "unfavorability" ranking, derived from the conclusions at the end of Section B.2.1.3, namely:

- Favorable: LANL, SRS, Y-12/ORNL, and INL low "unfavorability,"
- Neutral: Pantex, NNSS, LLNL, and SNL, moderate "unfavorability," and
- Unfavorable: Hanford, WIPP, BNL, KCNSC, SNL-Albuquerque high "unfavorability."

Table B-7 summarizes those assignments, with green for low/favorable, yellow for moderate/neutral, and red for high/unfavorable.

Site	Support Infrastructure Unfavorability Ranking	Siting Risk	Political Risk
LANL	Low	Moderate	Moderate
SRS	Low	Low	Moderate
Pantex	Moderate	Low	Low
NNSS	Moderate	Low	Low
LLNL	Moderate	High	High
Y-12ª	Low	High	Moderate
ORNL	Low	Moderate	Moderate
WIPP	High	Low	Low
Hanford	High	Low	High
INL	Low	Low	Moderate
BNL	High	High	High
KCNSC	High	High	High
SNL	Moderate	Moderate	Moderate

Table B-7.	Summary	of Site	Risk Ran	kings
------------	---------	---------	-----------------	-------

Final Report for the Plutonium Pit Production Analysis of AlternativesAppendix B. Infrastructure Siting Analysis

Adopting subjective criteria, any sites with two or more high rankings are least preferred: LLNL, Hanford, BNL, and KCNSC. The most preferred sites are those with two or more favorable rankings and no unfavorable rankings: INL, SRS, Pantex, and NNSS. As mentioned above, LANL is grandfathered in because it is the only site at which it is currently possible to manufacture pits. Thus, the simple subjective ranking adopted in this subsection leads to the selection of five potentially satisfactory sites: INL, SRS, Pantex, NNSS, and LANL.

It is recognized that the methodology used to derive rankings from Table B–7 is extremely simplified – for example, it gives equal weight to each of support infrastructure, siting risk, and political risk. In the following section, a somewhat more sophisticated ranking method is presented.

B.5.2 Semi-Quantitative Ranking Based on Placings

The first attempt the IST made to perform a more rigorous analysis than that presented in Section 4.5.1 was to determine which of the sites ranked first, second, third, and so on, in each of three categories: total infrastructure count, economic, and risk. The overall ranking was then determined by using a simple methodology in which the rankings were simply added, and the site with the lowest score ranked first, and so on.

Total infrastructure count: Table B–8 summarizes the content of Tables B–2, B–3, and B–4. It simply counts the number of items available in the three categories: a) capital items and functions (maximum possible 13, see Table B–2); b) plant core infrastructure (maximum possible 6, see Table B–3); and operating infrastructure (maximum possible 6, see Table B–4). These three numbers are then summed for each site (maximum possible 25) and the sites are ranked in the final column of Table B–8 on the basis of that sum.

Economic criterion: This criterion focuses on a subset of six infrastructure items that are particularly costly, so that if the site already has them it has an immediate advantage. These are low-level liquid waste treatment, liquid TRU waste treatment, analytical chemistry capability, solid low-level and TRU waste handling capability, PIDADS, and a Security Category 1 site security system. The IST's initial approach was to simply count how many of these six items each site has, and to rank them accordingly. Subsequently, the sub-team decided to change this approach, because the variation in the cost of the six items is so great that the sub-team concluded that this variation should be taken into account, by adopting the simple weighting scheme described below. Note, however, that the ranking of the top five sites was not significantly changed when the weighting scheme was used.

The estimated costs of each of the high value infrastructure items were based on the data gathered during the LANL visit (Appendix A.2) and are as follows: low-level liquid waste treatment, \$80 million; liquid TRU waste treatment, \$90 million; analytical chemistry capability, \$50 million; solid low-level and TRU waste handling capability, \$100 million; PIDADS, \$250 million; and a Security Category 1 site security system, \$1,000 million. If a site already has some or all of these systems, points are assigned as follows:

•	Low-level liquid waste	1 point
---	------------------------	---------

- Liquid TRU waste 1 point
- Analytical chemistry 1 point
- Solid low-level and TRU waste 1 point
- PIDADS 3 points
- Category 1 site security system 10 points

Final Report for the Plutonium Pit Production Analysis of AlternativesAppendix B. Infrastructure Siting Analysis

If a site does not have a specific capability, its score for that capability is zero. The scores are then summed and the rankings of the sites determined on the basis of those scores, see Table B–9 with the maximum score being 17.

Risk criterion: The siting and political risk criterion is very simple. The score assigned for a low risk is 3, for a moderate risk it is 2, and for a high risk it is 1, for both siting risk and political risk (see **Tables B–5** and **B–6**). The two scores are then summed and the sites are ranked on the basis of that sum as shown in **Table B-10**, with the sites with the lowest scores ranking highest.

Overall ranking: **Table B–11** summarizes the rankings from **Tables B–8**, **B–9**, and **B–10**. The overall ranking is the sum of the three individual rankings – total infrastructure count, economic, and risk. The sites rank in the following order: SRS and INL, followed by Pantex and NNSS.

Final Report for the Plutonium Pit Production Analysis of Alternatives

Appendix B. Infrastructure Siting Analysis

	Capital Items and Functions	Plant Core Infrastructure	Operating Infrastructure	Total Infrastructure	
	Items available/items required	Items available/items required	Items available/items required	Sum	Rank
LANL ¹	13/13	6/6	6/6	25/25	
SRS	11/13	6/6	6/6	23/25	1
Pantex	6/13	6/6	5/6	17/25	5
NNSS	7/13	6/6	3/6	16/25	6
LLNL	11/13	4/6	4/6	19/25	4
Y12/ORNL	11/13	6/6	6/6	23/25	1
WIPP	2/13	5/6	2/6	9/25	10
Hanford/PNNL	4/13	5/6	2/6	11/25	9
INL	10/13	6/6	5/6	21/25	3
Brookhaven	1/13	2/6	0/6	3/25	11
KCNSC	2/13	4/6	6/6	12/25	8
SNL-Albuquerque	3/13	5/6	6/6	14/25	7
Greenfield	0/13	0/6	0/6	0/25	12

Table B-8. Ranking according to the total infrastructure count

¹ LANL excluded from ranking because it is grandfathered in, as explained above.

Table B-9. Ranking according to the economic criterion

	Liquid Low-Level Waste	Liquid TRU Waste	Analytical Chemistry	Solid Transuranic and Low-Level Waste	PIDADS	Category 1 Security System	Total Score	Rank
LANL ¹	1	1	1	1	3	10	17	
SRS	1	1	1	1	3	10	17	1
Pantex					3	10	13	6
NNSS				1	3	10	14	5
LLNL	1	1	1	1			4	8
Y12/ORNL			1	1	3	10	15	3
WIPP				1			1	9
Hanford/PNNL	1			1	3	10	15	3
INL	1	1	1	1	3	10	17	1
Brookhaven		- C - C	1				0	10
KCNSC							0	10
SNL-Albuquerque			1		3	10	13	6
Greenfield							0	10

1 LANL excluded from ranking because it is grandfathered in, as explained above.

Final Report for the Plutonium Pit Production Analysis of Alternatives Appendix B. Infrastructure Siting Analysis

	Siting Risk	Score	Political Risk	Score	Total Score	Ranking
LANL ¹	Moderate	2	Moderate	2	4	-
SRS	Low	3	Moderate	2	5	4
Pantex	Low	3	Low	3	6	1
NNSS	Low	3	Low	3	6	1
LLNL	High	1	High	1	2	9
Y12/ORNL	High	1	Moderate	2	3	8
WIPP	Low	3	Low	3	6	1
Hanford/PNNL	Low	3	High	1	4	6
INL	Low	3	Moderate	2	5	4
Brookhaven	High	1	High	1	2	9
KCNSC	High	1	High	1	2	9
SNL-Albuquerque	Moderate	2	Moderate	2	4	6
Greenfield	Indeterminate	na	Indeterminate	na	na	12

Table B-10. Ranking according to siting and political risk

^{1.} LANL excluded from ranking because it is grandfathered in, as explained above.

	Total Infrastructure	Economic	Risk	Total Score	Ranking
LANL ¹	31	· · · · · · · · · · · · · · · · · · ·			
SRS	1	1	4	6	1
Pantex	5	6	1	12	3
NNSS	6	5	1	12	3
LLNL	4	8	9	21	9
Y12/ORNL	1	3	8	12	3
WIPP	10	9	1	20	8
Hanford/PNNL	9	3	6	18	6
INL	3	1	4	8	2
Brookhaven	11	10	9	30	11
KCNSC	8	10	9	27	10
SNL-Albuquerque	7	6	6	19	7
Greenfield	12	10	12	34	12

Table B-11. Overall ranking by sum of placings

^{1.} LANL excluded from ranking because it is grandfathered in, as explained above.

Final Report for the Plutonium Pit Production Analysis of AlternativesAppendix B. Infrastructure Siting Analysis

B.5.3 Alternative Methods of Ranking

In addition to evaluating each of the sites by their ranking in each of the major categories (i.e., Total Infrastructure, Economics, and Risk), it was recognized that decision makers might value each of these major categories differently. The team performed an analysis that applied a wide range of reasonable weighting factors to each of the major categories and reassessed the rank order of the sites. These evaluations found the top ranked sites (i.e., SRS, LANL, INL, Pantex, and NNSS) consistently remained in the top rankings regardless of the distribution of weights applied to the scores. These results provide confidence that the list of top ranked sites is robust.

B.6 Conclusion

The AoA team has examined the candidate sites for the 80 ppy plutonium manufacturing facility from the perspectives of capital infrastructure items, core plant infrastructure, operating infrastructure, siting risk, and political risk. The results of this examination have been combined using a number of different subjective and semi-quantitative methods to yield the following robust result. In addition to LANL, SRS and INL are promising candidate sites, with NNSS and Pantex as backups.

Final Report for the Plutonium Pit Production Analysis of Alternatives Appendix C. Detailed Description of Alternatives

Appendix C. Detailed Description of Alternatives

The Analysis of Alternatives (AoA) team determined that the three most promising candidate sites for plutonium missions are Los Alamos National Laboratory (LANL), the Savannah River Site (SRS), and Idaho National Laboratory (INL). In addition, the team identified two additional sites that potentially could be used for parts of the plutonium mission, or for new build options: Pantex (PX) and the Nevada National Security Site (NNSS).

During the siting viability assessment, the team identified several existing Hazard Category 2, Security Category 1 facilities that might be viable for housing pit production or other plutonium missions:

- LANL: Plutonium Facility (PF-4)
- SRS: Mixed Oxide Fuel Fabrication Facility (MFFF), Waste Solidification Building (WSB), and K-Area Reactor
- INL: Fuel Processing Facility (FPF)

The team also identified both missions currently performed in PF-4 and portions of the pit production flow sheet that could potentially be moved to separate locations. These separable functions, as defined below, along with the list of promising sites and the list of available existing facilities were used to develop the alternatives.

Definitions of separable functions:

- Plutonium science and certification: Includes production of sub-critical articles and other test articles, and research and development.
- Metal preparation (prep): Includes disassembly of returned pits, purification of plutonium, disposition of any other material in the pit, recovery of plutonium residues, purification of the recovered plutonium, and processing of all waste produced. Includes flow sheet process steps up to and including electro-refining and size reduction, and aqueous processing capabilities. These processes were deemed separable from the rest of the pit production operations. Therefore, moving some or all of it to another location is included in the alternatives.
- Production: Includes all activities on the pit production flow sheet starting at casting and ending at final assembly and inspection.
- Advanced Recovery and Integration Extraction System (ARIES): Includes plutonium material disposition activities to support the Department of Energy's (DOE) Defense Nuclear Nonproliferation missions.
- Plutonium-238: Includes plutonium-238 processing activities to support weapons programs and DOE Office of Nuclear Energy missions.

C.1 Alternatives Overview

 Table C-1 shows a matrix of proposed alternatives.

Assumptions:

- At a minimum, plutonium science and certification capabilities currently at LANL and Lawrence Livermore National Laboratory would remain there.
- Chemistry and Metallurgy Research Replacement (CMRR) project and Plutonium Sustainment Program activities are completed in time for increased pit production milestones.

 Final Report for the Plutonium Pit Production Analysis of Alternatives
 Appendix C. Detailed Description of Alternatives

• Support infrastructure will be built or upgraded as required for each alternative.

		Sites		Notes		
0 - Status Quo	Metal Prep Production ~30 ppy	LANL (PF-4)			- PF-4 as configured after completion of CMRR and Pu Sustainment. - Estimate capacity - Excursions for multiple shifts	
1 - Split Production	Metal Prep Production various	LANL (PF-4)	LANL (PF-4)	LANL (PF-4) (Various Options)	 Use PF-4 as configured after completion of CMRR and Pu Sustainment. Additional production capacity in another facility. Various options for PF-4: Maximize discarding residues 	
	Production various	SRS (Existing)	INL (Existing)	LANL, SRS, INL, PTX, NNSS (New)	- Discontinue oxidizing Oranium - Remove Special Recovery Line & gas gun - No CT at LANL - perform at Pantex - Operate on multiple shifts - Sub-options for moving Pu238 and/or Aries	
2- Move Production and Metal Prep	Metal Prep Production 80 ppy	SRS (Existing)	INL (Existing)	LANL, SRS, INL, PTX, NNSS (New)	- PF-4 retains only Pu Science & Certification. - Full production, including metal prep somewhere else.	
2 Move Production	Metal Prep	LANL (PF-4)	LANL (PF-4)	LANL (PF-4)	- PF-4 retains Pu Science & Certification and Metal	
S - Move Production	Production 80 ppy	SRS (Existing)	INL (Existing)	LANL, SRS, INL, PTX, NNSS (New)	- Additional production capacity somewhere else.	
4 - Move Metal Prep	Production 80 ppy	LANL (PF-4)	LANL (PF-4)	LANL (PF-4)	- Pu Science & Certification and 80 ppy production together in PF-4.	
	Metal Prep	SRS (Existing)	INL (Existing)	LANL, SRS, INL, PTX, NNSS (New)	- Disassembly, metal prep, and residue recovery somewhere else. - If more space needed in PF-4, determine what else needs to move out	

Table C-1. Matrix of proposed alternatives

CMRR = Chemistry and Metallurgy Research Replacement; CT = computed tomography; PF-4 = Plutonium Facility; ppy = pits per year; Pu = plutonium.

Final Report for the Plutonium Pit Production Analysis of Alternatives Appendix C. Detailed Description of Alternatives

C.2 Detailed Descriptions of Alternatives

Tables C–2 through C–6 provide descriptions of alternatives at the three most promising sites and the two potential sites.

Alternative	Name	Description and Notes
LANLO	Status Quo Excursions: - Multiple shifts	 PF-4 contains plutonium science and certification, surveillance, metal prep, and ~30 ppy manufacturing capability. Evaluate pit capacity with planned equipment Evaluate pit capacity with planned equipment on multiple shifts (identify processes that do not benefit from additional shifts and add equipment if capacity constrained).
LANL1	Split Production LANL1-A – PF-4 as is after CMRR and plutonium sustainment complete – additional production space added outside of PF-4 as required LANL1-B – Maximize use of PF-4, leaving plutonium-238 and ARIES in PF-4 – additional production space added outside of PF-4 as required LANL1-C – Maximize use of PF-4, move plutonium-238, leave ARIES in PF-4 – additional production space added outside of PF-4 as required LANL1-D – Maximize use of PF-4, move plutonium-238, leave ARIES in PF-4 – additional production space added outside of PF-4 as required LANL1-D – Maximize use of PF-4, move ARIES, leave plutonium-238 in PF-4 – additional production space added outside of PF-4 as required LANL1-E – Maximize use of PF-4, move plutonium-238 and ARIES – additional production space added outside of PF-4 as required LANL1-E – Maximize use of PF-4, move plutonium-238 and ARIES – additional production space added outside of PF-4 as required Excursions: - Explore which alternatives can avoid construction to reach required produ	 PF-4 contains plutonium science and certification, surveillance, metal prep, and some capacity for pit production. Production capacity in PF-4 will be determined for each case, and additional lab space to meet production capacity requirement will be determined. Additional construction may be modular. Other construction approaches may be considered, depending on the size required. Define maximize use of PF-4 as: Maximize discarding residues rather than recovering Discontinuing uranium oxidation – melt instead Removing special recovery line and gas gun No CT at LANL (if required will be performed at PX or NTS) Sub-options include moving plutonium-238 and/or ARIES Evaluate production capacity in PF-4 for each case, and determine how much construction necessary to meet production requirements. Evaluate pit capacity with planned equipment on multiple shifts (identify processes that do not benefit from an additional shift and add equipment if capacity constrained).
LANL2	Move Metal Prep and Production into New Construction	PF-4 contains plutonium science, certification, and surveillance. 80 ppy production capability and metal prep in new construction facility at LANL.
LANL3	Move Production into New Construction	 PF-4 contains plutonium science, certification, surveillance, and metal prep. 80 ppy production capability established in new construction facility at LANL. Note that, in this case, it is assumed the equipment installed
LANL4	Full Production in PF-4, Metal Prep in New Construction	in PF-4 for the Plutonium Sustainment Program would remain in PF-4 for use by plutonium science and certification. PF-4 contains plutonium science, certification, surveillance, and 80 ppy production capability. Metal prep is established in a new construction facility at LANL.

Table C-2. Detailed descriptions for alternatives at LANL

Final Report for the Plutonium Pit Production Analysis of Alternatives Appendix C. Detailed Description of Alternatives

Alternative	Name	Description and Notes
ARIES = Advanced Reco	wery and Integrated Extraction System:	CMRR = Chemistry and Metallurgy Research Replacement:

ARIES = Advanced Recovery and Integrated Extraction System; CMRR = Chemistry and Metallurgy Research Replacement PF-4 = Plutonium Facility; ppy = pits per year.

Alternative	Name	Description and Notes
SRS1	Split production with LANL SRS1-A – 50 ppy in MFFF SRS1-B – 50 ppy in K-Area Reactor SRS1-C – 50 ppy in WSB SRS1-D – 50 ppy in new construction	 PF-4 contains plutonium science, certification, surveillance, metal prep, and ~30 ppy pit production. 50 ppy production capability at SRS. Note that the team will evaluate the production capacity of the Plutonium Sustainment project equipment. The capacity required at SRS will be adjusted to create the total of 80 ppy.
SRS2	Move Metal Prep and Production SRS2-A – Metal prep and 80 ppy in MFFF SRS2-B – Metal prep and 80 ppy in K-Area Reactor SRS2-C – Metal prep and 80 ppy in WSB SRS2-D – Metal prep and 80 ppy in new construction	PF-4 contains plutonium science, certification, and surveillance. 80 ppy production capability and metal prep at SRS.
SRS3	Move Production Only SRS3-A –80 ppy in MFFF SRS3-B –80 ppy in K-Area Reactor SRS3-C –80 ppy in WSB SRS3-D –80 ppy in new construction	 PF-4 contains plutonium science, certification, surveillance, and metal prep. 80 ppy production capability established at SRS. Note that, in this case, it is assumed that the equipment installed in PF-4 for the Plutonium Sustainment program would remain in PF-4 for use by plutonium science and certification.
SRS4	Move Metal Prep Only SRS4-A – Metal Prep in MFFF SRS4-B – Metal Prep in K-Area Reactor SRS4-C – Metal Prep in WSB SRS4-D – Metal Prep in new construction	PF-4 contains plutonium science, certification, surveillance, and 80 ppy production capability. Metal Prep is established at SRS.

Table C–3. Detailed de	scriptions for a	Iternatives	at SRS
------------------------	------------------	-------------	--------

MFFF = Mixed Oxide Fuel Fabrication Facility; PF = Plutonium Facility; ppy = pits per year; WSB = Waste Solidification Building.

Table C-4.	Detailed	descriptions	for alternatives at INL

Alternative	Name	Description and Notes
INL1	Split production with LANL INL1-A – 50 ppy in Fuel Processing Facility INL1-B – 50 ppy in new construction	PF-4 contains plutonium science, certification, surveillance, metal prep, and ~30 ppy pit production
	State M. A. B. Barrel and C. Barrel and St.	50 ppy production capability at INL.
		Note that the team will evaluate the production capacity of the Plutonium Sustainment project equipment. The capacity required at INL will be adjusted to create the total of 80 ppy.
INL2	Move Metal Prep and Production INL2-A – Metal prep and 80 ppy in Fuel Processing Facility	PF-4 contains plutonium science, certification, and surveillance.
10.02	INL2-B – Metal prep and 80 ppy in new construction	so ppy production capability and metal prep at inc.
INL3	Move Production Only	PF-4 contains plutonium science, certification, surveillance, and metal prep.
	INL3-A –80 ppy in Fuel Processing Facility INL3-B –80 ppy in new construction	80 ppy production capability established at INL.
		Note that, in this case, it is assumed that that the equipment installed in PF-4 for the Plutonium

Final Report for the Plutonium Pit Production Analysis of Alternatives Appendix C. Detailed Description of Alternatives

		Sustainment Program would remain in PF-4 for use by plutonium science and certification.
INL4	Move Metal Prep Only INL4-A – Metal prep in Fuel Processing Facility	PF-4 contains plutonium science, certification, surveillance, and 80 ppy production capability.
	INL4-B – Metal prep in new construction	Metal prep is established at INL.

PF-4 = Plutonium Facility; ppy = pits per year.

Alternative	Name	Description and Notes
NNSS1	Split production with LANL- 50 ppy in new construction	 PF-4 contains plutonium science and certification, surveillance, metal prep, and ~30 ppy pit production 50 ppy production capability at NNSS. Note that the team will evaluate the production capacity of the Plutonium Sustainment project equipment. The capacity required at INL will be adjusted to create the total of 80 ppy.
NNSS2	Move Metal Prep and Production Metal prep and 80 ppy in new construction	PF-4 contains plutonium science and certification, surveillance. 80 ppy production capability and metal prep at NNSS.
NNSS3	Move Production Only (PF-4 retains metal prep) 80 ppy in new construction	 PF-4 contains plutonium science and certification, surveillance, and metal prep. 80 ppy production capability established at NNSS. Note that, in this case, it is assumed that the equipment installed in PF-4 for the Plutonium Sustainment Program would remain in PF-4 for use by plutonium science and certification.
NNSS4	Move Metal Prep Only (PF-4 production) NNSS4-A – Metal prep in DAF NNSS4-B – Metal prep in new construction	PF-4 contains plutonium science and certification, surveillance, and 80 ppy production capability. Metal prep is established at NNSS.

Table C–5. Detailed descriptions for alternatives at NNSS

DAF = Device Assembly Facility; PF-4 = Plutonium Facility; ppy = pits per year.

Table C-6. Detailed descriptions for alternatives at PX

Alternative	Name	Description and Notes
PX1	Split production with LANL-	PF-4 contains plutonium science and certification, surveillance, metal prep, and ~30 ppy pit production
		50 ppy production capability at PX.
		Note that the team will evaluate the production capacity of the Plutonium Sustainment project equipment. The capacity required at INL will be adjusted to create the total of 80 ppy.
PX2	Move Metal Prep and Production	PF-4 contains plutonium science and certification, surveillance.
	Metal prep and 80 ppy in new construction	80 ppy production capability and metal prep at PX.
PX3	Move Production Only (PF-4 retains metal prep)	PF-4 contains plutonium science and certification, surveillance, and metal prep.
	80 ppy in new construction	80 ppy production capability established at PX.
		Note that, in this case, it is assumed that the equipment installed in PF-4 for the Plutonium Sustainment Program would remain in PF-4 for use by plutonium science and certification.

PF = Plutonium Facility; ppy = pits per year.

Final Report for the Plutonium Pit Production Analysis of AlternativesAppendix D. Siting and Policy Risk

Appendix D. Siting and Policy Risk

D.1 Introduction

The purpose of this appendix is to examine a selection of potential sites at which the pit manufacturing capability, or portions thereof, might be placed, from the point of view of siting and policy risk, with a view to identifying a few promising candidates for further study.

The chosen list of sites is as follows:

- Los Alamos National Laboratory (LANL)
- Savannah River Site (SRS)
- Pantex Plant (Pantex)
- Nevada National Security Site (NNSS)
- Lawrence Livermore National Laboratory (LLNL)
- Y-12 National Security Site¹ (Y-12)
- Oak Ridge National Laboratory (ORNL)
- Waste Isolation Pilot Plant (WIPP)
- Hanford²
- Idaho National Laboratory (INL)
- Brookhaven National Laboratory (BNL)
- Kansas City National Security Campus (KCNSC)
- Sandia National Laboratories (SNL)
- Paducah, KY
- Portsmouth, OH

At first sight, it might appear that some of the above can be dismissed by cursory inspection. However, the team believes that by examining a large number of potential sites with a comparable degree of rigor, the eventual choice of a short list of sites for further evaluation will have enhanced credibility.

D.2 Siting Factors Considered

The following factors were considered in making a subjective evaluation of the risk associated with siting the pit manufacturing capability (or parts thereof) at each of the candidate sites.

1. The Area of the Site: If the site is small the manufacturing facility cannot be placed far away from the boundary. This would tend to contribute a relatively large amount to site risk. The arbitrary criteria chosen for this analysis are: a small site with an area of less than 10 square miles has relatively high risk; a large site with an area exceeding 100 square miles has a relatively low risk;

¹ Y-12 and ORNL are presented separately here although in other parts of the analysis (e.g., the team's investigation of infrastructure capabilities) they are treated as one site.

² In other parts of the team's analysis it is assumed that, should the pit manufacturing capability be placed at Hanford, it could draw on any infrastructure capabilities present at the nearby Pacific Northwest National Laboratory (PNNL).

Final Report for the Plutonium Pit Production Analysis of AlternativesAppendix D. Siting and Policy Risk

and any site with an area from 10-100 square miles will be characterized by the rather imprecise term medium, i.e., it makes a medium contribution to site risk.

- 2. Relevant Site Information within 5 Miles: Miscellaneous items of information are collected under this heading, including population within that radius, distance to the nearest resident, nature of the countryside (e.g., farming, forested, unpopulated, industrial), and any environmental factor deemed relevant (e.g., a major river flows through the site or there is a lake or other sensitive environmental area). On the basis of these considerations, a purely subjective judgement is made as to whether the factors within 5 miles make a low, moderate, or high contribution to siting risk.
- 3. Nearby Centers of Population: A few representative cities or towns are chosen and their population, distance, and direction are tabulated. Again, a subjective assessment is made of whether these potentially are low, moderate, or high contributors to siting risk.
- 4. Population within 50 Miles: The population within 50 miles is estimated because, in environmental impact statements and other siting analyses, this is often used as the basis to estimate population radiation dose either for routine operation or for hypothetical accident scenarios. Again, an arbitrary range is chosen: the potential contribution to overall site risk is low if the 50-mile population is less than 500,000, high if it is more than 2,000,000, and moderate if it is in between.
- 5. Predominant Wind Direction: A wind rose for each site is obtained (or in some cases wind roses). If the predominant wind direction is toward nearby residents and/or major centers of population this is considered to increase the overall site risk. If it blows away from populated areas, it is regarded as a low contributor to site risk.

In addition to these five factors the team also considered *policy risk*. This, of course, is highly subjective. In assessing whether policy risk is high, moderate, or low the team asked whether there was a history of policy protest or interference at or near each site. A specific example of a site that ultimately did not make the short list is BNL. In the past there was a huge outcry over the proposed Shoreham nuclear reactor, which was located not far from BNL. The reactor was abandoned even though it was essentially complete, had many safety features, and had already cost several billion dollars. In that case, it is clear that the policy risk is high or even very high. Other relevant information, where pertinent, might include the presence of nearby national parks or other sensitive environmental receptors, or Native American Indian reservations.

Once information had been collected for all six factors (area, relevant site information within 5 miles, nearby centers of population, population within 50 miles, predominant wind direction, and policy risk) the team made a subjective assessment of overall siting risk. This assessment was then combined with available infrastructure data for each site to provide a ranking of the sites, and a basis for identifying a few sites at which all or parts of the pit manufacturing facility might be placed. See Chapter 4.

Final Report for the Plutonium Pit Production Analysis of AlternativesAppendix D. Siting and Policy Risk

D.3 Sources of Data

The principal sources of data were:

- *Site fact sheets* on Department of Energy's (DOE's) web site, energy.gov. This proved to be a particularly reliable source for site areas.
- The Missouri Census Data Center at http://mcdc.missouri.edu/websas/caps10c.html. This is a free source for the population in circles with user-chosen radii for any site in the country, based on 2010 census data.³
- *"Suburban Stats"* at https://suburbanstats.org/population/provides the population of any city in the country, also based on 2010 census data.
- Environmental impact statements, Environmental Assessments, and annual site reports. These are good sources for wind roses, some maps, some population data, and where candidate buildings for the pit manufacturing capability (if any) are located.
- *Google maps* are good for estimating as-the-crow-flies distances and assessing the nature of the surroundings (e.g., farming, forested, urban, industrialized).

D.4 Summary of Results

The results of the siting risk analysis are presented in **Table D–1**. Based solely on the number of red or green cells in each row of the table one can make a rough ranking of the sites:

- Favorable: SRS, NNSS, Hanford, INL, WIPP.
- Neutral/moderate: LANL, ORNL, SNL, Portsmouth, and Paducah.
- Unfavorable: LLNL, Y-12, BNL, and KCNSC.
- The results of the policy risk analysis are provided in **Table D–2**.

A couple of observations are pertinent. First, Y-12 shows a higher siting risk than does ORNL because the former is at the Northeast corner of the Oak Ridge Reservation (ORR) a short distance from the city of Oak Ridge, whereas the latter is in the center of ORR, about 4 miles from the nearest residents. Second, the relative ranking of LANL is moot. Since it is the only site at which it is currently possible to manufacture a pit, it has been "grandfathered" in.

³ If further detail is required, the Missouri Census Data Center can break down the population figures by ethnicity, gender, and age.

Final Report for the Plutonium Pit Production Analysis of Alternatives

Appendix D. Siting and Policy Risk

		Site Factors							
				Nearb	y Cities		Population	Predominant	Assessment of Relative Risks
Site	Area (square Relevant Site Information miles)/acres Within 5 Miles	Name	Population	Distance (miles)	Direction	within 50 Miles	Wind Direction (from)	Arising from Siting Issues	
LANL	36/23,000	Fram PFI, the sity of Los Mamor lies about 5.3 miles due N. In other directions, sparsely exputated.	Los Alamos, NM White Rock, NM Santa Fe, NM	12,000 5,800 68,000	1.3 (southern edge) 5 24	N SE SE	378,000	S (daytime) - i.e., towards Los Alamos NW-SW (night)	Moderate
SRS	310/200,000	Within site (measured from F-area, site of MFFF).	Jackson, SC Augusta, GA Aiken, SC	1,700 196,000 30,000	7 20 18	NW NW N	790,000	W Not towards cities listed to left	Low
Pantex	28/18,000	Predominantly farming, sparsely populated. Only 2 people within 2 miles, (~360 within 5 miles), some unpopulated hill country to NW	Panhandle, TX Amarillo, TX	2,500 190,000	10 10	NE SW	316,000	S-SW Away from Amarillo	Low
NNSS	1,360/870,000	No people within 5 miles of DAF	North Las Vegas, NV	217,000	90	SE	42,000	sw	Low
LLNL	<u>х</u> /баг.	The city of Livermore abuts the west eim fourmany of the site. There are tens of thousands of people within 5 miles, mostly to the west.	Livermore, CA Pleasanton, CA Dublin, CA	81,000 70,000 46,000	5 Doty (20100) 17 14	E ESE E	7,700,000	W, WSW, SW, SSW Away from cities listed to left	High
Y-12	1.25/811 at NL comer at ONI (52/33,500)	Neurest Kouses "LSDY N of PIDADS. Entire city of Dak Ridge within 5 miles.	Oak Ridge, TN Knoxville, TN	29,000 180,000	2 (center) 20 (center) 9 (deces approach)	N Slightly S of E SE	1,200,000	About equally from SW- SSW/NE-NNE	High
ORNL	6.9/4,400 towards center of ORR (52/33,500)	Nearest houses ~ 4 miles E and S. Most of 5-mile circle radius within ORR.	Oak Ridge, TN Knoxville, TN	29,000 180,000	6 (center) 22 (center) 11 (closest approach)	NE Slightly N of E ESE	1,200,000	About equally from SW- SSW/NE-NNE	Moderate
WIPP	16/10,000	Very sparsely populated, numerous oil and natural gas wells.	Loving, NM Carlsbad, NM No other city within 30 miles	1,400 26,000	17 24	WSW WNW	113,000	SE Passing N of Carlsbad	Low
Hanford	586/375,000	Within site (e.g., measured from Area 200E or 200W)	Richland, WA Kennewick, WA Pasco, WA	48,000 74,000 60,000	17 30 30	SE SE	560,000	NW, WNW, W Mostly not directly towards nearby cities	Low

Table D-1. Summary of siting risk analysis

Final Report for the Plutonium Pit Production Analysis of Alternatives

Appendix D. Siting and Policy Risk

Site	Site Factors								
				/ Cities	Repulation	Prodominant	Assessment of		
	Area (square miles)/acres	Relevant Site Information Within 5 Miles	Name	Population	Distance (miles)	Direction	within 50 Miles	Wind Direction (from)	Arising from Siting Issues
INL	890/570,000	Within site (depending on where pit production facility would be sited). Very sparse just outside site boundary	Arco/Butte City, ID Blackfoot, ID Idaho Falls, ID	1,000 12,000 57,000	20 40 50	WNW SE E	179,000	SW Not towards nearby cities	Low
BNL	0/5,000	*23,000 becade within one mile of site boundary, population within 5 miles *57,000	Brookhaven Township, MA	Ma6,000	Occupies ~530 mi ² around site	Surrounds site	6.200,000	Westerly	High
KCNSC	0.29/186	Nearest Nouses ~0.5 miles NE ~98,000 people within 5 miles	Grandview, MO Belton City, MO Kansas City, MO	2 5 20	24,400 23,000 460,000	NNE SSE N	2,200,000	5 Towerdis Kartees -City	High
SNL	13.4/8,600 within Kirkland AFB (80/51,000)	Mostly empty except to N in Albuquerque. 25,000 people within 5 miles, nearest houses at ~3 miles	Albuquerque, NM South Valley, NM	7 8	546,000 41,000	NNW W	910,000	From E to SE Towards Rio Grande Valley and SW Albuquerque metropolitan area	Moderate
Paducah, KY	1.2/250 willin ferced area 5.6/3.550	Predominantly farming. ~7,600 people. Ohio River within 2 miles.	Metropolis, IL Paducah, KY	6,500 25,000	5 7	NE ESE	534000	SW-S Towards Metropolis	Moderate
Portsmouth, OH	1.9/1.200 within total site area 5.9/3.780	Mainly wooded, some farming. ~6,200 people	Piketon, OH Portsmouth, OH	2,200 20,000	2.5 17	NNW S	690000	SW-S Not towards cities	Moderate

Final Report for the Plutonium Pit Production Analysis of Alternatives Appendix D. Siting and Policy Risk

Site	Severity of Policy Risk	Comments/Explanation
LANL	Moderate	The city of Los Alamos is only 1.3 miles to the north of the Plutonium Facility and there has been considerable controversy in the past about changes in mission. In addition, there are many Native American Indian reservations within 50 miles of the site, and the Bandelier National Forest is nearby (a few years ago a fire there almost encroached upon Technical Area 55). On the other hand, one would expect many members of the local population to welcome new jobs and expenditures. On balance, the policy risk is moderate
SRS	Moderate	There has been considerable controversy, including law suits, over the Mixed Fuel Fabrication Facility. However, this is also a site where one would expect many members of the local population to welcome new jobs and expenditures. On balance, the policy risk is moderate.
Pantex	Low	There is little history of conflict with neighbors. Pantex already handles pits.
NNSS	Low	Remoteness and size of site are considerable plusses. However, the low severity of policy risk could be revised upwards if, for example, there is any residual conflict arising from the Yucca Mountain controversy
LLNL	High	Large numbers of people nearby. There has been intentional reduction of the amount of plutonium at LLNL – the local population is not likely to want to see that reversed.
Y-12	Moderate	The northern boundary of Y-12 adjacent to the PIDADS is very close to the city of Oak Ridge.
ORNL	Moderate	Likely to be lower than Y-12 because ORNL is in the middle of the Oak Ridge Reservation, a considerable distance from the closest houses. However, should pit manufacturing be established in Oak Ridge, use would likely be made of both Y-12 and ORNL and it would be difficult to disentangle the policy risk associated with what would not really be separate sites.
WIPP	Low	Extremely remote, but would possibly require either revision of the Land Withdrawal Act or a new act to be passed.
Hanford	High	Much previous controversy (e.g., about tanks) and great local concern about potential contamination of the Columbia River.
INL		Extreme remoteness and a large site should mitigate public concerns. However, INL is currently operating under a consent decree with the State of Idaho that may make it difficult to establish new activities that require bringing plutonium onsite. On balance, the policy risk is moderate.
BNL	High	In a very populated area. There is a history of hostility to nuclear power – the nearby Shoreham Nuclear Power Plant was abandoned after it had been completed because of local opposition. Likely to be an outcry over the possibility of bringing plutonium to the site.
KCNSC	High	The site is by definition dedicated to non-nuclear components. It is also very small and close to large concentrations of population.
SNL	Moderate	The amount of special nuclear material held at SNL has been considerably reduced and there would likely be concern if it were proposed to reverse that trend.
Paducah, KY	High	Current expectations are that the plant will be completely shut down and radioactive materials removed.
Portsmouth, OH	High	Current expectations are that the plant will be completely shut down and radioactive materials removed.
Greenfield	High	This would be site dependent, but it is hard to imagine that there would not be an outcry if a pit manufacturing facility were placed in a true greenfield.

Table D-2. Subjective policy risk analysis

Final Report for the Plutonium Pit Production Analysis of AlternativesAppendix D. Siting and Policy Risk

In a way similar to that already done for both the site infrastructure and the siting risk analysis, it is possible to develop a rough ranking of the sites from Table 2–5.

- Favorable: Pantex, NNSS, WIPP, and INL.
- Neutral: LANL, SRS, Y-12/ORNL, and SNL.
- Unfavorable: LLNL, Hanford, BNL, KCNSC, Portsmouth, and Paducah.

<u>Caveat</u>: Site risk and policy risk alone are not the only factors that determine whether a site is suitable or not. These factors must be balanced against others, such as cost and the availability of suitable infrastructure. See Chapter 4.

D.5 Site-Specific Data

The following sections are repositories for the data that were collected on each site. Each pertinent section also provides screen shots of Google maps at various scales, wind roses, and other relevant maps or tables.

Final Report for the Plutonium Pit Production Analysis of AlternativesAppendix D. Siting and Policy Risk

D.6 Los Alamos National Laboratory

*Surrounding population:*⁴ From the Missouri Census Data Center,⁵ based on the 2010 Census, the population within 5 miles is approximately 12,200 and the population within 50 miles is approximately 378,300. Separately, LANL has estimated that, in 2020, the population within 5 miles will be approximately 12,400, and the population within 50 miles approximately 450,000, see **Table D–3**.⁶

Nearest centers of population:⁷

- Los Alamos, NM (population approximately 12,000) approximately 1.3 miles due north of the Plutonium Facility (to nearest houses).
- White Rock, NM (population approximately 5,800) approximately 5 miles SE of Technical Area 55 (TA-55) (to nearest houses).
- Santa Fe, NM (population approximately 68,000), approximately 24 miles SE.

Nature of surroundings within 5 miles: See **Figure D–1**. Apart from Los Alamos and White Rock, essentially unpopulated, no industrial activity except for the site itself.

Size of site: 36 square miles (approximately 23,000 acres).8

Most likely wind direction: See **Figure D–4**. During the day, the predominant wind direction is from the south, i.e., towards Los Alamos. During the night, it is more or less evenly distributed from NW-SW, mostly not directly towards the city from TA-55.

Initial Subjective Assessment of Public External Individual and Societal Risk from pit production at LANL: <u>Moderate</u>, because of closeness to Los Alamos, relative smallness of the site, and predominant wind direction towards the city during the day.

Policy Risk: The risk that policyly motivated opposition could cause substantial difficulties should LANL be chosen as the site for manufacturing 80 pits per year (ppy) would appear to be low because the site already manufactures some pits and is currently working through the plutonium sustainment project that will result in a production capability of 30 ppy. One would not expect much controversy should that capability be expanded to 80 ppy. However, there are some factors that could potentially generate policy controversy, including the relative closeness of the nearest housing in Los Alamos, concerns about the nearby Bandelier National Monument, and the presence of several Native American Indian reservations within 50 miles. These factors introduce uncertainty. Thus, the policy risk for this site is assessed to be moderate.

⁴ Measured from TA-55.

⁵ <u>http://mcdc.missouri.edu/websas/caps10c.html</u>.

⁶ DOE (U.S. Department of Energy) 2013, Draft Supplement Analysis for the Nuclear Infrastructure Programmatic Environmental Impact Statement for Pu-238 Production for Radioisotope Power Systems, DOE/EIS-0310-SA-02, Washington DC, September obtained from, <u>http://www.id.doe.gov/insideNEID/PDF/Pu-238 Supplement Analysis.pdf</u>.

⁷ Distances estimated using Google Maps (Figures D–1 and D–2) and Figure D–3, measured from TA-55: populations mainly obtained from https://suburbanstats.org/population/.

⁸ http://www.ncsl.org/research/environment-and-natural-resources/los-alamos-national-laboratory.aspx.

Final Report for the Plutonium Pit Production Analysis of Alternatives Appendix D. Siting and Policy Risk

(Source DOE/EIS-0310-SA-02, Table 3-45)									
	5 Miles		10 Miles		20 Miles		50 Miles		
Population	Population	Percent of Total							
Nonminority	8,619	69	13,493	67	21,883	36	197,224	44	
Total Hispanic ^b	2,075	17	3,613	18	31,897	52	201,687	45	
American Indian or Alaska Native ^a	185	1	1,043	5	5,475	9	27,801	6	
Other Minority ^a	3,615	29	5,556	28	34,206	56	222,516	50	
Total Minority ^a	3,800	31	6,599	33	39,681	64	250,317	56	
Total Population	12,419	100	20,092	100	61,564	100	447,541	100	
Low-Income	352	3	777	4	8,712	14	54,194	12	

Table D–3. Estimated population distribution surrounding LANL in 2020

. DOE/EIS 0210 SA 02 Table 2 45)

^a Includes Hispanic persons.
 ^b Includes all Hispanic persons regardless of race.

Note: To convert miles to kilometers, multiply by 1.609. Totals may not equal the sum of subcategories due to rounding. The potentially affected area comprises the area within a 50-mile (80-kilometer) radius of the site.

Final Report for the Plutonium Pit Production Analysis of Alternatives

Appendix D. Siting and Policy Risk



Figure D-1. Google map of Los Alamos area

Los Alamos is approximately at tip of blue arrow, Santa Fe at tip of red arrow. Map is approximately 60 miles E-W and approximately 30 miles N-S.

Final Report for the Plutonium Pit Production Analysis of Alternatives

Appendix D. Siting and Policy Risk



Figure D–2. Larger scale Google map of LANL and Los Alamos

Map is approximately 8 miles E-W and 4 miles N-S. TA-55 is approximately at tip of blue arrow.

Final Report for the Plutonium Pit Production Analysis of AlternativesAppendix D. Siting and Policy Risk



Figure D–3. Map of Los Alamos Site

(Source: Final Surplus Plutonium Disposition Supplemental Environmental Impact Statement, Figure 1-3⁹)

⁹ DOE (U.S. Department of Energy) 2015, *Final Surplus Plutonium Disposition Supplemental Environmental Impact Statement*, DOE/EIS-0283-S2, Washington DC, April, obtained from http://www.srs.gov/general/pubs/envbul/documents/EIS-0283-S2 SPD Vol 1 EIS Chapters.pdf.

Final Report for the Plutonium Pit Production Analysis of AlternativesAppendix D. Siting and Policy Risk



(Source: Final Surplus Plutonium Disposition Supplemental Environmental Impact Statement, Figure 3–13. Top left is closest to TA-55.)

Final Report for the Plutonium Pit Production Analysis of AlternativesAppendix D. Siting and Policy Risk

D.7 Savannah River Site

Surrounding population: There are no members of the public within 5 miles of F-Area (which is where the Mixed Oxide Fuel Fabrication Facility [MFFF] is located) because that is entirely within the site (see **Figures D–5** and **D–6**). The total number of people within 10 miles is approximately 7,200 and the total out to 50 miles is approximately 790,000, based on the 2010 census.¹⁰

Centers of population:¹¹

- The nearest town to F-Area is Jackson, SC (population approximately 1,700) approximately 7 miles NW.
- The biggest nearby city is Augusta, GA (population approximately 196,000) approximately 20 miles NW.
- The next largest city is Aiken, SC (population approximately 30,000), approximately 18 miles N.
- There are several other smaller cities too numerous to tabulate within 10-30 miles (see Figure D–7).

Nature of surroundings within 5 miles of F-Area (MFFF): Essentially unpopulated with no farming or industrial activity because the area is all within the site. See Figures D–5 and **D–7**.

Size of site: 310 square miles (approximately 200,000 acres).¹² F-Area (MFFF) is approximately 6 miles from the closest site boundary.

Most likely wind direction: **Figure D–8** shows four wind roses at various heights. Except for the one at the greatest height, the predominant winds are westerly, i.e., not directed towards the largest centers of population. At the greatest height, there is a somewhat greater probability of winds from the south (i.e., towards Aiken). However, for major accidents, one is generally concerned with releases near ground level so the predominant westerly winds are more significant.

Initial Subjective Assessment of Public External Individual and Societal Risk in the event that pit production is relocated to Savannah River: <u>Low</u> because of large distances to population centers, sparse population within 5 miles of MFFF, a very large site, and predominant wind direction not towards population centers.

Policy Risk: Factors that tend to make the policy risk low are the substantial distances to the nearest population and the fact that SRS has a long history of handling plutonium and associated wastes. In addition, many politicians have expressed concern that MFFF may be abandoned, so the prospect of the facility being put to constructive use might be attractive to the local community. However, there is an ongoing lawsuit concerning MFFF¹³ that has not yet been fully resolved.¹⁴ Therefore, the policy risk is estimated to be moderate. It is not assessed to be high because one assumes that the prospect of work for the site will lead to compromise.

¹⁰ Missouri Census Data center, <u>http://mcdc.missouri.edu/websas/caps10c.html.</u>

¹¹ Distances estimated from F area (site of MOX facility) using Google Maps and Figure D–7: populations obtained from <u>https://suburbanstats.org/population/</u>.

¹² <u>http://www.savannahrivernuclearsolutions.com/faq01.htm#q1</u>.

¹³ The Post and Courier, Haley Backs Plutonium Removal, Reasserts MOX Lawsuit, April 4th 2016, <u>http://www.postandcourier.com/archives/haley-backs-plutonium-removal-reasserts-mox-lawsuit/article_6b2c712f-a16c-5210-</u> 8e91-68a30bb3e26e.html.

¹⁴ Aiken Standard, *Judge Dismisses Part of Lawsuit over Savannah River Site MOX Plutonium Disposal*, February 17th 2017, <u>http://www.aikenstandard.com/news/judge-dismisses-part-of-lawsuit-over-savannah-river-site-mox/article_4b5ef716-ee49-11e6-b19a-37eb5bc7d58d.html</u>.

Final Report for the Plutonium Pit Production Analysis of Alternatives

Appendix D. Siting and Policy Risk



Figure D–5. Larger scale Google map of Savannah River Site

Map is approximately 30 miles E-W and 15 miles N-S. F-Area (site of MOX facility) is approximately at tip of blue arrow

Final Report for the Plutonium Pit Production Analysis of Alternatives Appendix D. Siting and Policy Risk



Figure D–6. Map of Savannah River Site

(Source: Final Surplus Plutonium Disposition Supplemental Environmental Impact Statement, Figure 1-2¹⁵)

¹⁵ DOE (U.S. Department of Energy) 2015, Final Surplus Plutonium Disposition Supplemental Environmental Impact Statement, DOE/EIS-0283-S2, Washington DC, April 2015, obtained from

http://www.srs.gov/general/pubs/envbul/documents/EIS-0283-S2 SPD Vol 1 EIS Chapters.pdf.

Final Report for the Plutonium Pit Production Analysis of Alternatives

Appendix D. Siting and Policy Risk



Figure D-7. Google map of Savannah River Site and vicinity

Map is approximately 60 miles E-W and 30 miles N-S. F-Area (site of MFFF facility) is approximately at tip of blue arrow.

Final Report for the Plutonium Pit Production Analysis of AlternativesAppendix D. Siting and Policy Risk



Figure D–8. Wind roses at various heights at Savannah River Site

(Source: Final Surplus Plutonium Disposition Supplemental Environmental Impact Statement, Figure 3-2)

Final Report for the Plutonium Pit Production Analysis of AlternativesAppendix D. Siting and Policy Risk

D.8 Pantex

Surrounding population: Population within 5 miles is approximately 360 (only 2 within 2 miles), and within 50 miles is approximately 316,000, based on the 2010 census per Suburban Stats¹⁶ (c.f. EIS-0225-SA-05-2013¹⁷ also gives approximately 316,000 within 50 miles).

*Nearest centers of population:*¹⁸ Estimated from Google maps. See **Figures D–9** and **D–10**.

- Panhandle, TX (population approximately 2,500), approximately 10 miles NE.
- Amarillo, TX (population approximately 190,000), approximately 10 miles SW.

Nature of surroundings within 5 miles: See **Figure D–11**. Predominantly farming, some unpopulated hill country to NW. Within this distance, only isolated houses.

Adjacent to plant: See Figures D–10, **D-12**, and **D–13**. PIDADS is near the southern boundary of the plant, Texas Tech research farm immediately to the south.

Size of site: 28 square miles (18,000 acres) with most activity concentrated in 2,000 acres.¹⁹

Most likely wind direction: **Figure D–14** provides the wind rose from nearby Amarillo airport. The predominant wind direction is from the south to south west and so does not blow towards Amarillo from Pantex.

Initial Subjective Assessment of Public External Individual and Societal Risk in the event that pit production is relocated to Pantex: <u>Low</u> because of moderately large distances to population centers, sparse population within 5 miles of the plant, largish site, and predominant wind direction not towards population centers.

Policy Risk: Factors that tend to make the policy risk low are the substantial distances to the nearest population and the fact that Pantex has a long history of handling pits. At the time of writing the author was not aware of any history of policy opposition to Pantex. Therefore, the policy risk at Pantex is assessed to be <u>low</u>.

¹⁶ <u>http://mcdc.missouri.edu/websas/caps10c.html.</u>

 ¹⁷ DOE (U.S. Department of Energy) 2012, *Final Supplement analysis for the Final Environmental Impact Statement for the Continued Operation of the Pantex Plant and Associated Storage of Nuclear Weapon Components*, DOE/EIS-0225-SA-05, Washington DC, November, obtained from https://energy.gov/sites/prod/files/EIS-0225-SA-05, Washington DC, November, obtained from https://energy.gov/sites/prod/files/EIS-0225-SA-05, Washington DC, November, obtained from https://energy.gov/sites/prod/files/EIS-0225-SA-05, Washington DC, November, obtained from https://energy.gov/sites/prod/files/EIS-0225-SA-05-2013.pdf.

¹⁹ About Pantex, <u>http://www.pantex.com/about/Pages/default.aspx</u>.

Final Report for the Plutonium Pit Production Analysis of Alternatives

Appendix D. Siting and Policy Risk



Figure D–9. Google map showing location of Pantex Site

Map is approximately 30 miles E-W and 15 miles N-S.

Final Report for the Plutonium Pit Production Analysis of AlternativesAppendix D. Siting and Policy Risk





(Source: DOE/EIS-0225-SA-05, Figure 1-2)

Final Report for the Plutonium Pit Production Analysis of Alternatives

Appendix D. Siting and Policy Risk



Figure D–11. Google map showing the vicinity of the Pantex Site at approximately 2.5 miles to 1 inch scale

The map shows the predominantly agricultural and sparsely populated nature of the countryside within 5 miles or so of Pantex.

Final Report for the Plutonium Pit Production Analysis of Alternatives

Appendix D. Siting and Policy Risk



Figure D–12. Google map of the Pantex Plant showing PIDADS

Map approximately 1.9 miles E-W and 0.95 miles N-S.

Final Report for the Plutonium Pit Production Analysis of AlternativesAppendix D. Siting and Policy Risk



Figure D–13. Map of Pantex Site

(Source: DOE/EIS-0225-SA-05, Figure 1-2)

Final Report for the Plutonium Pit Production Analysis of AlternativesAppendix D. Siting and Policy Risk



Figure D-14. Wind rose for Amarillo Airport

(Source: http://www.weather.gov/ama/amarillowindroseinformation)

Final Report for the Plutonium Pit Production Analysis of AlternativesAppendix D. Siting and Policy Risk

Nevada National Security Site

*Surrounding population:*²⁰ Population within 10 miles is 4, and that within 50 miles is 42,000. See DOE/EIS-0246D,²¹ Table G–5. The Missouri Census Data Center²² reports 0 population within 10 miles and only approximately 14,000 within 50 miles, based on 2010 census data.

*Nearest center of population:*²³ North Las Vegas, NV (population approximately 217,000) approximately 90 miles SE.

Nature of surroundings within 5 miles of the Device Assembly Facility (DAF): Unpopulated. See **Figure D–15**.

Size of site: 1,360 square miles (approximately 870,000 acres).²⁴ See **Figure D–16**.

Most likely wind direction: **Figure D–17** shows that the predominant wind direction in the southern half of NNSS, near DAF, is from the south west, not towards any major center of population.

Initial Subjective Assessment of Public External Individual and Societal Risk in the event that pit production is relocated to NNSS: <u>Low</u> because of large distances to population centers, zero population within 5 miles of site, and predominant wind direction not towards population centers.

Policy Risk: There are so few people within 50 miles of this site that the policy risk is expected to be low, unless there is some residual fallout from the controversy associated with Yucca Mountain.

²⁰ Measured from the Device Assembly Facility (DAF). See Figure D–15 for the location of DAF.

²¹ DOE (U.S. Department of Energy) 2011, Draft Site-Aide Environmental Impact Statement for the Continued Operation of The Department of Energy/National Nuclear Security Administration Nevada National Security Site and Off-Site Locations in the State of Nevada (NNSS SWEIS), DOE/EIS-0246D, Washington DC, July, obtained from

https://nnsa.energy.gov/aboutus/ouroperations/generalcounsel/nepaoverview/nepa/nnsssweis. ²² http://mcdc.missouri.edu/websas/caps10c.html.

²³ Distances estimated from DAF using Google Maps, see Figure D–16: populations obtained from <u>https://suburbanstats.org/population/</u>.

²⁴ <u>http://www2.nstec.com/Pages/NNSS-Mission.aspx</u>.

Final Report for the Plutonium Pit Production Analysis of Alternatives

Appendix D. Siting and Policy Risk



Figure D–15. Google map of NNSS area Map is approximately 60 miles E-W and approximately 30 miles N-S. Blue spot identifies area containing DAF.

Final Report for the Plutonium Pit Production Analysis of Alternatives Appendix D. Siting and Policy Risk





(Source: DOE/EIS-0246D Figure 2-2)

Blue circle adjacent to DAF.

Final Report for the Plutonium Pit Production Analysis of Alternatives Appendix D. Siting and Policy Risk



Figure D-17. Wind roses at NNSS



Bottom right wind rose is closest to DAF, which is approximately at the blue dot.

Final Report for the Plutonium Pit Production Analysis of AlternativesAppendix D. Siting and Policy Risk

D.9 Lawrence Livermore National Laboratory

Surrounding population: Population within 5 miles is approximately 76,000 based on the 2010 census,²⁵ and that within 50 miles is 7,700,000. The distance from Superblock to the nearest population is approximately 0.6 miles. See **Figure D–18**.

Representative nearby centers of population:²⁶

- Livermore, CA (population approximately 81,000); city center is approximately 3 miles E.
- Pleasanton, CA (population approximately 70,000) approximately 9 miles ESE.
- Dublin, CA (population approximately 46,000), approximately 14 miles E.

Nature of surroundings within 5 miles: Heavily populated to E and SE, see **Figure D–19**. Sparsely populated to the W and S.

Size of site: 1 square mile (approximately 640 acres).²⁷

Most likely wind direction: **Figure D–20** shows two wind roses, one for the wet season and one for the dry season. In both seasons, the wind blows most of the time from the W, WSW, SW, and SSW, i.e., away from populated areas.

Initial Subjective Assessment of Public Individual and Societal Risk in the event that pit production is relocated to LLNL: <u>High</u> because of short distances to population centers and very small site, slightly mitigated by winds predominantly blowing towards relatively sparsely populated areas.

Policy Risk: <u>High</u> because LLNL has been reducing material-at-risk (MAR) at the site (and presumably the public would not want that to be reversed), the site is very small, and there are very large populations both close-in and within 50 miles.

²⁵ <u>http://mcdc.missouri.edu/websas/caps10c.html</u>.

²⁶ https://suburbanstats.org/population/.

²⁷ <u>https://www.llnl.gov/about</u>.

Final Report for the Plutonium Pit Production Analysis of Alternatives

Appendix D. Siting and Policy Risk



Figure D–18. Google map of LLNL and immediate vicinity

Map is approximately 3.8 miles E-W and 1.9 miles N-S.

Blue dot is over Superblock.

Final Report for the Plutonium Pit Production Analysis of Alternatives

Appendix D. Siting and Policy Risk



Figure D–19. Google map of San Francisco Bay area Map is approximately 60 miles E-W and 30 miles N-S. LLNL is approximately at tip of blue arrow.

Final Report for the Plutonium Pit Production Analysis of AlternativesAppendix D. Siting and Policy Risk





(Source: DOE/EIS-0348 and EIS-0236-S3²⁸ Figure 4.7.3-1)

²⁸ DOE (U.S. Department of Energy) 2005, Final Site-Wide Environmental Impact Statement: Continued Operation of Lawrence Livermore National Laboratory and Supplement Stockpile Stewardship and Management, DOE/EIS-0348 and EIS-0236-S3, Washington DC, March, obtained from <u>https://energy.gov/nepa/downloads/eis-0348-and-eis-0236-s3-final-site-wideenvironmental-impact-statement.</u>

Final Report for the Plutonium Pit Production Analysis of AlternativesAppendix D. Siting and Policy Risk

D.10 Y-12 National Security Site and Oak Ridge National Laboratory

Surrounding population: Within 2 miles, 0 for ORNL and approximately 3,300 for Y-12; within 5 miles approximately 6,600 and approximately 32,700, respectively; within 50 miles both approximately 1,200,000. Populations from the University of Missouri Census data center, based on the 2010 census.²⁹

*Nearby Centers of Population:*³⁰ See Figures D–21 and D–22.

- Oak Ridge, TN (population approximately 29,000), centered 2 miles N of Y-12 PIDADS and approximately 6 miles NE of ORNL.
- Knoxville, TN (population approximately 180,000), centered approximately 20 miles slightly S of E from Y-12 and approximately 22 miles slightly N of E from ORNL. Nearest point of approach (roughly at I-40/162 intersection) approximately 9 miles SE of Y-12, 11 miles ESE of ORNL.
- Other centers of population within 30 miles: Oliver Springs, Clinton, Rocky Top, Lenoir City, Farragut, Kingston, and Harriman

Nature of surroundings within 5 miles:

- Y-12 situated to S of Oak Ridge. Shortest distance between PIDADS and nearest house approximately 1,500 feet. The whole of the city of Oak Ridge is within 5 miles of Y-12. See Figure D–21.
- ORNL most of the land within 5 miles of ORNL is inside the ORR, except to the east and south, just across the Clinch River, where residences can be found in the 4-5-mile range. See Figure D–21.

Size of site: Y-12 – 1.25 square miles (approximately 811 acres),³¹ ORNL – 6.9 square miles (approximately 4,400 acres),³² both located within ORR which has an area of 52 square miles (33,508 acres),³³ see **Figures D–23**, **D–24**, and **D–25**.

Most likely wind direction: ORR-ASER-2015 presents a large number of wind roses on the Y-12 and ORNL sites.³⁴ These vary somewhat depending on location and height. On average, it seems that, at lower elevations (e.g., 10 meters above ground level) winds from the NE or ENE are about as probable as winds from the SW or SSW. The wind roses from taller meteorological towers tend to show a more consistent predominant wind direction from the SW. In any event, none of the wind roses show any particular orientation towards either relatively unpopulated or relatively populated areas.

Initial Subjective Assessment of Public Individual and Societal Risk in the event that pit production is relocated to the Oak Ridge Reservation: For Y-12 <u>high</u> because of proximity to the city of Oak Ridge. For ORNL, somewhat lower (<u>moderate</u>) because the laboratory is in the middle of the Oak Ridge Reservation. The 50-mile population is over one million for both sites. This is higher than for most of the sites being analyzed in this appendix.

²⁹ <u>http://mcdc.missouri.edu/websas/caps10c.html</u>.

³⁰ Distances estimated using Google Maps, see Figures D–22 through D–25: populations obtained from <u>https://suburbanstats.org/population/</u>.

³¹ <u>http://www.y12.doe.gov/sites/default/files/pdf/page/ygg-14-0371r3 about y12.pdf</u>.

³² https://science.energy.gov/laboratories/oak-ridge-national-laboratory/.

³³ DOE (U.S. Department of Energy), Oak Ridge Reservation Annual Site Report 2015, DOE/ORO/2509, Oak Ridge, TN, obtained from <u>https://doeic.science.energy.gov/ASER/aser2015/index.html</u>.

³⁴ <u>http://web.ornl.gov/adm/fo/lp/orrm/page7.htm</u>.

Final Report for the Plutonium Pit Production Analysis of AlternativesAppendix D. Siting and Policy Risk

Policy Risk: Assessed to be moderate because Y-12 is the national center for uranium and there might be resistance to adding significant plutonium inventory.

Final Report for the Plutonium Pit Production Analysis of Alternatives

Appendix D. Siting and Policy Risk



Figure D-21. Google map showing ORNL Map is approximately 15 miles E-W and 7.5 miles N-S. ORNL identified by blue dot, Y-12 by red dot.

Final Report for the Plutonium Pit Production Analysis of Alternatives

Appendix D. Siting and Policy Risk



Figure D-22. Google map of area surrounding the city of Oak Ridge Map is approximately 60 miles E-W and 30 miles N-S. ORNL identified by blue dot, Y-12 by red dot.

Final Report for the Plutonium Pit Production Analysis of Alternatives

Appendix D. Siting and Policy Risk



Figure D–23. Oak Ridge Reservation

(Source: ORR-ASER-2015, Figure 1-2)

Final Report for the Plutonium Pit Production Analysis of Alternatives

Appendix D. Siting and Policy Risk



Figure D–24. Close-up of SW end of Y-12 showing PIDAS

Final Report for the Plutonium Pit Production Analysis of Alternatives

Appendix D. Siting and Policy Risk



Figure D-25. Close-up of ORNL

Final Report for the Plutonium Pit Production Analysis of AlternativesAppendix D. Siting and Policy Risk

D.11 Waste Isolation Pilot Plant

Surrounding population: Population near the site is very sparse. See **Figures D–26** and **D–27**. The nearest residences are ranches 3.5 miles SSW and 7 miles WNW.³⁵ The population within 5 miles is 2 and within 10 miles is 7, and that within 50 miles is approximately 113,000, based on the 2010 census.³⁶

Representative nearby centers of population:³⁷

- Loving, NM (population approximately 1,400) approximately 17 miles WSW.
- Carlsbad, NM (population approximately 26,000) approximately24 miles WNW.
- No other city within 30 miles, see Figure D–27 and **D–28**.

Nature of surroundings within 5 miles: Essentially unpopulated with many oil or natural gas wells. See Figures D–27 and **D–29**.

Size of site: 16 square miles (approximately 10,000 acres).³⁸

Most likely wind direction: **Figure D–30** shows the WIPP wind rose at 33 meters. The most likely wind direction is from the SE, which would pass north of Carlsbad.

Initial Subjective Assessment of Public External Individual and Societal Risk in the event that pit production is relocated to WIPP: <u>Low</u> because of large distances to population centers, sparse population within 5 miles of site, and predominant wind direction not towards population centers.

Policy Risk: The authors have no reason to believe this would be other than <u>low</u>.

³⁵ DOE (U.S. Department of Energy) 1992, *Waste Isolation Pilot Plant Site Environmental Report for Calendar Year 1991*, DOE/WIPP 92-007, Washington DC, obtained from

http://wipp.energy.gov/information_repository/cca/CCA_1996_References/Chapter%202/CREL259.PDF. ³⁶ http://mcdc.missouri.edu/websas/caps10c.html.

³⁷ Distances estimated from the center of WIPP using Google Maps, see Figure D–26: populations obtained from <u>https://suburbanstats.org/population/</u>.

³⁸ www.https://energy.gov/em/waste-isolation-pilot-plant.

Final Report for the Plutonium Pit Production Analysis of Alternatives

Appendix D. Siting and Policy Risk



Figure D-26. Google map of vicinity of WIPP Site

WIPP is approximately at tip of blue arrow.

Map is approximately 60 miles E-W and 30 miles N-S.

Final Report for the Plutonium Pit Production Analysis of Alternatives

Appendix D. Siting and Policy Risk



Figure D–27. Larger scale Google map of WIPP Site Map is approximately 15 miles E-W and 7.5 miles N-S. The many small rectangles are sites for oil wells, see Figure A.7-3.

Final Report for the Plutonium Pit Production Analysis of AlternativesAppendix D. Siting and Policy Risk



(Source: Final Surplus Plutonium Disposition Supplemental Environmental Impact Statement, Figure 1-4.³⁹)

D-44

³⁹ DOE (U.S. Department of Energy) 2015 *Final Surplus Plutonium Disposition Supplemental Environmental Impact Statement*, DOE/EIS-0283-S2, Washington, DC, April, obtained from http://www.srs.gov/general/pubs/envbul/documents/EIS-0283-S2_SPD_Vol_1_EIS_Chapters.pdf.

Final Report for the Plutonium Pit Production Analysis of Alternatives

Appendix D. Siting and Policy Risk



Figure D–29. Oil well near WIPP

Final Report for the Plutonium Pit Production Analysis of AlternativesAppendix D. Siting and Policy Risk



Figure D–30. 2005 wind rose for WIPP at 33 meters⁴⁰

⁴⁰ DOE (U.S. Department of Energy) 2009, Subparts B and C Compliance Recertification, Application for the Waste Isolation Pilot Plant Content of Compliance Recertification Application(s) (40 CFR § 194.15), 2009, obtained from www.wipp.energy.gov/library/cra/2009 cra/CRA/Section 15/Section 15.htm#Figure 15-2.

Final Report for the Plutonium Pit Production Analysis of AlternativesAppendix D. Siting and Policy Risk

D.12 Hanford

Surrounding population: Population within 10 miles is 2, and within 50 miles approximately 560,000, per the University of Missouri Census Data Center.⁴¹

*Nearest centers of population:*⁴² See **Figures D–31** and **D–32**.

- Richland, WA (population approximately 48,000) approximately 17 miles SE of Area 200E.
- Kennewick, WA (population approximately 74,000) and Pasco, WA (population approximately 60,000) approximately 30 miles SE of Area 200E.

Nature of surroundings within 5 miles: See Figures D–31 and **D–33**. Essentially unoccupied except for site facilities.

Size of site: 586 square miles (approximately 375,000 acres).⁴³ Area 200E is approximately 10 miles from nearest site boundary.

Most likely wind direction: A detailed study of Hanford Site climatology by Pacific Northwest National Laboratory (PNNL)⁴⁴ provides tabular joint frequency distributions that show, at Areas 200E and 200W, the wind blows from W-NW 40-45 percent of the time. This is usually not towards the Tri-Cities area, although winds from the NW may just skirt the northeastern fringes of the cities.

Initial Subjective Assessment of Public External Individual and Societal Risk in the event that pit production is relocated to Hanford: <u>Low</u> because of large distances to population centers, sparse population within 5 miles of Area 200E, the very large site, and predominant wind directions mostly not towards population centers.

Policy Risk: Considerable controversy has centered on potential contamination of the Columbia River. This is such a high-profile issue that the policy risk should be considered at least moderate.

⁴¹ http://mcdc.missouri.edu/websas/caps10c.html.

⁴² Populations obtained from <u>https://suburbanstats.org/population/</u>.

⁴³ <u>http://www.hanford.gov/page.cfm/FunFacts.</u>

⁴⁴ PNNL (Pacific Northwest National Laboratory) 2005, Hanford Site Climatological Summary 2004 with Historical data, PNNL-15160, Richland, WA, May, obtained from <u>http://www.pnl.gov/main/publications/external/technical_reports/PNNL-15160.pdf</u>.

Final Report for the Plutonium Pit Production Analysis of Alternatives

Appendix D. Siting and Policy Risk



Figure D–31. Google map of Hanford area

Map approximately 50 miles E-W and 25 miles N-S. Plant is at top center, Tri-Cities area to South/South East.