Supplement Analysis for the National Environmental Policy Act Environmental Assessment LINAC COHERENT LIGHT SOURCE-II (DOE/EA-1975-SA-01)

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Cover Photo: SLAC West Campus Aerial View

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List of Acronyms and Abbreviations

AADT	annual average daily traffic
ALOHA	Area Locations of Hazardous Atmospheres
BTH	Beam Transport Hall
CEQ	Council on Environmental Quality
CRLF	California red-legged frog
DART	Days Away, Restricted, and Transfer
dB	decibel(s)
dBA	A-weighted decibel(s)
DOE	U.S. Department of Energy
EA	Environmental Assessment
EPA	U.S. Environmental Protection Agency
FEE	Front End Enclosure
FEH	Far Experimental Hall
FONSI	Finding of No Significant Impact
GHG	greenhouse gas
I-280	Interstate 280
ISEMS	Integrated Safety and Environmental Management System
kW	kilowatt
LCLS	Linac Coherent Light Source
L_{dn}	day-night averaged sound level
L_{eq}	equivalent continuous noise level
NAAQS	National Ambient Air Quality Standards
NEH	Near Experimental Hall
NEPA	National Environmental Policy Act
NESHAP	National Emission Standards for Hazardous Air Pollutants
PM_{10}	particulate matter with a diameter of 10 microns or less
$PM_{2.5}$	particulate matter with a diameter of 2.5 microns or less
SAAQS	State Ambient Air Quality Standards
SFBAAB	San Francisco Bay Area Air Basin
SLAC	SLAC National Accelerator Laboratory
SMOP	Synthetic Minor Operating Permit
SWPPP	Storm Water Pollution Prevention Plan
UH	Undulator Hall
WSHP	Worker Safety and Health Program
XFEL	X-ray free electron laser

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1.0 INTRODUCTION

1.1 SLAC National Accelerator Laboratory Overview

The SLAC National Accelerator Laboratory (SLAC) is operated by Stanford University under contract to the U.S. Department of Energy (DOE). SLAC's research campus is located on the San Francisco Peninsula in an unincorporated portion of San Mateo County, California. SLAC was founded in 1962 to site and operate a particle collider and to conduct physics research, accelerator science, and particle physics. More recently, SLAC has been involved in photon science and astrophysics as well. SLAC is a multi-program national laboratory that uses electron and positron beams to explore frontier questions in accelerator research, particle physics, astrophysics, and the structure and function of matter. Its largest facility is the Linear Accelerator (Linac) which is comprised of an aboveground 2-mile-long Klystron Gallery (356,000 square feet) and the belowground Accelerator Housing (115,000 square feet) situated beneath the Klystron Gallery.

1.2 Existing LCLS Facilities and 2002 Environmental Assessment

One of SLAC's major scientific facilities is the Linac Coherent Light Source (LCLS), the world's first hard X-ray free electron laser (XFEL). The brightness and other properties of the LCLS X-ray laser beams enable the simultaneous investigation of a material's electronic and structural properties. LCLS investigations cover material sciences, catalytic sciences, structural molecular biology, and molecular environmental sciences. The potential environmental effects of the construction and operation of the LCLS were evaluated under the National Environmental Policy Act (NEPA) in an Environmental Assessment (EA) (DOE 2002). After public review, DOE published a Finding of No Significant Impact (FONSI) (DOE 2003).

Construction of LCLS was completed in 2009, and experiments began during fall 2009. LCLS uses SLAC's existing Linac (see Figure 1-2 of the 2014 EA) to generate and accelerate the beam. However, LCLS uses only the last third (eastern 0.6 mile – Sectors 20 through 30) of the 2-mile-long, 30-sector Linac, with an electron injector at Sector 20. The LCLS project included construction of a Beam Transport Hall (BTH), Undulator Hall (UH), Electron Beam Dump (EBD), Front End Enclosure (FEE), Near Experimental Hall (NEH), and Far Experimental Hall (FEH) (see Figure 1-3 of the 2014 EA). LCLS users access the beam in experimental halls, which contain experimental stations with X-ray beam optics, diagnostic equipment, and control systems. NEH is partially buried and contains approximately 25,000 square feet of research facilities. The UH and FEH are completely underground and provide another 25,000 square feet of research facilities.

The commissioning and routine operation of LCLS resulted in employment of approximately 100 additional permanent SLAC employees. In addition, up to 40 visiting researchers work at the LCLS at a given time. The LCLS predominantly supports only one experiment at a time, which typically requires ten

researchers; the additional researchers are on site to prepare upcoming experiments and close out completed experiments.

1.3 LCLS-II and 2012 and 2014 Environmental Assessments

During 2011 and 2012, DOE and SLAC completed a NEPA EA (DOE 2012) for SLAC's proposed Linac Coherent Light Source-II project (LCLS-II). LCLS-II originally was an expansion of LCLS, with an additional beam, an additional experimental hall, and working stations to increase the number of experiments that could be completed. DOE determined that the additional facilities would not result in significant environmental effects and published a FONSI in March 2012.

In 2013, DOE's Office of Science determined that instead of strictly increasing experimental capacity, LCLS-II also should be upgraded to enhance its experimental capabilities and perform new types of experiments. These upgrades would require dismantling and removing existing equipment and utilities within Sectors 0 through 10 of the existing Accelerator Housing and Klystron Gallery, and installing new superconducting accelerator equipment. To support this new superconducting accelerator, SLAC planned to construct two cryogenic plants to produce extremely cold liquid helium that would circulate through the accelerator, allowing production of a more powerful beam, and thus enhancing experimental capabilities. The plan included a primary 4-kilowatt (kW) cryogenic plant near Sector 4 of the existing Klystron Gallery and a smaller (approximately 1-kW) cryogenic plant adjacent to the primary plant or near Sectors 0-1, to provide additional cryogen production capacity and backup capacity during maintenance shutdowns of the primary plant. The LCLS-II project also would require upgrades to existing LCLS equipment and utilities, including those contained in the BTH, UH, NEH, and FEH. One of the upgrades would be consistent with the original purpose of increasing capacity and would install a second beamline, but not the large new experimental hall described in the 2012 EA. SLAC completed a new NEPA review for the LCLS-II project with these enhanced capabilities and published the resulting EA (DOE 2014) and FONSI in 2014.

1.4 Proposed Cryogen Plant Reconfiguration

Since DOE published the most recent FONSI in 2014, DOE and SLAC have completed a more detailed design of the superconducting Linac and have determined that the project will require more refrigeration capacity for cryogenic helium to cool the accelerator than envisioned in the 2014 EA, and that the second cryogenic plant—originally planned to be smaller than the primary plant—will need approximately the same capacity and will need to be approximately the same size (4 kW) as the primary plant. With the larger second cryogenic plant, rather than using the existing cooling tower as originally planned, the reconfigured cryogenic plants also will require a new water cooling tower on the same site.

1.5 Purpose of Current Supplement Analysis (SA)

This document provides an analysis of the potential impacts of the proposed reconfigured cryogenic plants, a new cooling tower, and other added components. It contains a description of the revised project layout, the larger second cryogenic plant and added cooling tower, and the added construction and operation requirements, as well as an analysis of the incremental impacts of construction and operation not previously addressed in the 2014 EA. Because the previously planned and reconfigured cryogenic plants, cooling tower, and other components would be within the same footprint as those described in the 2014 EA, DOE has determined that the potential environmental impacts of this change should be analyzed in this SA to determine if they are bounded by the previous EA. If the determination is made in this SA that the impacts analyzed in the existing EA bound those of the proposed changes, then the project may proceed. The SA will be made available to the public after the determination has been made. If it is found in the SA that the potential impacts are not bounded by the previous EA, then additional NEPA analysis and documentation will be required (DOE 2005).

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2.0 DESCRIPTION OF PROPOSED CRYOGEN PLANT RECONFIGURATION

SLAC would construct and operate two cryogenic plants at the western end of the SLAC property to provide cryogenic helium for the LCLS-II superconducting linear accelerator. The original plan described in the 2014 EA included a 4-kW cryogenic plant at Sector 4, and an approximately 1-kW plant at Sector 0-1 to provide additional capacity and backup during maintenance shutdowns. The reconfigured plan would include the original 4-kW plant and a second 4-kW plant within the same building at the same location.

Figure 2-1 shows the overall layout of the reconfigured cryogenic plants for LCLS-II, including the cryogenic plants at a single location. Rather than two separate cryogenic plant sites, the plants would both be constructed at Sector 4 within a single building. Therefore, both plants would be constructed within the topographical depression that exists at that location, minimizing views of the plants from surrounding areas. Both plants would be constructed as described for the primary plant in the 2014 EA, and both would be within a single, conventional steel-frame, corrugated metal building. The tallest structures would be approximately 40 feet above the elevation of the foundation, and the building would have a footprint of approximately 40,000 square feet. The smaller plant (described in the 2014 EA) would not be constructed. Both plants would require refrigeration units, storage tanks, cold boxes, and other equipment, as described previously.

The reconfigured plants would require additional cooling for the cryogenic plant compressors, and thus a new cooling tower. The original plan described in the 2014 EA was to use existing on-site cooling towers; however, the additional cooling required for the combined larger cryogenic plant capacity would require a new cooling tower at the cryogenic plant site. This requirement also would result in more water lost to evaporation in the cooling tower. The original plan described in the 2014 EA would have added 55,000 gallons to SLAC's daily water use for the larger plant and approximately 19,500 gallons for the smaller plant, for a total increase of approximately 74,500 gallons per day (an increase of approximately 38 percent in SLAC's current daily water usage of 200,000 gallons per day). For the reconfigured plant, the combined water use would be approximately 120,000 gallons per day (an incremental increase of 45,500 gallons per day). SLAC would offset this additional water consumption to the extent practicable by designing and operating the proposed action in a manner consistent with the SLAC Site Sustainability Plan.

Construction of the larger second plant would require an additional increment of truck trips to transport a larger volume of plant components as well as larger individual pre-fabricated plant components to the construction site, including tanks and the components for the cooling tower. Rather than a single substation/transformer, the reconfigured plant site would require two transformers. However, many aspects of the reconfiguration of the 2014 proposed action would be unchanged. Construction would not require additional workers and would not require substantially more or larger construction equipment or

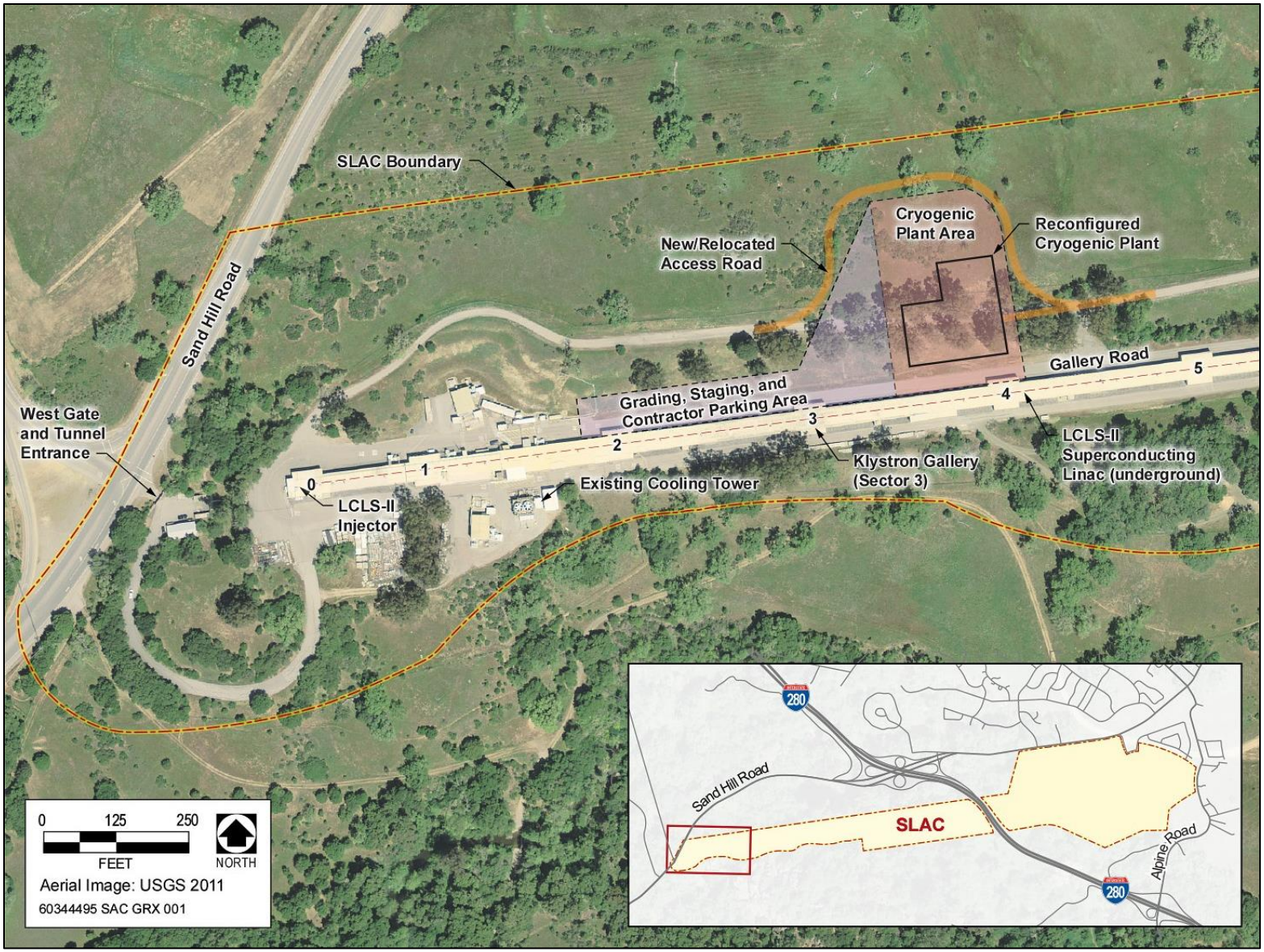

Figure 2-1 Reconfigured Proposed Action Layout

excavations because construction would be consolidated at one location. Furthermore, the planned 39-month construction schedule for the 2014 proposed action would not change. Moreover, construction would not require additional staging areas, site preparation, grading, paving, or landscaping because the two plants would be constructed side-by-side at the planned site of the primary cryogenic plant. Therefore, the planned reconfiguration also would not create additional impervious surface and would not require additional stormwater drainage. Construction would be subject to the same standard environmental protection measures and minimization and avoidance measures described in the 2014 EA to reduce or eliminate potential minor adverse construction and operational impacts from dust, greenhouse gas emissions, ground disturbance, potential minor spills, noise, and waste disposal.

As described in the 2014 EA, portions of the design and fabrication of the cryogen plant and cryomodules would be completed at other national laboratories, including Thomas Jefferson National Accelerator Facility, Lawrence Berkeley National Laboratory, Fermilab, and Argonne National Laboratory, and this aspect of the 2014 proposed action would not change. Delivery of the larger components for the second plant could add an additional increment of vehicle miles for delivery to SLAC. However, component delivery at SLAC would be the same as that described in the 2014 EA and would use the Alpine Road gate, the main entrance, and occasionally the west gate at Sand Hill Road and Whiskey Hill Road.

Similarly, the larger second cryogenic plant would not change the construction process for other components of the 2014 proposed action, including removal of existing equipment and utilities or installation of the superconducting linear accelerator within the Klystron Gallery and Linac tunnel. Furthermore, it would not change the work planned for other parts of the SLAC campus (east of Sector 11), which would include replacing undulators, modifying beam dumps, constructing a second beamline, constructing additional shielding to contain incrementally higher radiation generated by the beam, and other related changes.

Operation of the plants would be nearly identical to that described in the 2014 EA. The proposed reconfiguration would require three additional operations and maintenance workers. Also, the larger second plant would require an additional increment of power, water, and refrigerant (nitrogen deliveries). For example, the plan addressed in the 2014 EA described approximately three to four nitrogen deliveries per week for make-up volume. The reconfigured plants would require four to five deliveries per week. At decommissioning, the reconfigured cryogenic plants would generate an additional increment of equipment and utilities for recycling. However, the reconfigured plants would not generate any additional radioactive waste, which would occur only in areas exposed to the beam.

During operations, SLAC would comply with all the site's plans and environmental measures, described in the 2014 EA, including the site-wide Storm Water Pollution Prevention Plan (SWPPP) (SLAC 2007), SLAC's Site Sustainability Plan (SLAC 2013), Executive Orders 13423 and 13514, SLAC discharge permits, and SLAC's procedures for spill prevention, traffic control, health and safety, radiological safety, fire prevention, and waste management.

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3.0 SUPPLEMENT ANALYSIS

This section evaluates the potential environmental impacts of the proposed reconfiguration of the cryogenic plants in view of the environmental analysis conducted in the 2014 EA. It revisits the impact analysis that was completed for the 2014 EA, evaluates any potential impacts associated with the plant reconfiguration, and evaluates whether construction or operation of the reconfigured plants would result in new impacts not addressed in the 2014 EA. For any incremental impacts, this section evaluates whether those impacts would be addressed by the existing avoidance and minimization measures presented in the 2014 EA and if additional measures are needed. The following subsections (3.1 through 3.12) present the impact evaluations for air quality, biological and cultural resources, geology and soils, health and safety, hydrology and water quality, noise and vibration, socioeconomics and environmental justice, transportation, visual resources, waste management, and cumulative effects (including climate change). As with the 2014 EA, this document does not address land use because the reconfigured proposed action is within the boundaries of lands leased by DOE and would not require construction of off-site power, storm water, wastewater, or other utilities.

3.1 Air Quality

Reconfiguration of the cryogenic plants would have an incremental impact on air emissions. Construction and operation of the plants, including the second plant and new cooling tower, would require additional construction and would require an increase in electrical power during operation. This section addresses potential impacts on air quality from emissions of criteria air pollutants during construction and operation of the reconfigured proposed action. Because greenhouse gas (GHG) emissions would have potential cumulative effects only on global climate change, GHGs are addressed in Section 3.15, "Cumulative Effects."

Recalculations were made to estimate emissions of criteria pollutants from the proposed action with the reconfigured cryogenic plants and results were compared to the National Ambient Air Quality Standards (NAAQS) and State Ambient Air Quality Standards (SAAQS), where applicable. Area air quality currently is classified by the U.S. Environmental Protection Agency (EPA) as a non-attainment/marginal area for the 8-hour ozone standard and the new federal fine particle (particulate matter with a diameter of 2.5 microns or less [$PM_{2.5}$]) standard. For all other federal standards, the San Francisco Bay Area Air Basin (SFBAAB) is in attainment or unclassified. The SFBAAB currently is in non-attainment for both the 1-hour and 8-hour standards for ozone, particles with a diameter of 10 microns or less (PM_{10}), and $PM_{2.5}$ based on State standards. The 2014 EA contains the NAAQS and SAAQS for each criteria air pollutant and the current attainment designations for the SFBAAB (see Table 3-2 in the 2014 EA). Reconfiguration of the cryogenic plants would not affect the aspects of SLAC's operation that would comply with the National Emission Standards for Hazardous Air Pollutants (NESHAP) regulations, including radiation; therefore, these emissions are not addressed in this document.

The 2014 EA used CalEEMod to calculate emissions from all construction activities, including clearing and grubbing, excavation, installation of retaining walls, installation of subgrade utilities, preparation of foundation and pads, building construction, building finishing, and paving. **Table 3-1** shows the emissions calculated in the 2014 EA and lists the additional increment of emissions from constructing the larger, second cryogenic plant. These results are compared with the general conformity *de minimis* levels and SLAC's Synthetic Minor Operating Permit (SMOP) limits (BAAQMD 2013). Table 3-1 shows that emissions would not increase substantially and would be well below conformity levels and SMOP limits. Attachment A provides more detailed calculation spreadsheets.

Table 3-1 Proposed Action Construction Emissions from 2014 EA and Incremental Change with Reconfigured Cryogenic Plants

Construction Year	Annual Emissions (tons per year)			
	VOCs	NO_x	PM_{10}	$PM_{2.5}$
2016	0.86	10.5	1.17	0.78
2017	0.45	5.76	0.97	0.6
2018	0.25	2.28	0.84	0.48
Construction Emissions (2014 EA)	1.56	18.54	2.98	1.86
Revised Construction Emissions with Reconfigured Cryogenic Plants †	2.00	23.83	3.83	2.39
de minimis Levels	100	100	100	100
Overall SLAC Emissions*	12.8	19.5	<1	<1
SLAC's SMOP Limits	35	35	35	35
Exceed *de minimis* Levels or SMOP Limits?	No	No	No	No

Notes:
† Total cryogenic plant power capacity increase from 5 kW to 8 kW.
* Overall SLAC emissions do not include emissions from the proposed action.
Sources: 2014 EA and AECOM 2015 calculations

The incremental increase in construction emissions was estimated using the CalEEMod output from the 2014 EA, calculating a proportional increase in the size of building construction and including a safety factor of three for a reasonable worst-case incremental increase in construction emissions to cover the additional construction truck trips (five per week) and increased equipment and fuel that would be required to build a larger cryogenic plant and new cooling tower.

The 2014 EA also provided an estimate of operational emissions, including from energy consumption (for the injector, cryogenic plants, lighting, and equipment), water use, and vehicle trips for additional employees. The project also would consume water and natural gas for space heating. **Table 3-2** presents the estimated annual operations emissions for the 2014 EA and the incremental increase in emissions with the reconfigured cryogenic plants. The incremental increase was estimated using a method similar to that described above for construction and assumed that the added emissions would be related to the energy

Table 3-2 Proposed Action Operational Emissions from 2014 EA and Incremental Change with Reconfigured Cryogenic Plants

Emission Source	Annual Emissions (tons per year)			
	VOCs	NO_x	PM_{10}	$PM_{2.5}$
Area	0.305	0	0	0
Energy	0.004	0.034	0.003	0.003
Motor Vehicles	0.005	0.01	0.009	0.003
Operational Emissions (2014 EA)	0.314	0.044	0.012	0.006
Emissions from increased energy consumption from reconfigured cryogenic plants †	0.0064	0.0544	0.0048	0.0048
Emissions from increased motor vehicle trips	0.005	0.01	0.009	0.003
Revised Operational Emissions with Reconfigured Cryogenic Plants	0.33	0.11	0.03	0.01
de minimis Levels	100	100	100	100
Overall SLAC Emissions*	12.8	19.5	<1	<1
SLAC's SMOP Limits	35	35	35	35
Exceed *de minimis* Levels or SMOP Limits?	No	No	No	No

Notes:
† Total cryogenic plant power capacity increase from 5 kW to 8 kW.
* Overall SLAC emissions do not include emissions from the proposed action.
Sources: 2014 EA and AECOM 2015 calculations

required to operate the larger cryogenic plant capacity and new cooling tower. Because of the increase from 5 kW to 8 kW (a 60 percent increase in power), the emissions associated with energy consumption were increased by 60 percent. To account for additional maintenance worker commutes and helium/nitrogen deliveries, the estimated increase in emissions also assumed that motor vehicle emissions would double. Table 3-2 shows that with the increase in energy consumption and motor vehicles, SLAC's operational emissions still would be well below its SMOP limits and conformity levels for each pollutant.

3.2 Biological Resources

The areas directly adjacent to the cryogenic plant construction site consist of non-native annual grasses with several oak trees. San Francisquito Creek, Bear Creek, and unnamed tributaries are present in the area, and one intermittent stream is located approximately 500 feet to the east. The adjacent forested areas provide habitat for a variety of wildlife, including raptors (e.g., red-tailed hawk). California red-legged frog (CRLF), a federal-listed threatened species and a California species of concern, has been observed in downstream areas of San Francisquito Creek and a mile north of SLAC at Lawler Ranch Road; however, no known occurrences have been observed at SLAC. The mature oaks and snags adjacent to the project site may provide limited roosting habitat for special-status bats, as described in the 2014 EA.

Impacts from reconfiguration construction would be nearly identical to those described in the 2014 EA, would occur within the same footprint, and would not affect streams, wetlands, or the larger oaks in the adjacent grassland. Potential wildlife impacts would be minimized by installing an exclusion fence (silt fence) around the cryogenic plant site under a biologist's supervision, and by teaching construction workers about wildlife protection laws and procedures. The adjacent oaks may provide habitat for songbirds, raptors, and bats. However, as described in the 2014 EA, wildlife in the areas around the Klystron Gallery likely are adapted to human activity, and the larger trees that could provide bird and bat habitat would not be removed.

During reconfigured plant operation, the potential impacts would be nearly identical to those described in the 2014 EA. The larger second plant would result in an added increment of operational noise at Sector 4, but less noise at Sector 0-1 because the smaller plant would not be constructed. As described above, wildlife in the area is acclimated to human activity and existing SLAC operational activities. As described in the 2014 EA, some jurisdictions (e.g., County of San Diego) have adopted a 60 decibel (dB) threshold for special-status bird species (Bioacoustics Research Team 1997; AASHTO 2008). As described in the 2014 EA noise analysis (Section 3.7, "Noise and Vibration"), noise levels directly adjacent to the cryogenic plants (at a distance of 5 feet outside the cryogenic plant wall) would be approximately 61.5 to 64 dB. However, because both plants would be within a building, the addition of a second, equally sized noise source would increase operational noise levels by only 2 to 3 dB. Because of the noise attenuation that would be provided by soil berms, only the area immediately adjacent to the plants would exceed 60 dB, even with two cryogenic plants. Because most of the area around the plants is treeless, noise impacts on birds and wildlife would be minor. Moreover, the avoidance and minimization measures, including constructing a perimeter berm, identified in the 2014 EA would reduce impacts on biological resources and would minimize noise impacts on surrounding areas and any incremental effects associated with construction or operation of the reconfigured cryogenic plants would be minor.

3.3 Cultural Resources

The potential cultural resources impacts of the reconfigured cryogenic plants would be nearly identical to those described in the 2014 EA, because the 2014 proposed action footprint would be unchanged and the proposed grading and excavation needed to construct a level area for the plants and the perimeter berms would be nearly identical to the 2014 proposed action. The 2014 EA, in coordination with a Stanford University archaeologist, assessed the potential to encounter archaeological and paleontological resources, or to affect historic structures. A site reconnaissance and records review showed that most of the area around the Klystron Gallery was highly disturbed during construction of the Accelerator Housing, and that the proposed action would have no impact on known resources. Nevertheless, the 2014 EA requires development and implementation of an inadvertent discovery plan, consistent with procedures developed by Stanford University, to minimize impacts in the event of a discovery.

The 2014 EA also found that the reconfiguration changes to Building 001 (the Accelerator Housing) and Building 002 (the Klystron Gallery), which were constructed in 1964 and 1965, respectively, would be consistent with the designed use of those buildings and would have no impact. The only potential difference resulting from reconfiguring the cryogenic plants would be the potential for additional or larger utility trenches between the plants and the Klystron Gallery. However, any additional trenching for utilities for the second plant would occur in areas heavily disturbed during construction of the Accelerator Housing. Furthermore, any additional connections to the new superconducting linear accelerator at Sector 4 would be primarily underground and would have no impact on the historical integrity of structures greater than 50 years old, and the new cooling tower would be covered by a screen so that its form and color would be consistent with the nearby Klystron Gallery. During operation, no ground disturbance would take place, and thus no impact would occur.

3.4 Geology and Soils

The potential geology and soils impacts of the reconfigured cryogenic plants would be nearly identical to those described in the 2014 EA, because the proposed action footprint would be unchanged and the proposed grading and excavation needed to construct a level area for the plants and the perimeter berms would be nearly identical to the original 2014 plan. The only potential difference resulting from reconfiguring the cryogenic plants would be the potential for additional or larger utility trenches between the plants and the Klystron Gallery. However, any additional trenching for utilities for the second plant would occur in flat, paved areas, already heavily disturbed during construction of the Accelerator Housing, and therefore would not affect any points of geological interest, such as exposed bedrock, nor exacerbate landslide, liquefaction, or other seismic risks. Furthermore, any additional excavation would be within the originally planned footprint of the proposed action, and any potential erosion impacts would be addressed by the project's SWPPP. During operation, no ground disturbance would take place, and thus no impact would occur.

3.5 Health and Safety

Overall risks to human health and safety would not change substantially with reconfiguration of the cryogenic plants. Construction of the larger second plant would be completed with the same number of workers and over the same 39-month schedule described in the 2014 EA, and thus no additional increment of occupational injuries would occur. The increase in operational staffing of three maintenance workers would result in a potential incremental increase in industrial injuries. As described in **Table 3-3**, based on past occupational injury rates for SLAC, the reconfiguration could result in 0.8 recordable cases and 0.4 Days Away, Restricted, and Transfer (DART) cases. As described in the 2014 EA, occupational health would be addressed by SLAC's highly developed Integrated Safety and Environmental Management System (ISEMS) and Worker Safety and Health Program (WSHP).

Table 3-3. Proposed Action Potential Workplace Injuries from 2014 EA and Incremental Change with Reconfigured Cryogenic Plants

Health and Safety Evaluation	Added Full-time Operational Staff	Worker Hours over 20 Years of Operation	Total Recordable	DART cases
2014 EA	6	240,000	1.6	0.8
Reconfigured Cryogenic Plants	3	120,000	0.8	0.4
Note: Based on SLAC Total Recordable Cases (TRC) of 1.4 and Days Away, Restricted, or Transferred (DART) of 0.7 for 2013				

Because the reconfigured cryogenic plants would not use radioactive materials during construction and would have no effect on operation of the superconducting linear accelerator or the number or type of experiments, this change would have no incremental impact on construction or operation worker or public radiation exposure. Shielding and other protective measures described in the 2014 EA would remain. Furthermore, the reconfigured plants would not increase the probability of a non-routine accident (e.g., fire, structural failure, beamline mis-direction) or malevolent act, and as described in the 2014 EA, these types of events would be addressed by SLAC's existing safety and response programs.

Reconfiguration of the cryogenic plants could result in an incremental increase in human health and safety because of the larger overall volume of cryogens at the plant site and the increased frequency of liquid helium and liquid nitrogen deliveries. To assess these risks, the 2014 EA evaluated reasonable worst-case cryogen scenarios using EPA's Areal Locations of Hazardous Atmospheres (ALOHA) air dispersion model. For helium, the EA evaluated potential exposure risks from a release of the entire helium inventory (4,200 gallons) within 2 minutes from a pipeline system rupture. For liquid nitrogen, it evaluated a spill at the delivery dock by a truck delivering refrigerant make-up volume through a 4-inch-diameter hose and a spill rate of 120 gallons per minute.

For the helium release modeled in the 2014 EA, serious human health effects were limited to a distance of 36 feet of the spill, with less serious, reversible effects (e.g., eye or skin irritation) within approximately 154 feet. With the reconfigured cryogen plants, the overall inventory of helium would increase from 4,200 gallons to approximately 6,800 gallons. The reconfigured plants would operate as two separate units; however, as a reasonable worst-case scenario, the evaluation assumed an accident scenario where the helium inventory from both plants would be released. The release was evaluated using ALOHA (see Attachment B), which showed that the serious health effects from a spill of this larger volume would be limited to a distance of approximately 33 to 36 feet, and less serious effects within approximately 137 feet. These distances are not substantially different from the modeling results in the 2014 EA and show that the effects of a helium spill would not be sensitive to the released volume. This result is consistent with the properties of helium, which has a very low molecular weight, rises very quickly, and is quickly diluted in the atmosphere. Therefore, because of the remote location of the cryogenic plant site and the small number of workers involved in operation and maintenance, such a spill would be unlikely to affect

additional workers. Furthermore, SLAC workers have extensive experience with cryogens and manage SLAC's existing inventories of liquid nitrogen, helium, and carbon dioxide, and no further protective measures are required beyond SLAC's existing engineering and facility designs, applicable codes and standards, and cryogen-related standard operating procedure.

For the liquid nitrogen delivery and spill scenario, no change in nitrogen air concentrations would occur because nitrogen deliveries would be conducted in the same way as described in the 2014 EA, and the modeled air concentrations were below the EPA model criteria. The only incremental change would be that nitrogen deliveries could be required more often to maintain the liquid nitrogen supply for the two larger plants. However, as described above for liquid helium, each delivery would be covered by SLAC's cryogen-related standard operating procedure, facility designs, and building codes, and this incremental effect would be inconsequential.

3.6 Hydrology and Water Quality

Potential environmental impacts on hydrology and water quality would be nearly identical as those described in the 2014 EA for the original cryogenic plant layout. As described in Section 2, "Description of Proposed Cryogen Plant Configuration," both cryogen plants, and supporting equipment such as the cooling tower, would be constructed within the original footprint at Sector 4. Therefore, the volume of runoff and the peak rate of runoff from the cryogen plant site would be only slightly larger from that described in the 2014 EA, and no incremental effect on San Francisquito Creek, Bear Creek, or their tributaries would occur. In fact, because SLAC would not construct the 1-kW cryogenic plant at Sector 0-1, the new impervious areas associated with the cryogenic plants may be lower than that shown in the 2014 EA.

For the same reasons, potential impacts on water quality would not change substantially from those described in the 2014 EA. Stormwater runoff during construction would be addressed by a project-specific stormwater permit and SWPPP, and SLAC would comply with a site-wide stormwater discharge permit issued by the State Water Resources Control Board. The number of truck deliveries would increase because of the larger second cryogenic plant and new cooling tower; however, those impacts would be addressed by stormwater best management practices and would not contribute substantially to impacts on downstream water quality. The reconfigured plants would have no incremental impacts on groundwater and would cause no change in the accelerator's power, and thus no change would occur in the potential for formation of radionuclides in soil or groundwater.

Overall, any incremental effects associated with construction or operation of the proposed action with reconfiguration of the cryogenic plants and added cooling tower would be addressed by compliance with existing regulations and policies as well as planned, project-specific minimization measures. Those measures, identified in the 2014 EA, would include implementing stormwater best management practices and adhering to spill prevention control measures for construction equipment.

The reconfigured plants would require additional cooling and a new cooling tower would result in an added increment of water use (45,500 gallons per day) from evaporation. SLAC would offset this additional water consumption to the extent practicable by designing and operating the proposed action in a manner consistent with the SLAC Site Sustainability Plan. In addition, the entire Stanford University campus, including SLAC, is conserving water by reducing landscape irrigation and overall potable water use, with a goal of reducing potable water use to 25 percent below 2013 levels. Other campus-wide measures include repairing plumbing leaks and converting lawns to water-efficient landscaping. Stanford's Water Conservation program has reduced domestic water use by over 21 percent to approximately 2.1 million gallons per day (Stanford University 2015). While the proposed action would increase water use by approximately 2 percent, the trend in Stanford's overall water use is downward, and the increased water consumption from the new cooling tower would be offset by continued water conservation and sustainability programs.

3.7 Noise and Vibration

Reconfiguring the cryogenic plants would have the potential to change the noise impact of the proposed action by adding a second 4-kW plant at Sector 4 while eliminating the 1-kW plant at Sector 0-1, which is closer to the site boundary and residences that are located approximately 2,000 feet to the west. Therefore, potential noise impacts of this change were re-evaluated using data from the 2014 EA and spreadsheet calculations.

This re-evaluation focused on the nearest receptors only for several reasons. The 2014 EA showed that the only potential noise receptors who could perceive noise from the proposed action were the closest residences west of Sand Hill Road in Woodside. Furthermore, the proposed action would be located in an isolated area on the western end of the SLAC campus, and the previous noise evaluation in the 2014 EA showed that any receptors at SLAC (more than a mile to the east) or in residential or commercial areas to the north, east, or south of SLAC would not be affected. Therefore, this analysis evaluated potential impacts only on the nearest receptors (approximately 2,000 feet west of Sector 4) while accounting for ambient noise as measured for the 2014 EA, including the noise from Sand Hill Road and Whiskey Hill Road.

Ambient noise is a substantial factor at the west end of SLAC and ranges from 55.7 to 58.4 A-weighted decibels (dBA) equivalent continuous noise level (L_{eq}) during the day (7 a.m. to 10 p.m.) and from 47.7 to 50.6 dBA L_{eq} at night (10 p.m. to 7 a.m.). The higher daytime noise levels can be attributed to Sand Hill Road and Whiskey Hill Road traffic. The town of Woodside does not have a noise ordinance; however, the town has set an objective of 55 dBA (day-night averaged sound level [L_{dn}]) in the daytime and 40 dBA (L_{dn}) at night. Therefore, existing noise levels exceed the town's goals.

To estimate potential changes in construction noise levels, calculated operational noise levels from LCLS-II were used to estimate off-site noise levels at the nearest residences to the west. The noise levels for construction account for construction equipment that emits noise between 73 and 85 dBA at 50 feet at

Sector 4 (and removal of the source at Sector 0-1). Because the new 4-kW plant would be located farther away - approximately 1,000 feet from the nearest receptors on Manzanita Way - construction noise levels would be decreased by approximately 5 dB. Thus, the noise increase above ambient noise levels would be lower than the original plant configuration that was evaluated in the 2014 EA.

To estimate potential changes in operational noise levels, the calculated operational noise levels from LCLS-II were used to estimate off-site noise levels at Manzanita Road by accounting for the addition of the second 4-kW plant and elimination of the 1-kW plant. In the 2014 EA, the calculated operational noise levels from LCLS-II at the nearest residential receptors were predicted to range from 13.0 to 44.5 dBA L_{eq}. It was conservatively assumed that adding the second 4-kW plant would generate the same noise levels of 13.0 to 44.5 dB at the nearest residential receptors and that this increase would account for the added cooling tower. Noise from the cooling tower would be minimized by screening from the adjacent building and by including noise considerations when selecting equipment during final design and procurement. Therefore, the operational noise level would be 16.0 to 47.5 dB, because doubling the noise source would add only 3 dB. Operational noise would increase slightly, from approximately 44.5 to approximately 47.5 dBA L_{eq}. Thus, the noise increase above ambient noise levels would be higher than the original plant configuration evaluated in the 2014 EA. However, this increase would be 3 dB at the nearest receptors. After accounting for ambient noise, which varies from 46.2 to 67.5 dBA L_{eq}, this small increase likely would not be noticeable to most receptors. Nevertheless, as described in the 2014 EA, options to minimize noise effects, such as selecting quiet equipment or adding enclosures or sound barriers, would be evaluated during final design.

The 2014 EA estimated construction vibration at the nearest receptors to be approximately 52.6 VdB, which would be substantially below perceptibility according to Federal Transit Administration guidelines; the guidelines state that a vibration level of 65 VdB is the threshold of perceptibility for humans (FTA 1995). Therefore, DOE determined that because of the distance to the construction area, construction would not result in vibration at the nearest receptors, and no further evaluation of vibration is required.

3.8 Socioeconomics and Environmental Justice

The 2014 EA described the existing population, ethnicity, employment, income, housing, and the local economy near SLAC and evaluated the potential socioeconomic and environmental justice impacts of the proposed action, including the potential for adverse human health or environmental impacts that could disproportionately affect a minority or low-income population. The analysis showed that the area around SLAC is less diverse than the surrounding area, and that the area is relatively affluent in terms of income, home prices, and employment opportunities, with no identified low-income populations in the area.

In this setting, the small increment of additional workers and expenditures required to increase the size of the second cryogenic plant would have no impact on employment and would not require in-migration of workers that would affect the population or housing market. Because the proposed action's estimated cost would increase from approximately $895 million to $1035 million, the larger second plant and added

cooling tower and other equipment could result in an incremental increase in beneficial economic impacts on the local economy and construction industry, as well as on other areas where components would be fabricated. Any changes in operational impacts would be inconsequential and would be related only to a small increase in employment for meeting maintenance requirements and from a marginally higher expenditure for the added increment of liquid helium and nitrogen to supply the superconducting accelerator with cryogen.

Neither project construction nor operation would result in incremental impacts on environmental justice because the environmental impacts of the proposed action change would be minor, and no low income populations or minority populations would be affected disproportionately.

3.9 Transportation

Reconfiguration of the cryogenic plants would result in incremental construction traffic impacts, from increasing daily truck traffic from 20 to 25 trucks. No additional construction workers would be necessary. Thus, the total number of trips per day would increase from 60 to 65, with the peak worker population (40) plus truck traffic. As described in the 2014 EA, traffic on local roads (i.e., Sand Hill Road and Alpine Road) ranges from approximately 14,000 to 19,000 trips per day. Under the original plan, no road would experience an annual average daily traffic (AADT) increase of greater than 0.5 percent. At 65 trips per day, the percent increase in daily traffic would be negligible, and little or no impact on public travel would occur.

Likewise, any increase in traffic accidents involving construction-related vehicles would be very low. In the 2014 EA, based on California statistics (CHP 2014), the calculated number of potential project traffic injuries was 0.5 and the number of traffic fatalities was close to zero. Because the reconfigured plants and cooling tower would require only five additional trucks per day (250 miles driven, based on the distance to San Jose), the incremental increase in accidents would be negligible.

For project operation, the reconfiguration would add three workers but not researchers, and would increase nitrogen deliveries by approximately one per day. Based on the area traffic numbers described above and in the 2014 EA, and the low number of miles that would be driven for one additional delivery per day and three workers, DOE has determined that the related traffic and potential injury impacts would be negligible, and no additional quantitative analysis is required.

3.10 Visual Resources

Reconfiguration of the cryogenic plants and added cooling tower would have the potential to affect the existing visual setting by constructing two 4-kW plants at Sector 4. SLAC facilities have been present in the area since the 1960s and generally are screened from view by the area's rolling hills. The affected area would be Sand Hill Road west of Interstate 280 (I-280) as well as the section of I-280 near the crossing of

the Klystron Gallery with views to the west and Sector 4. Because the incremental increase in truck traffic would be limited to transporting components for the larger second plant, this analysis assumes that any visual impact of additional haul trucks would be inconsequential, and this section focuses on the potential visual impacts of the reconfigured cryogenic plants on off-site areas. It does not address other aspects that would not change with the reconfigured plants, such as tree removal, the staging areas, and the day-to-day construction schedule.

As described in the 2014 EA, the cryogenic plant site is located in a topographical depression north of Sector 4, inherently limiting views of construction and the completed plants from distant viewing points. Any incremental visual impacts of the cryogenic plant building at Sector 4 would be limited for the following reasons. As described in the 2014 EA, views of the area are obscured by the intervening landscape. Construction of the tallest structures may be visible from the surrounding hills and from I-280; however, views from the surrounding hills would occur from a distance of over a mile, and motorist views from I-280 would be very brief because they would occur at highway speeds. At such a distance (or distance and speed for motorists), it may be difficult to discern the construction area. Furthermore, the construction site would be screened by the intervening topography, including the hill located directly to the west.

Views of the completed cryogenic plants would be similar to those described above for construction and would consist of very brief views for passing motorists and from distant vantage points. No impact would occur from the previously proposed 1-kW plant because it would not be constructed. The tallest structures for both 4-kW plants would be approximately 40 feet high. The new cooling tower would generate a steam plume when operating; however, like the plumes from other SLAC cooling towers, the steam would dissipate rapidly at low elevations.

SLAC would use several design measures to minimize views of the cryogenic plants. In addition to screening from topography, and as described in the 2014 EA, SLAC would use excavated soils to construct a soil berm around the plant site. SLAC also would construct the plant site foundation below the existing grade, which would enhance the screening effect of the berm, and SLAC also would plant trees and shrubs to obscure views. The new cooling tower would be covered by a screen such that its pattern and color would match the adjacent Klystron Gallery. The tallest structures may be visible briefly for passing motorists on Sand Hill Road and from the surrounding hills, but only from a distance of approximately a mile. These same structures also may be visible to motorists on I-280; however, any view would be extremely brief when traveling at highway speeds. Attachment C provides a view of the cryogenic plant building looking west from Sand Hill Road. This view could be considered the worst case because it does not include the new plantings adjacent to the plant that would screen views.

Similarly, nighttime views would be affected by an increment of additional lighting at Sector 4 for the larger cryogenic plant building; however, lighting also would be incrementally reduced because the 1-kW plant would not be constructed. As described in the 2014 EA, all lighting would be directed downward to

minimize lighting effects and would be consistent with the existing lighting that SLAC provides for the Klystron Gallery and adjacent driveways.

Overall, the visual impacts of the reconfigured cryogenic plants, cooling tower, and supporting equipment would be limited and would be minimized by constructing the foundation at Sector 4 at a lower elevation than the existing topography, not constructing the 1-kW plant at Sector 0-1, using excavated soils to construct a berm around the plants, preserving existing trees and other vegetation, planting new trees on ridge tops to obscure views, and designing the plants to reduce their visibility (e.g., layout, colors). In addition, as described in the 2014 EA, the buildings' appearance would be consistent with the existing, long-term presence of SLAC's experimental facilities and associated buildings. Therefore, the incremental visual impact of the reconfigured cryogenic plants would be low, with only minor differences from the impacts analyzed in the 2014 EA.

3.11 Waste Management

The waste management impacts of the reconfigured cryogenic plants would be nearly identical to those described in the 2014 EA. Construction would generate the same volume of excavated soils, which would be tested for contaminants and then would be used on-site for berm construction, relocated to another area at SLAC, or disposed at a Class II landfill. Construction of the larger second plant would generate a minor additional increment of construction wastes (e.g., waste paint, fuels, rags) and an additional increment of solid waste, such as packaging, which would be handled by existing SLAC waste management programs and would be recycled to the extent practicable.

The reconfigured cryogenic plants would have no impact on other aspects of construction or operation and would not result in additional radioactive wastes. Any additional increment of waste generation at the fabrication sites would be managed at those locations. Similarly, any additional increment of wastes generated for operation of the larger second cryogenic plant and added cooling tower would be addressed by existing regulations and SLAC's existing policies and programs for safe handling, storage, and transport of these hazardous materials, as described in detail in the 2014 EA.

3.12 Cumulative Effects

The cumulative impact analysis for reconfiguration of the cryogenic plants presented next revisits and augments the cumulative impact analysis presented in the 2014 EA, but it focuses only on the changes related to the altered layout of the cryogenic plants and the additional refrigeration capacity. It evaluates the potential incremental cumulative effects of the reconfigured cryogenic plants and added cooling tower in view of other projects at SLAC and in the surrounding area based on the list of projects presented in the 2014 EA. The No Action alternative, unchanged from the previous analysis in the 2014 EA, has not been re-evaluated.

3.12.1 Air Quality

The minor incremental effect of the reconfigured cryogenic plants on air emissions would have an inconsequential cumulative impact on air quality. The reasonable worst-case incremental emissions increases described in Section 3.1, "Air Quality" (see Tables 3-1 and 3-2), would not conflict with the State Implementation Plan or exceed SLAC's SMOP limits.

In addition to LCLS-II, several other sources of emissions in the region (San Mateo County) would contribute to the overall regional emission inventory. **Table 3-**Error! Reference source not found.**4** shows he construction and operational emissions for the proposed action in view of the most recent data for regional emissions, which include SLAC emissions. The summary table shows that the increased emissions at SLAC would be a small percentage of the regional emissions. Therefore, the addition of the second cryogenic plant and added cooling tower would have a minor contribution to regional air quality impacts and any incremental effects on air quality would be negligible.

Table 3-4 Regional Annual Emissions for 2014 EA and Reconfigured Cryogenic Plants

Source	Annual Emissions			
	VOCs (tons/year)	**NO_x (tons/year)**	**PM_{10} (tons/year)**	**$PM_{2.5}$ (tons/year)**
Proposed Action – Reconfigured (Construction*)	1.11	13.5	1.50	1.00
Proposed Action – Reconfigured (Operation)	0.32	0.06	0.01	0.01
Regional Emissions (San Mateo County**)	9,567	17,202	3,789	1,497
Percent of Proposed Action Emissions to Regional Emissions*	0.01%	0.08%	0.04%	0.07%

Notes:

* Estimates for worst case year of construction.

** Daily emissions converted to annual estimates assuming 365 days/year of emissions. Regional emissions from San Mateo County include SLAC.

This EA SA also includes an evaluation of the potential incremental increase in greenhouse gas (GHG) emissions. The evaluation was conducted according to the Council on Environmental Quality's (CEQ) new December 2014 draft guidance (CEQ 2014) for evaluating the effects of GHG and climate change under NEPA. The guidance recommends evaluating the direct, indirect, and cumulative effects of GHG emissions (particularly for projects with high emissions and a long lifespan) and the implications of climate change for the environmental effects of the proposed action. To help federal agencies determine when to quantify GHG emissions in NEPA evaluations, CEQ provided a reference point of 25,000 metric tons of GHG emissions per year (MTCO2e/year).

In the 2014 EA, construction GHG emissions were substantially below the CEQ reference point. Using the CalEEMod results from the 2014 EA and increasing the emissions attributed to building construction to account for the larger cryogenic plant building, added cooling tower, and supporting equipment, **Table 3-5** shows that annual GHG emissions would still be well below the reference point and no further evaluation is warranted.

Table 3-5 Proposed Action Construction GHG Emissions for 2014 EA and Reconfigured Cryogenic Plants

Construction Year	2014 Environmental Assessment Annual Emissions (MTCO2e/year)	Annual Emissions for Reconfigured Cryogenic Plants (MTCO2e/year)
2016	891	1,146
2017	455	585
2018	228	293
Threshold	25,000	25,000

Note:
MTCO2e = metric ton carbon dioxide equivalent
Sources: 2014 EA and AECOM 2015 calculations

In addition, the direct (e.g., vehicles) and indirect (energy consumption) incremental increases of GHG during operations were evaluated. **Table 3-6** shows that the direct and indirect GHG emissions for the original plan would be below the CEQ reference point of 25,000 $MTCO_2e$. However, the energy required for the reconfigured cryogenic plants and supporting equipment would push the annual indirect GHG emissions (approximately 32,209 $MTCO_2e$/year) above the CEQ reference point and therefore additional evaluation of these emissions is presented below.

Table 3-6 Estimated Proposed Action Operational GHG Emissions for 2014 EA and Reconfigured Cryogenic Plants

Source	Annual Emissions ($MTCO_2e$/year)		
	Original Project	**Reconfigured Proposed Action**	**CEQ Reference Point**
Direct			
Natural Gas	38	60.8	
Motor Vehicles	9.2	9.2	
Total Direct	47	70	25,000
Indirect			
Electricity	17,324	27,718	
Water Use	3,034	4,490	
Waste Generation	0.35	0.35	
Total Indirect	**20,358**	**32,209**	**25,000**

Note: $MTCO_2e$ = metric ton carbon dioxide equivalent; N/A = not applicable
Sources: 2014 EA and AECOM 2015 calculations

The reconfigured proposed action with operation of the superconducting linear accelerator, cryogenic plants, cooling tower, and other supporting equipment, would be inherently energy intensive. The additional required energy for operation of the proposed action with the reconfigured cryogenic plants would increase GHG emissions from approximately 20,358 to approximately 32,209 $MTCO_2e$/year (see Table 3-6). Thus the proposed action's impacts would include GHG emissions during construction as well as from 20 years of operation. Together, these emissions would have a potential incremental impact on climate change.

Federal, state, local governments are working to reduce GHG emissions and impacts from climate change. The federal government has taken a number of steps to reduce GHG emissions, conserve energy, reduce demand, and promote development of renewable energy sources and technologies. These steps apply to DOE and all other branches of the federal government. Executive Order (EO) 13423, Strengthening Federal Environmental, Energy, and Transportation Management, dated January 24, 2007 (EPA 2010), sets goals in the areas of energy efficiency, acquisition, renewable energy, toxics reductions, recycling, renewable energy, sustainable buildings, electronics stewardships, fleets, and water conservation. EO 13514, Federal Leadership in Environmental, Energy, and Economic Performance, signed on October 5, 2009, specifically addresses agency GHG reduction targets, reductions in petroleum, potable water, watering of landscaping, solid waste, construction and demolition debris, and other targets. EO 13693 "Departmental Sustainability," issued on March 19, 2015, extends the GHG reduction goals through the year 2025. By implementing these EOs, the federal government as a whole has reduced GHG emissions.

Pursuant to these EOs, DOE developed GHG reduction goals and DOE's national laboratories have prepared sustainability plans. Specifically, SLAC prepares and implements an annual Site Sustainability Plan (SLAC 2013) to meet those goals. Consistent with DOE's goals, SLAC plans to continue purchasing renewable energy certificates, replacing aging equipment with highly efficient equipment, constructing energy-efficient buildings, and reducing emissions from worker commutes. Overall, through the National Laboratory Impact Initiative (DOE 2015), DOE's national laboratories, such as the National Renewable Energy Laboratory, are working to develop energy-efficient technologies for use in the private sector. Thus the federal government, DOE, the national laboratories, and SLAC, are working to roll back GHG emissions from a wide range of activities. Although the proposed action would be energy intensive, it would be consistent with these EOs and its construction and operation would comply with SLAC's Site Sustainability Plan (SLAC 2013).

The indirect impacts of LCLS-II GHG emissions are potential advancements in basic science in the fields of materials, medicine, and energy. As described by DOE's Basic Energy Sciences Advisory Committee (BESAC) in "Directing Matter and Energy: Five Challenges for Science and the Imagination" (DOE 2007), a goal of LCLS-II would be advancements in control of materials processes, chemical reactions, and energy conversion. Advancements in energy could lead to more efficient renewable energy technologies.

The proposed action's cumulative effects, as described in the 2014 CEQ draft NEPA guidance, could include effects associated with climate change such as sea level rise, reduced water availability,

ecological changes, more severe wildfires, and more heavy downpours and flooding, among others. However, the proposed action would emit a negligible amount of GHGs and would have minimal effects on climate change.

3.12.2 Biological, Cultural, and Geological Resources

In conjunction with other projects, reconfiguration of the cryogenic plants would have no incremental impacts on removal of vegetation or other direct impacts on wetlands, cultural resources, or geological formations or soils. The footprint of the reconfigured cryogenic plant construction would be the same as that described in the 2014 EA, and the smaller plant at Sector 0-1 would not be constructed; therefore, any incremental addition to cumulative effects on these resources habitats would be negligible. Minor additional excavations for utilities would be within areas heavily disturbed by construction of the Accelerator Housing in the 1960s. Therefore, because the reconfigured plants would have no incremental impacts on previously undisturbed areas, no incremental cumulative impact would occur.

3.12.3 Hydrology and Water Quality

Reconfiguration of the cryogenic plants would have a negligible contribution to cumulative hydrologic or water quality impacts. This change would not increase the footprint of the proposed action, and eliminating the smaller plant at Sector 0-1 could reduce the overall footprint, amount of added impervious surface, and potential for increased runoff or related water quality issues. Any increased pollutants resulting from additional workers and truck deliveries or additional operation and maintenance activity would be offset by SLAC's compliance with stormwater regulations and the implementation of site-wide and project-specific SWPPPs. Thus, any incremental effect on water quality would not contribute substantially to cumulative effects on hydrology or water quality in adjacent waterways, which are addressed at the regional level as described in the 2014 EA (i.e., by the Santa Clara Valley Urban Runoff Pollution Prevention Plan, and by San Mateo County).

3.12.4 Noise

Construction and operation of the reconfigured cryogenic plants would result in an additional increment of noise at Sector 4. However, other SLAC projects would be located approximately 2 miles away, and no other projects with noise would overlap. Therefore, no cumulative impact would occur.

3.12.5 Traffic

The 2014 EA identified the potential for minor, short-term (construction-related) cumulative traffic impacts on Alpine Road from workers and transport of demolition debris and deliveries. However, as described above, reconfiguring the cryogenic plants would have a negligible contribution to traffic and an even smaller contribution to cumulative impacts.

3.12.6 Visual Resources

Reconfiguration of the cryogenic plants would be visible only from limited vantage points, including brief views by passing motorists of the surrounding hills, but only from a distance of approximately a mile. Because the only other SLAC facility in the area is the Klystron Gallery, and because no other projects at SLAC, Stanford University, or the surrounding area would be visible from these areas, reconfiguration of the cryogenic plants would have no cumulative visual impact.

3.12.7 Waste Management

The reconfigured cryogenic plants would have only a minor incremental effect on the generation of construction and operational waste that would be addressed by site plans and policies, including requirements for reduction and recycling in the SLAC Site Sustainability Plan (SLAC 2013). Therefore, the reconfigured action would have only a minor effect on waste generation. Other projects also would produce solid waste, including excavated material and construction and demolition wastes. However, in compliance with State and local regulations as well as federal EOs, much of this material would be reused or recycled, reducing its effects on waste management. Considered together with these projects, no cumulative impact would occur.

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4.0 SUMMARY AND CONCLUSION

DOE has conducted this Supplement Analysis to determine if the analyses in the 2014 EA bound the potential impacts from changes in the project. This includes evaluating the potential environmental effects of reconfiguring the cryogenic plants for LCLS-II, including construction of two 4-kW plants and a new cooling tower and other supporting equipment at Sector 4, and eliminating the proposed smaller plant at Sector 0-1. LCLS-II was subject to NEPA review in 2014, and DOE published an EA and FONSI. However, because SLAC developed additional detail regarding refrigeration needs for operation of the proposed action's superconducting linear accelerator, DOE has prepared this Supplement Analysis to support a decision regarding whether further environmental analysis and documentation are required under NEPA.

For all resource areas, the reconfigured action would result in very similar impacts compared with the previous plan that was evaluated in the 2014 EA. The reconfigured cryogenic plants would be constructed within the same footprint as described in the 2014 EA. The reconfiguration would not result in new impacts, and any minor additional incremental impacts would be offset by the contravening effects of eliminating the smaller cryogenic plant at Sector 0-1, implementing the project-specific avoidance and minimization measures described in the 2014 EA, designing the reconfigured facilities to have a similar form and color as the adjacent Klystron Gallery, and by multi-agency efforts to reduce GHG emissions. Therefore, DOE has determined that the potential impacts from proposed changes in the LCLS-II project are bounded by the 2014 EA and no further NEPA analysis and documentation is needed.

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The following table lists the individuals responsible for preparing this EA SA. The SA was prepared for DOE and SLAC through a contract with AECOM.

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ATTACHMENT A: Air Emissions Calculations

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Proposed Action Construction Emissions for 2014 EA and Incremental Change with Reconfigured Cryogenic Plants				
Construction Year	**Annual Emissions (tons per year)**			
	VOCs	**NO_x**	**PM_{10}**	**$PM_{2.5}$**
2016	0.86	10.5	1.17	0.78
2017	0.45	5.76	0.97	0.6
2018	0.25	2.28	0.84	0.48
Construction Emissions (2014 EA)	1.56	18.54	2.98	1.86
Emissions attributed to Cryogenic Plant Construction (one seventh)	0.22	2.64	0.42	0.26
Remaining Project Portion	1.33	15.89	2.55	1.59
Incremental Emissions Attributed to Reconfigured Cryogenic Plants (3x)	0.66	7.944	1.27	0.79
Revised Construction Emissions with Reconfigured Cryogenic Plants †	2.00	23.83	3.83	2.39
de minimis Levels	100	100	100	100
Overall SLAC Emissions*	12.8	19.5	<1	<1
SLAC's SMOP Limits	35	35	35	35
Exceed *de minimis* Levels or SMOP Limits? No No	No	No	No	No

Note:

† Total cryogenic plant power capacity increase from 5kW to 8 kW

* Overall SLAC emissions do not include emissions from the Proposed Action.

Source: 2014 EA and AECOM 2015 Calculations

Proposed Action Operational Emissions for 2014 EA and Incremental Change with Reconfigured Cryogenic Plants				
Emission Source	**Annual Emissions (tons per year)**			
	VOCs	**NO_x**	**PM_{10}**	**$PM_{2.5}$**
Area	0.305	0	0	0
Energy	0.004	0.034	0.003	0.003
Motor Vehicles	0.005	0.01	0.009	0.003
Operational Emissions (2014 EA)	0.314	0.044	0.012	0.006
Emissions from increased energy consumption from reconfigured cryogenic plants †	0.0064	0.0544	0.0048	0.0048
Emissions from increased motor vehicle trips	0.005	0.01	0.009	0.003
Revised Operational Emissions with Reconfigured Cryogenic Plants	0.33	0.11	0.03	0.01
de minimis Levels	100	100	100	100
Overall SLAC Emissions*	12.8	19.5	<1	<1
SLAC's SMOP Limits	35	35	35	35
Exceed *de minimis* Levels or SMOP Limits? No	No	No	No	No

Note:
† Total Cryogenic plant power capacity increase from 5kW to 8 kW
* Overall SLAC emissions do not include emissions from the Proposed Action.
Source: 2014 EA and AECOM 2015 Calculations

ATTACHMENT B: Aloha Modeling Results

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SITE DATA:
  Location: PALO ALTO, CALIFORNIA
  Building Air Exchanges Per Hour: 0.20 (unsheltered single storied)
  Time: July 14, 2015  1543 hours PDT (using computer's clock)

CHEMICAL DATA:
  Chemical Name: HYDROGEN                 Molecular Weight: 2.02 g/mol
  PAC-1: 65000 ppm   PAC-2: 230000 ppm    PAC-3: 400000 ppm
  LEL: 40000 ppm     UEL: 750000 ppm
  Ambient Boiling Point: -252.8° C
  Vapor Pressure at Ambient Temperature: greater than 1 atm
  Ambient Saturation Concentration: 1,000,000 ppm or 100.0%

ATMOSPHERIC DATA: (MANUAL INPUT OF DATA)
  Wind: 1 meters/second from N at 3 meters
  Ground Roughness: 10 centimeters        Cloud Cover: 0 tenths
  Air Temperature: 20° C
  Stability Class: F (user override)
  No Inversion Height                     Relative Humidity: 50%

SOURCE STRENGTH:
  Leak from hole in horizontal cylindrical tank
  Flammable chemical escaping from tank (not burning)
  Tank Diameter: 9 feet                   Tank Length: 14.3 feet
  Tank Volume: 6816 gallons
  Tank contains liquid                    Internal Temperature: -254° C
  Chemical Mass in Tank: 2.05 tons        Tank is 100% full
  Circular Opening Diameter: 12 inches
  Opening is 0 feet from tank bottom
  Ground Type: Concrete
  Ground Temperature: equal to ambient
  Max Puddle Diameter: Unknown
  Release Duration: 2 minutes
  Max Average Sustained Release Rate: 1,020 kilograms/min
     (averaged over a minute or more)
  Total Amount Released: 1,858 kilograms
  Note: The chemical escaped as a liquid and formed an evaporating puddle.
  The puddle spread to a diameter of 17.5 meters.

THREAT ZONE:
  Model Run: Heavy Gas
  Red   : less than 10 meters(10.9 yards) --- (400000 ppm = PAC-3)
  Note: Threat zone was not drawn because effects of near-field patchiness
    make dispersion predictions less reliable for short distances.
  Orange: 11 meters --- (230000 ppm = PAC-2)
  Note: Threat zone was not drawn because effects of near-field patchiness
    make dispersion predictions less reliable for short distances.
  Yellow: 42 meters --- (65000 ppm = PAC-1)
  Note: Threat zone was not drawn because effects of near-field patchiness
    make dispersion predictions less reliable for short distances.

THREAT AT POINT:
  Concentration Estimates at the point:
  Downwind: 8 meters                      Off Centerline: 0 meters
  Max Concentration:
     Outdoor: 464,000 ppm
     Indoor:  3,000 ppm
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ATTACHMENT C: SLAC Visual Simulation

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LOS 2: Sand Hill Road – Proposed Building

SLAC HDR

Note that views of close up street-level views of trees are often distorted in GoogleEarth images.

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