18

NLC Conventional Facilities

Contents

18.1 Introduction

The NLC conventional facilities integrate the geotechnical and topological conditions of a generic site with a sub surface linac housing and klystron gallery structure. Conventional above-grade infrastructure and support facilities generally found in high-energy physics laboratories are included along with other necessary items associated with such a very large project. A non-specific site is assumed as no site has yet been selected. Many detailed specifics regarding the conventional facilities are not as yet addressed. The goal for this report has been to quantify the general ideas to a degree adequate to define the starting point for a detailed bottoms-up conceptual design report effort. Figures 18-1 through 18-5 show details of the NLC facility and are found at the end of this chapter.

18.2 Site

The overall NLC site is approximately 32 km in length and two km in width with four distinct functional areas; detectors, campus, injectors and linac. The site is assumed to be located such that reasonable access to adequate power, water, transportation and housing is available. The center of the site would be the location of the interaction point and the detector facilities. This central location might also be the location of the campus area, however the best campus area will very likely be selected with local access and transportation considerations being the driving factors. Opposite ends of the site would each have an injector area with a damping ring. At just one of the injectors a positron target and a pre-damping ring would be added. Between the detector area and each of the two injector areas would be a linac housing and a klystron gallery.

The linac areas with their associated utility support structures would make up the largest single portion of the overall site conventional facilities

The NLC site geology and topology should be such that both tunneling and cut-and-cover methods of construction are practical and utilized. A site having a high proportion of competent rock would be ideal and is the preferred site considered for the NLC. Excellent work with respect to geology, topography and site selection was done for the SSC project and has been used to advantage for the NLC. Attachment C to the SSC Conceptual Design Report, dated March 1986, documents that earlier work.

The NLC is estimated to require 300 MW of electric power to be supplied from two 230-kV transmission lines running parallel to the NLC. Three main substations are planned, one near each end of the site and one in the center. The primary distribution voltage from the main substations along the linac would be 34.5 kV. Two hundred small unit substations, adjacent to or in utility clusters along the klystron gallery, would supply the appropriate utilization equipment distribution power. The site water-cooling system would consist of approximately eight forty-MW cooling towers distributing water to utility cluster heat exchangers that transfer heat from ten-megohm low-conductivity water systems. Total site water demand would be about 3,000 gallons per minute and would come from a combination of existing offsite sources and those developed onsite. Conventional site facilities would include roads and parking for about 1400 vehicles as well as fire protection, water and waste treatment, communications, cable plant, and construction-related mobilization and site preparation. The primary roadway to the site would be four 12-ft lanes to support heavy assembly deliveries. The secondary linac roadway would have two 12-ft lanes with shoulders adequate to stabilize the roadway base.

For the major infrastructure construction phase of the project a concrete batch plant is assumed to be provided on site with a rail siding extension to bring in the associated bulk material needed for concrete. This rail extension would be of use later for locating modular installation and maintenance clusters associated with NLC operations. These clusters would be 40 and 20-ft transportainers loaded with tools, stored components, field offices, and mini shops. The modular clusters would be relocated off-shift to follow and support on-shift operations, installation and maintenance.

18.3 Campus

The campus area is planned to house and support about 2500 persons and provide the needed facilities to build, operate and maintain the NLC. It consists of 16 buildings, the largest being a four-story main laboratory building of 350,000 square feet. This building would include a 1000-seat auditorium, a cafeteria, conference rooms, offices and light electronics laboratories as well as a central computer facility. This building would house the central administrative area for the laboratory.

Six heavy-fabrication buildings with high bays, office mezzanines, light and medium cranes, would be needed in the industrial area of the campus together with three smaller shops buildings. The shop buildings would be used for various machining and assembly operations. These industrial buildings would total roughly 210,000 square feet and have an adjacent paved outdoor staging area for larger assembly and preparation. Two conventional warehouses will be needed during and after construction for storing the various materials and assemblies that will make up the NLC. These structures would total about 80,000 square feet in area. The campus area would also have a vehicle service area, water and sewage treatment facilities and an emergency rescue and services facility.

18.4 Injectors

Each electron injector facility will include an injector with a short linac section, a 715-ft-circumference damping ring, and a compressor section with a second linac section. The positron injector will also have a pre-damping ring and a positron target. These facilities will be rigid-frame box structures of cast-in-place concrete. They will be positioned at a depth to align with the arcs at the ends of the main linac beam tunnels. The roof spans in the damping rings are substantially greater than for the bored tunnels. A hard rock site, mined with a horizontal cutter wheel machine, would be ideal for the damping-ring enclosures. Tunnel sections between the injector and damping-ring enclosures may be bored. Structures for the supporting injector utility clusters would be somewhat similar to those used for the main klystron gallery and linac. Should the campus area be located adjacent to one of the injector areas, then the supporting utility, power supply and instrumentation structures could be installed at the surface. The injectors will have local control rooms that slave to the main NLC control room.

18.5 Linac

The linac housing tunnel is planned to be bored with a tunnel boring machine at an average depth of forty ft. Its total length is a maximum of about twenty miles, less sections where the beam passes through cast buildings and enclosures such as the detector area and the damping rings. The finished inside diameter is planned to be 12 ft, with a concrete or shotcrete liner and a concrete floor or invert. A hard rock site might possibly require less concrete depending on rock strata and water migration. Utility chases from the linac housing to the klystron gallery and utility cluster alcove above will be installed at 156-ft intervals along the linac to provide water cooling and other utilities. The minimum earth cover between the ceiling of the linac beam housing and the floor of the klystron gallery above is 20 ft for adequate personnel radiation shielding. The klystron gallery above will enclose klystrons, modulators, power supplies, instrumentation and controls. It will extend over most but not all of the beam housing tunnel below, as klystrons and related rf penetrations are not required along the entire length of the beam housing tunnel. A minimum of twelve miles of klystron gallery is planned for the rf systems. It is planned to be 30 ft in width. The utility cluster alcoves, at 156-ft intervals, will enclose motors, pumps, cooling and power system panels and controls.

The klystron gallery and utility cluster alcoves would be constructed using cut-and-cover methods and be below the surface at a depth sufficient to distribute surface traffic loads without the need for an excessively thick roof structure. Besides the utility chase housing penetrations, the housing will have 24-in inch diameter rf waveguide penetrations at six-m intervals along the beam housing. The utility chases will contain all utilities, including low conductivity water and cables, but would exclude rf waveguide. Housing and gallery entrances for vehicles and personnel are planned to be spaced at one-km intervals with adequate access ventilation and lock-up baffles to restrict air movement during linac operations.

The final-focus areas will extend from the detector building to the interaction point switch wyes at the ends of the linac where the beam is turned gradually to allow for two IPs and two detectors. The wyes are approximately two km from the interaction points. The two interaction points will be 40-m apart in the detector building making a single building feasible to house two detectors. A total of eight muon spoilers will be distributed in the four final-focus sections. Sizable structures to support and install these will be required. Their nominal dimensions fill the 12-ft inside diameter of the bored linac tunnel for three m along the beam z axis.

18.6 Detectors

The detector building facility will require about 100,000 square feet of total area. It will have a high bay area with a heavy bridge crane common to the entire facility. Two pit areas will match the two detector bore elevations to the final-focus beam line elevations. The pit will have light concrete sidewalls with earth tiebacks for support. The two pits will be structurally isolated from each other to segregate respective motion and vibration. Mezzanines will be included for computer, control room and office facilities. Areas for essential power conversion, low conductivity water, and cryogenic equipment will also be included both within and about the detector building. Shop areas will be provided for welding, metal fabrication, and instrument testing and calibration.

The two detectors will weigh in the order of 50,000 tons each and will require a precision steel and concrete floor pinned to bedrock for support. The detectors are assumed to be constructed in sub-assemblies that are skid, jacked and hoisted into place. The design of the detector building is driven by the design of the detectors themselves as the orientation and sequencing necessary for detector assembly must be consistent with the building layout. The detector control room will operate both detectors along with the instrumentation and data acquisition necessary for the relevant experimentation. Detector operation and control will be both local and remote to the NLC main control room. Kitchen, shower and rest facilities will be included to support personnel around the clock. Table 18-1 lists attributes of the interaction building, as well as those of the balance of the NLC conventional facilities.

General Site			
Area:	16,000 acres	2 km × 32 km	64 square km
Orientation:	North-South	Adjacent power R/W	Two circuits @ 230 kV
Population:	2500 persons	Peak occupancy	400 vehicles
Power:	300 MW	3 230-kV substations	@ 100 MW each
Water:	3000 gpm	Base + peak blowdown	@ 300 MW
Cooling:	320 MW	8 cooling towers	@ 40 MW each

Site Components		
Campus:	800,000 sq. ft.	Total square feet
Laboratory Bldg.	350k sq. ft.	One 4-story office-lab
Fabrication Bldgs.	181k sq. ft.	2 hvy., 4 med., w/ cranes
Shop Bldgs.	37k sq. ft.	Three light machine shops
Warehouses	80k sq. ft.	Two @ 40k sq. ft. each
Miscellaneous Bldgs.	152k sq. ft.	Small light buildings
Structures:		
Klystron Gallery	18.4 km × 9.25 m	1,809,000 sq. ft.
Beam Housing	31 km × 3.7 m ID	14 ft. TBM bore @ −40 ft. el.
I&C, Utility Alcoves	650, two per sector	400 sq. ft. each
Utility Chases	650, two per sector	6-ft dia. × 25 ft
rf Penetrations	2318 at 26-ft intervals	2-ft dia. × 25 ft
Housing & KG Access	34 with labyrinths	Two tiered ramps @ 1 km
Damping Rings	Two e^+ and One e^-	715-ft cir., 50k sq. ft. ea.
Injectors	Two housings	23k sq. ft. each
Position Target	One dual housing	28k sq. ft. for 2 targets
Final Focus	Four @ 2 km each	w/muon spoilers & dumps
Interaction Bldg.	One bldg., pit & crane	100k sq. ft. for 2 detectors
Utilities:		
Electrical	34.5-kV ring bus & ckts.	200 double-end unit subs
Communications	Phone, computer, radio	w/ fibre net, SCADA, video
Site H_2O + Waste	Water-waste, processing	Fire, reclaimed water lagoon
Roads & Parking	54 km roads, 1400 spaces	34 km 2-lane, 20 km 4-lane
Alcove Utilities	650 system clusters	Accel, klys, mag LCW; CA, HVAC
Cable Plant	Wire, tray, racks	337,750 cables; 6,825 racks
Alignment Network	Surface, X-fer, tunnel	Laser trackerbot, barcode index

Table 18-1. *Next Linear Collider zero-order design: Facility criteria.*

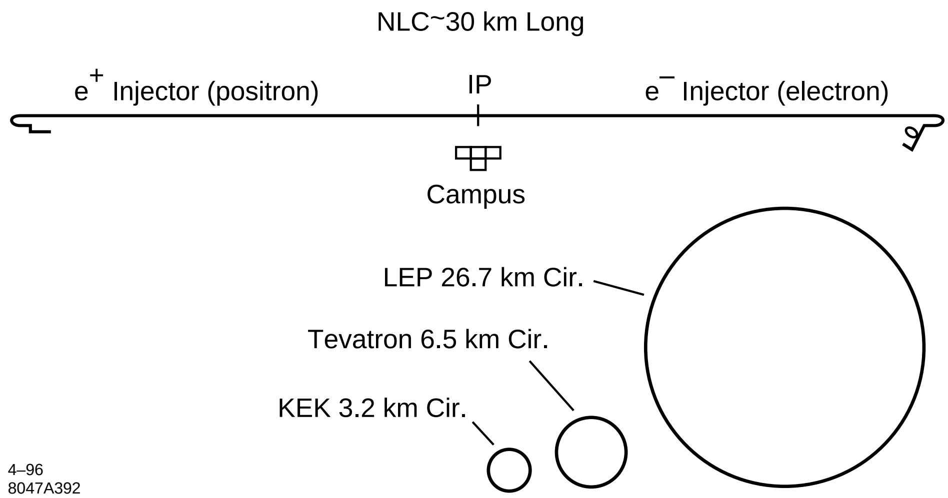

Figure 18-1. *NLC site relative proportions.*

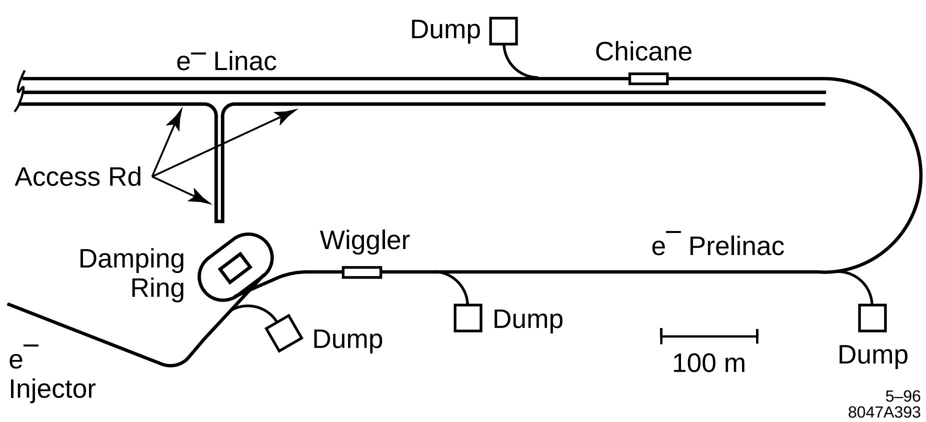

Figure 18-2. *NLC e^- injector and damping ring.*

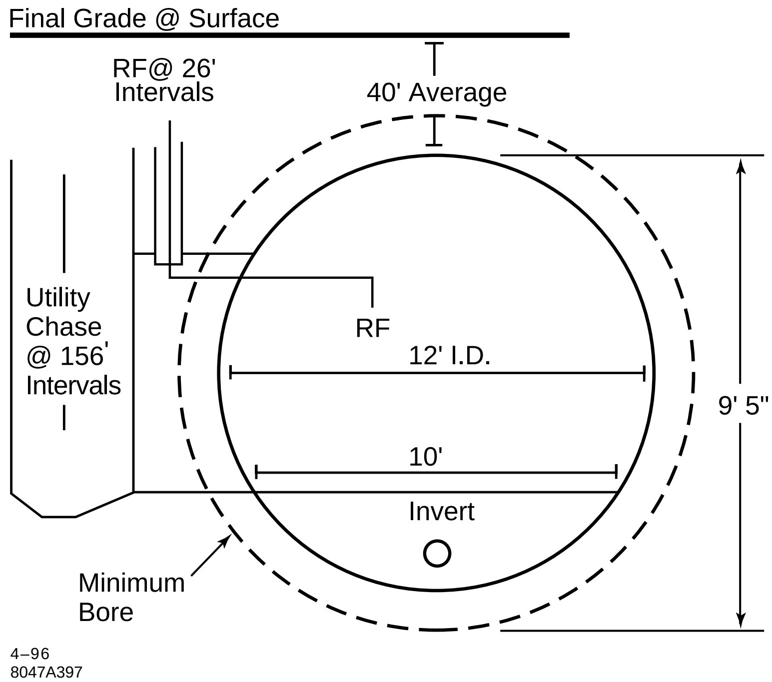

Figure 18-3. *NLC beam tunnel housing.*

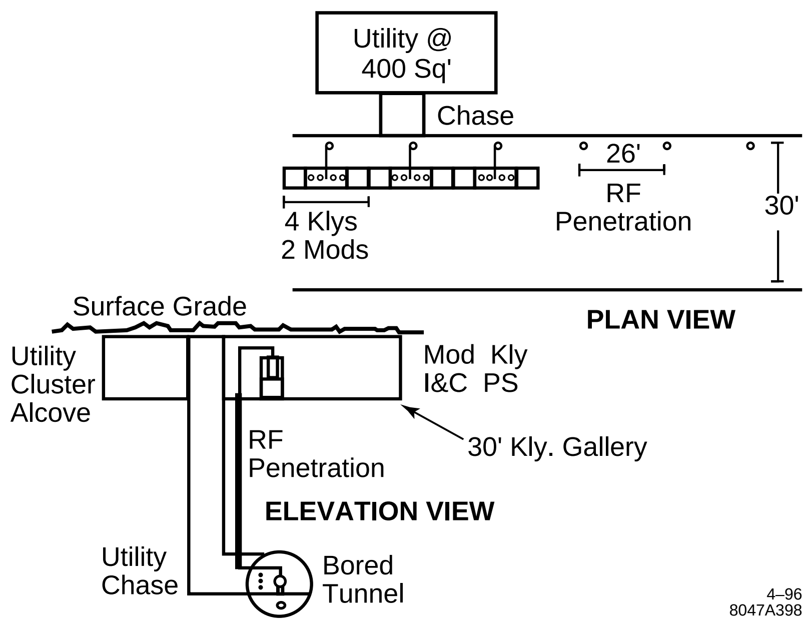

Figure 18-4. *NLC half-sector linac layout.*

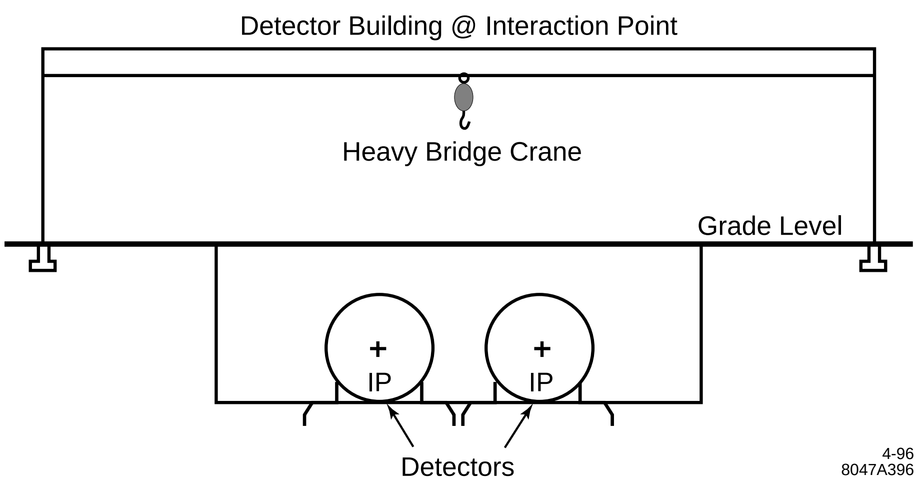

Figure 18-5. *NLC interaction point.*

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