CONVENTIONAL FACILITIES PARAMETERS
(as in the CDR)

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1. SUMMARY

Areas

Infrastructure	:	60 miles x 50' → 360 acres
Campus	:	5500' x 3000' → 380 acres
Injector	:	8300' x 7700' → 1470 acres
Service Areas	:	8 x 500' x 500' → 46 acres
Exit Areas	:	8 x 300' x 300' → 16 acres
West Cluster	:	31496'$^+$ x 700'* → 510 acres
East Cluster	:	31496'$^+$ x 700'* → 510 acres
Experimental Areas	:	6 x 900' x 300' → 36 acres
Collider (North & South Arcs)	:	209,134'$^+$ x 700'* → 3390 acres

Electrical Power Demand (See Annex 2)

Peak Demand: 178 MW (162 MW without experiments)
Average Demand: 117 MW (105 MW without experiments)

Water Demand (See Annex 3)

Potable water: 500 gpm
Industrial and fire protection water
(campus and partly injector): 500 gpm
Industrial water (partly Injector & Collider) from 23 wells:1500 gpm
(without experiments: 1200 gpm)

Miscellaneous

Fire protection storage: 6 tanks x 300,000 gallons each
Sewage plant effluent discharge: 150,000 gallons/day
Storage lagoon: 3 acres
Heating rate (coldest month): 55 x 10^6 Btu/hour
Telecommunications 4000 lines: 200 trunks

N.B.: * 25' inside of ring from the beam line
675' outside of ring from the beam line
$^+$ measured along the beam line

Buildings (gross area - occupancy) - Below ground enclosures - Power demand

	Buildings Gross Areas (sq. feet)	Below Ground Enclosures (sq. feet)	Electricity (MW) Peak	Electricity (MW) Average	Persons (See Annex 4) Total	Persons (See Annex 4) Day/Average
Central off & lab bldg	371,000		2.6	2.6	1370	1020
Heavy works buildings	169,000		1.34	1.34	370	370
Shop buildings	30,100		.15	.15	150	150
Warehouses	80,000		.24	.24	60	60
Misc. buildings	32,900		.67	.67	150	20
Total Campus	683,000		5.00	5.00	2100	1620
Linac	15,300	10,200	1.2	1.2		
L.E.B.	11,600	11,900	2.4	1.4		
M.E.B.	11,700	101,800	27.53	9.53		
H.E.B.	29,700	262,100	19.67	15.0		
Test beam area	21,300	21,000	-	-		
Total injector	89,600	407,000	50.8	27.1	50	10
Collider	138,300	2,835,000	104.4	71.6	100	20
Experimental areas (including experiments)	228,800	139,300	17.6 (16)	13.6 (12)	750	460
Total	1,140,000	3,381,000	177.8 156.5[x] 144.4[xx]	117.3 104.5[x] 95.4[xx]	3000	2110

[x] with a diversity factor of 1.32 applied on L.V.

[xx] with a diversity factor of 1.32 applied on L.V. and without experiments

2. CAMPUS

2.1 General

Area: 5500' x 3000' → 380 acres

Electrical power demand (in detail below)
- Installed: 9.6 MVA
- Peak : 5 MW
- Average : 5 MW

Water demand
- Installed:
  - Potable, industrial and fire protection water: 1000 gpm (also feeding Linac, LEB, MEB, and partly HEB)
  - One Storage tank (potable, industrial and fire protection water): 300,000 gallons
- Peak demand: Potable water: 500 gpm; Industrial water: 250 gpm; Fire protection water: 1000 gpm
- Normal demand: Potable, industrial and fire protection water: 750 gpm

2.2 Central Offices & Laboratory Building

One four floor and incomplete basement building and atrium

Gross area: 371,000 sq. feet
Net area : 245,900 sq. feet

Offices	:	73,400 sq. feet
Laboratories	:	76,500 sq. feet
Conference rooms	:	10,900 sq. feet
Lounge & meetings	:	13,800 sq. feet
Display	:	2,400 sq. feet
Computer room	:	18,000 sq. feet
Magnetic tape storage	:	10,500 sq. feet
Control room	:	6,000 sq. feet
Cafeteria	:	7,800 sq. feet
Kitchen & Food Service	:	3,200 sq. feet
Infirmary	:	1,700 sq. feet
Receiving & Storage	:	8,400 sq. feet
Mechanical	:	9,100 sq. feet
Maintenance	:	4,200 sq. feet

Occupancy
- day/average: 1020 persons
- Total (including shifts): 1370 persons

Auditorium: 1000 seats

Electrical power demand
- Installed: 3 MVA (2 x 1.5 MVA)
- Peak : 2.6 MW
- Average : 2.6 MW

2.3 Heavy Works Buildings

The location of these buildings is not finalized, and may be partially or totally inside the campus or in the experimental areas.

Heavy works buildings I and II
Gross area: 2 x 40,100 sq. feet

Cranes: 2 x 30^T in each building

Electrical power demand
Installed: 2 x 0.75 MVA
Peak : 2 x 0.35 MW
Average : 2 x 0.35 MW

Heavy works buildings III, IV, V and VI
Gross area: 4 x 20,200 sq. feet

Cranes: 1 x 30^T and 1 x 15^T in each of heavy buildings

Electrical power demand
Installed: 4 x 0.5 MVA
Peak : 4 x 0.16 MW
Average : 4 x 0.16 MW

Occupancy: 370 persons

2.4 Shop Buildings

Shop building I (machine shop)
Gross area: 11,550 sq. feet

Cranes: 1 x 10^T and 1 x 5^T

Electrical power demand
Installed: 0.3 MVA
Peak : 0.05 MW
Average : 0.05 MW

Shop buildings II and III (carpenter/sheet metal workshop and piping/cryogenics workshop
Gross area: 2 x 9,275 sq. feet

Cranes: 2 x 5^T in each building

Electrical power demand
Installed: 2 x 0.3 MVA
Peak : 2 x 0.05 MW
Average : 2 x 0.05 MW

Occupancy: 150 persons

2.5 Warehouses

Gross area: 80,000 sq. feet (2 buildings)

Cranes: 1 x 5^T per warehouse

Occupancy: 60 persons

Electrical power demand
- Installed: 1 MVA (2 x 0.5 MVA)
- Peak : .24 MW
- Average : .24 MW

2.6 Miscellaneous Buildings

Emergency services (2), hose tower, vehicle service, water treatment, sewage treatment, visitor control (2)

Gross area: 32,900 sq. feet (8 buildings)

Occupancy
- day/average: 20 persons
- Total (including shifts): 150 persons

Electrical power demand
- Installed: 1.2 MVA (4 x 0.3 MVA)
- Peak : .17 MW
- Average : .17 MW

N.B.: - One of the emergency buildings is located in the East Cluster and needs one well (20 gpm) and package treatment plant.
- The demand for external lighting is estimated at 0.5 MW.

3. INJECTOR

3.1 Linac

Tunnel
- Length: 494'
- Cross section: 12' x 12'
- Below ground enclosure: 6900 sq. feet

Transfer tunnel to LEB
- Length: 410'
- Cross section: 8' x 8'
- Below ground enclosures: 3300 sq. feet

Building
- Gross area: 15300 sq. feet (1 building)
- One equipment hatch: 42' x 6'
- Exit with stairs/ventilation shaft: 2 x 15' diameter

Electrical power demand

Installed:	HV:*	~2.0 MVA (part of T3 transformer output)
	LV:	.5 MVA
	Σ:	~2.5 MVA
Peak:	HV:	0.8 MW
	LV:	0.4 MW
	Σ:	1.2 MW
Average:	HV:	0.8 MW
	LV:	0.4 MW
	Σ:	1.2 MW

Cooling water demand
- Circulating Water
  - Cooling tower water: 550 gpm
  - Low conductivity water: 1000 gpm
- Make-up water
  - Installed: one LCW generating plant: 100 gpm (also feeding LEB, MEB, HEB and collider)
    130 gpm (provided by campus network)
  - Average demand: 25 gpm for Linac
    100 gpm for LCW generating plant

3.2 LEB

Tunnel
- Length +: 817'
- Cross section: 8' x 8'
- Below ground enclosures: 11600 sq. feet

N.B.: * HV = 13.8Kv
MV = 4160v
LV = 480v/240v/120v
+ measured along beam line

Transfer tunnel to MEB
- Length: 40'
- Cross section: 8' x 8'
- Below ground enclosures: 320 sq. feet

Buildings
- Sector BB
  - Gross area: 2760 sq. feet (1 building)
  - Exit with stairs/vent. shafts: 1 x 15 ft. diameter
- Sector DD
  - Gross area: 2230 sq. feet (1 building)
  - Exit with stairs/vent shafts: 1 x 15 ft. diameter
  - One equipment hatch: 24' x 6'
- Sectors CC, EE & FF
  - Gross area: 3 x 2200 sq. feet (3 buildings)

Electrical power demand

Installed:	HV:	~2.5 MVA	(part of T1 and T3 transformers output)
	LV:	1.5 MVA	
	Σ:	~4.0 MVA	
Peak:	HV:	1.2 MW	
	LV:	1.2 MW	
	Σ:	2.4 MW	
Average:	HV:	0.2 MW	
	LV:	1.2 MW	
	Σ:	1.4 MW	

Cooling water demand
- Circulating water
  - Cooling tower water: 170 gpm
  - Low conductivity water: 125 gpm
- Make up water
  - Installed : 10 gpm (provided by campus network)
  - Average demand: 6 gpm

3.3 MEB

Tunnel
- Length:+ 6233'
- Cross section: 10' internal diameter
- Below ground enclosure: 69500 sq. feet

Transfer tunnels to HEB (2)
- Length: 3230'
- Cross section: 10' internal diameter
- Below ground enclosure: 32300 sq. feet

Buildings
- Sectors GG, HH, LL, JJ, MM
  - Gross area: 5 x 1890 sq. feet (5 buildings)
  - Exit with stairs/vent. shafts: 5 x 15' diameter

N.B.: + measured along beam line

Sector KK
Gross area: 2230 sq. feet (1 building)
Exit with stairs/vent. shafts: 1 x 15' diameter
One equipment hatch: 24' x 6'
One cooling tower

Electrical power demand

Installed:	HV:	~38 MVA (part of T1 & T3 transformers output)
	LV:	1.575 MVA (7 x 0.225 MVA)
	Σ:	~40 MVA
Peak:	HV:	26.9 MW
	LV:	.63 MW (including test beam facilities)
	Σ:	27.53 MW
Average:	HV:	8.9 MW
	LV:	.63 MW (including test beam facilities)
	Σ:	9.53 MW

Cooling water demand
Circulating water
Cooling tower water: 2560 gpm
Low conductivity water: 1875 gpm
Make up water
Installed: 120 gpm (provided by campus network)
Average demand: 95 gpm

3.4 HEB

Tunnel
Length:+ 19666 feet
Cross section: 10' internal diameter
Below ground enclosures: 207,600 sq. feet

Injection tunnels to collider (2)
Length: 5446 feet
Cross section: 10' internal diameter
Below ground enclosures: 54460 sq. feet

Buildings

Sector NN
Gross area: 13650 sq. feet (5 buildings)
Exit with stairs/refrigeration shaft: 1 x 30' diameter
One cooling tower
Sector PP
Gross area: 3750 sq. feet (3 buildings)
Exit shaft with stairs: 1 x 15' diameter
Two air coolers
Sector QQ
Gross area: 3870 sq. feet (1 building)
Exit shaft with stairs: 1 x 15' diameter
One cooling tower
Sector RR
Gross area: 3750 sq. feet (3 buildings)
Exit shaft with stairs/vent. shaft: 1 x 15' diameter
One cooling tower

N.B.: + measured along beam line

Sector SS
Gross area: 1890 sq. feet (1 building)
Exit shaft with stairs: 1 x 15' diameter
Sector TT
Gross area: 2820 sq. feet (2 buildings)
Exit shaft with stairs: 1 x 15' diameter
One cooling tower

Electrical power demand

Installed:	HV:~25 MVA	(part of T2 and T3 transformers output; including test beam area)
	MV: 5 MVA	
	LV: 2.4 MVA	(1 x 1 MVA, 1 x .5 MVA, 4 x .225 MVA)
	Σ:~32 MVA	
Peak:	HV: 14.67 MW	(including test beam area)
	MV: 3.5 MW	
	LV: 1.5 MW	
	Σ: 19.67 MW	
Average:	HV: 11.3 MW	(including test beam area)
	MV: 2.2 MW	
	LV: 1.5 MW	
	Σ: 15.0 MW	

Cooling water demand
Circulating water
Cooling tower water: 3225 gpm
Low conductivity water: 1550 gpm
Make-up water
Installed: 120 gpm (provided partly by campus network: 30 gpm and partly by 3 wells and package treatment plants: 90 gpm)
Average demand: 110 gpm

3.5 Test Beam Area

Tunnel
Length: 700'
Cross section: 8' x 8'
Below ground enclosure: 5600 sq. feet

Pipes
Length: 6020' (2 pipes from tunnel to target hall, 4 pipes from target hall to test hall)
Internal diameter: 14"

Target hall
Dimensions: 245' x 36'
Below ground enclosures (tunnel, target hall, quad enclosures, and dipole enclosure): 15,380 sq. ft.

Buildings
Test beam experimental hall & service building → target & quad buildings
Gross area: 21,300 sq. feet (4 buildings)
2 x 30^T cranes
1 cooling tower

Electrical power demand

- HV: included in HEB
- LV: included in MEB

Cooling water demand

- Circulating water
  - Cooling water tower: 1350 gpm
  - Low conductivity water: 685 gpm
- Make-up water
  - Installed: 50 gpm (1 well and package treatment plant)
    one storage tank (industrial and fire protection): 300,000 gallons
  - Average demand: 47 gpm

4. COLLIDER

Tunnel

Length:+ North arc : 19.805 miles
South arc : 19.805 miles
West cluster: 5.965 miles
East cluster: 5.965 miles
Total length: 51.54 miles

Cross section: 10' internal diameter

Aborts and beam dumps (2)

Length: 3120'
Beam dump: 50' x 24' x 24

Below ground enclosures:

Tunnel (North and South arcs, East and West clusters, less experimental areas and enlarged tunnels): 269,535' x 10'	=	2,695,300 sq. feet
Power alcoves: 60 x 135 sq. feet	=	8,100 sq. feet
Refrigerator enclosures: 10 x 8950 sq. feet	=	89,500 sq. feet
Access enclosures: 10 x 1950 sq. feet	=	19,500 sq. feet
Injection, RF, aborts and beam dumps:	=	22,600 sq. feet
Total:	=	2,835,000 sq. feet

Buildings

a. North and South Arcs

Service areas A,B,C,D,E,F,G,H
Gross area: 8 x 11,650 sq. feet (24 buildings)
Access shafts: 8 x 30' diameter w/ stairs & elevators
8 cooling towers

Exit areas A,B,C,D,E,F,G,H
Gross area: 8 x 960 sq. feet (8 buildings)
Exit shafts: 8 x 20' internal diameter
8 air coolers

b. West and East Clusters

RF areas Q and R, & abort
Gross area: 2 x 5090 sq. feet (4 buildings)
4 cooling towers

Service areas West and East
Gross area: 2 x 12,680 sq. feet (6 buildings)
Access shafts: 2 x 30' diameter w/stairs & elevators
2 cooling towers

Exit areas V and Q
Gross area: 2 x 960 sq. feet (2 buildings)
Exit shafts: 2 x 20' internal diameter
2 air coolers

N.B.: + measured along beam line

Electrical power demand

Cryogenics

Installed:

MV: 60 MVA (12* x 5 MVA)
LV: 10.5 MVA (14 x 0.75 MVA)
Σ: 70.5 MVA

Peak

MV: 27.6 MW
LV: 6.0 MW
Σ: 33.6 MW

Average

MV: 23.2 MW
LV: 6.0 MW
Σ: 29.2 MW

Magnet power supply

Installed: HV: ~50 MVA (part of 10 x 7 MVA transformers outputs)

Peak : HV: 41.5 MW
Average : HV: 18.12 MW

RF power supply

Installed: HV: ~15 MVA (part of transformer T3 output)

Peak : HV: 8 MW
LV: 1 MW
Σ: 9 MW

Average : HV: 8 MW
LV: 1 MW
Σ: 9 MW

Miscellaneous surface and underground

Installed: LV: 52.5 MVA (30 x .75 MVA, 60 x .5 MVA)

Peak : LV: 20.3 MW

Average : LV: 15.3 MW

Total

Installed: HV: ~65 MVA
MV: 60 MVA
LV: 63 MVA
Σ: ~188 MVA

Peak : HV: 49.5 MW
MV: 27.6 MW
LV: 27.3 MW
Σ: 104.4 MW

Average HV: 26.1 MW
MV: 23.2 MW
LV: 22.3 MW
Σ: 71.6 MW

*NB: 10 x 5 MVA transformers for H_e compressors
2 x 5 MVA transformers for N_2 compressors (must be 2 x 7.5 MVA)

Cooling water demand

- Circulating water
  - Cooling tower water: 14,810 gpm
  - Low conductivity water: 3240 gpm
- Make-up water
  - Installed: 785 gpm (14 wells and package treatment plants)
    one LCW generating plant: 100 gpm
    1 storage tank (East cluster): 300,000 gallons
    (potable, industrial and fire protection water)
  - Average demand: 490 gpm for collider
    100 gpm for LCW generating plant

5. EXPERIMENTAL AREAS

Type A collision halls S and T

Below ground enclosures
- Collision hall: 2 x 8450 sq. feet; 2 x 475,000 Cu. feet
- Assembly hall: 2 x 14,600 sq. feet; 2 x 862,000 Cu. feet
- Miscellaneous: 2 x 8200 sq. feet; 2 x 122,000 Cu. feet (by-pass, enlarged tunnels)
- Total: 2 x 31,250 sq. feet; 2 x 1,459,000 Cu. feet

Buildings
- Gross area: 2 x 57,200 sq. feet (4 buildings)
- 1 crane 50^T, 1 crane 25^T each hall
- 2 cooling towers

Type B collision halls Y and Z

Below ground enclosures
- Collision hall: 2 x 4300 sq. feet; 2 x 240,000 Cu. feet
- Enlarged tunnel: 2 x 13,900 sq. feet; 2 x 347,000 Cu. feet
- Assembly hall: 2 x 14,800 sq. feet; 2 x 875,000 Cu. feet
- Miscellaneous (by-pass): 2 x 5,400 sq. feet; 2 x 80,000 Cu. feet
- Total: 2 x 38,400 sq. feet; 2 x 1,542,000 Cu. ft.

Buildings
- Gross area: 2 x 57,200 sq. feet (4 buildings)
- 1 crane 50^T, 1 crane 25^T each hall
- 2 cooling towers

Electrical power demand

Installed:		:	18 MVA (4 x 3 x 1.5 MVA)
Peak :	buildings	:	1.6 MW (4 x 0.4 MW)
	experiments	:	16 MW (4 MW for each experiment)
Average: :	buildings	:	1.6 MW (4 x 0.4 MW)
	experiments	:	12 MW (3 MW for each experiment)

Cooling water demand

Circulating water
- Cooling tower water: 3000 gpm
- Chilled water: 2400 gpm

Make-up water
- Installed: 500 gpm (4 wells and package treatment plants)
- Average demand: building: 90 gpm
  - people: 100 gpm
  - experiments: 300 gpm (75 gpm for each experiment)

Annex 1

EXTERNAL DIMENSIONS OF BUILDINGS

1. CAMPUS

a. Central offices and laboratory building: 493' x 203'

b. Heavy works buildings:

Type I and II: 282' x 93'
Type III to VI: 217' x 93'

c. Shop buildings:

Type I: 218' x 53'
Type II and III: 175' x 53'

d. Warehouses: 325' x 123'

e. Miscellaneous:

Emergency services: 2 x 218' x 53'
Hose Tower: 19' x 18'6"
Vehicle services: 153' x 47'
Water treatment: 35' x 24'
Sewage treatment: 24' x 24'
Visitor control: 20' x 20'

2. INJECTOR

a. Linac

Klystron gallery: 282' 6" x 31'
Klystron gallery: 215' x 24'
Exit: 24' x 21'
Exit & equipment hatch: 89' x 21'

b. LEB

Sector BB: (power supply, exit) 67' 6" x 48'
Sector DD: (power supply, exit, equipment hatch) 67' 6" x 33'
Sectors CC, EE & FF: (power supply) 48' x 46'

c. MEB

Sectors GG & JJ: (power supply, exit, extraction) 67'6" x 28'
Sectors HH & LL: (power supply, exit) 67'6" x 28'
Sector KK: (power supply, injection, exit, equipment hatch) 67'6" x 33'
Sector MM: (power supply, RF, exit/vent) 67'6" x 28'

d. HEB

Sector NN: Compressors: 110'6" x 48'
Service building: 89' x 48'
48' x 46'6"
Injection/ejection: 2 x 38' x 24'6"
Sector PP: Power supply, exit/vent: 67'6" x 28'
Kicker power supply: 2 x 38' x 24'6"
Sector QQ: Power supply, RF, exit: 110'6" x 35'
Sector RR: Power supply, exit: 67'6" x 28'
Extraction: 2 x 38' x 24'6"
Sector SS: Power supply, exit: 67'6" x 28'
Sector TT: Power supply, exit: 67'6" x 28'
Injection: 38' x 24'6"

e. Test Beams

Experimental hall: 163' x 110'6"
Service building: 46' x 30'
Target station: 38' x 24'6"
Quad magnets bldg: 38' x 24'6"

3. COLLIDER

a. North and South arcs

Service areas A,B,C,D,E,F,G,H:
Compressor buildings: 8 x 110'6" x 48'
Service building: 8x {85' x 48'
46' x 45'

Exit areas A,B,C,D,E,F,G,H: 8 x 31' x 31'

b. West and East clusters

RF areas Q and R and abort:
RF: 2 x 89' x 35'
Abort/injection: 2 x 46' x 43'

Service areas West and East:
Compressor buildings: 2 x 132' x 48'
Service building: 2x {85' x 48'
46' x 45'

Exit areas V and Q: 2 x 31' x 31'

4. EXPERIMENTAL AREAS

Collision halls S,T,Y,Z:

Assembly hall: 4 x 304' x 123'
Exit: 4 x 24'6" x 24'

Internal Dimensions of Below Ground Enclosures

		Type A	Type B
Collision Hall	Central	70' x 75' x 60'	50' x 50' x 60'
	Forward	2 x 40' x 40' x 50'	2 x 25' x 36' x 50'
Enlarged Tunnels		2 x 70' x 15' x 15'	2 x 278' x 25' x 25'
By pass tunnels		6050 sq. feet x 15'	5350 sq. feet x 15'
Assembly hall		84' x 148' x 60'	84' x 148' x 60'
Access to assembly hall		24' x 40' x 60'	24' x 40' x 60'
Shielded door		40' x 29' x 50'	40' x 36' x 50'

SSC Power Supply

Installed power: For a given part of the system (ex: central offices and laboratories, He compressors) the power available at the end of the 13.8 kv feeder or at the secondary of the transformer 13.8 kv/4160v or 13.8 kv/480v.

Peak load: The maximum instantaneous load of a given part of the system resulting from the addition of the maximum of the sub-systems. For the cryogenic system it is the nominal power (see SSC-76).

Average load: A rough estimate of the power needed by a system taking into consideration that the normal running loads of the sub-systems are lower than their peak load (ex: starting of a motor, magnet power supplies).

NB: The maximum average load over a designated period of time (used for commercial transactions with the supplier of electricity) may be slightly lower.

Diversity factor (see Annex): The ratio of the sum of the individual maximum demands of the various subdivisions of the system to the maximum demand of the whole system.

* Systems or sub-systems where the diversity factor is applicable.

** Liquid nitrogen supply: the peak power of this system is not accounted for in the total peak power taking into consideration the fact that nitrogen storage can be used for electric power load leveling or to take advantage of time of day power pricing (see SSC-76).

SSC POWER SUPPLY

1. Campus

	Installed (MVA)	Peak (MW)	Average (MW)	Remarks
Central offices + labs	3 (2x1.5)	2.6	2.6	
H.W.B. I and II	1.5 (2x0.75)	0.7	0.7	
H.W.B. III to VI	2 (4x0.5)	0.64	0.64	
Shop bldgs. I to III	0.9 (3x0.3)	0.15	0.15	
Wareh. I and II	1 (2x0.5)	0.24	0.24	
Water + Sew. T.t.	0.6 (2x0.3)	0.1	0.1	
Emerg + Veh.Serv.Bldgs	0.6 (2x0.3)	0.07	0.07	
Ext. lighting		0.5	0.5	
Σ campus	9.6	5*	5*	(Drawing SE1) feeders C1,C2

2. Injector

		Installed (MVA)	Peak (MW)	Average (MW)	Remarks
Linac	HV•	~2 (part of T3 transformer output)	0.8	0.8	(Drawing SE1)
	LV•	0.5	0.4*	0.4*	
		~2.5	1.2	1.2	feeder D3
L.E.B.	HV	~2.5 (part of T1/T3 transformers output)	1.2	0.2	feeder A5
	LV	1.5	1.2*	1.2*	feeder D4
		~4.0	2.4	1.4	
M.E.B.	HV	~38 (part of T1/T3 transformers output)	26.9	8.9	feeders A3, A4
(included LV for test beams)	LV	1.575 (0.225x7)	0.63*	0.63*	feeder D4
		~40	27.53	9.53	
H.E.B.	HV	~25 (part of T2/T3 transformers output)	14.67	11.3	feeder C3+test beam
(included HV for test beams)	MV•	5	3.5	2.2	
	LV	2.4 (1x1 1x0.5 4x0.225	1.5*	1.5*	feeders C4,C5
		~32	19.67	15.0	
Σ injector		~78.5	50.8	27.1	

• HV: 13.8 kV
MV: 4160 V
LV: 480 V/240 V/120 V

3. Main ring and experimental halls

		Installed(MVA)		Peak(MW)	Average(NW)	Remarks
Cryogenics						Doc. SSC-76
		MVA	MW			
He compressors	MV	50 (10x5)	35	22	17.6	Nominal = Peak Average = Peak x 0.8
Auxiliaries	LV	7.5(10x.75)	5	5*	5*	
N_2 supply	MV	10(2x5)•	11.2	5.6**	5.6°	
	LV	3(2x1.5)	2	1 **	1 *	
			53.2	33.6	29.2	
Magnet power supply	HV					
Main ring				26.88 (8x3.36)	7.6 (8x0.95)	
East cluster				1.81	0.36	
West cluster				4.81	2.56	
Abort & transf lines				8 (2x4)	7.6 (2x3.8)	
				41.5	18.12	
RF power supply	HV			8 (2x4)	8 (4x2)	feeders RF1,RF2
	LV			1 (2x0.5)	1 (2x0.5)	
				9*	9*	
Surf. house power supply	LV			7.68*	7.68*	
Underground						
Tunnel & halls tech	LV			8	3	
Tunnel & halls util	LV			6.2	6.2	
				14.2*	9.2*	
Experiments				16 (4x4)*	12 (4x3)*	
Σ main ring + exp halls				122	85.1	
Σ				177.8	117.3	
Σ with diversity factor of 1.32 applied on * and ** not added up				156.5	104.5	
				(144.4 without experiments)	(95.4 without experiments)	

NB: • as in the CDR; must be 2x7.5 MVA

serving the farm. The National Electrical Safety Code, ANSI C2-1984, addresses this situation in Section 97D and requires a spark gap to interconnect the two neutrals.

DEMAND AND DIVERSITY FACTORS

261. Demand Factor. The ratio of maximum demand to total load connected, expressed as a percentage, is termed the demand factor of an installation. For example, if a residence having equipment connected with a total rating of 6000 W has a maximum demand of 3300 W, it has a demand factor of 55%. Demand factors of various types of large loads are helpful in designing systems, particularly those in buildings. As an example, a single household electric clothes dryer, of course, has a demand factor of 100%, but 25 dryers in a group have a demand factor of 33%. Similarly, three to five all-electric apartments in a multifamily dwelling have a demand factor of 45%. The lower the demand factor, the less system capacity required to serve the connected load. However, summer air conditioning and winter electric heating are loads that make for high demand factors.

262. Coincidence or Diversity Factor. The coincidence factor is defined as the ratio of the maximum demand of the load as a whole, measured at its supply point, to the sum of the maximum demands of the component parts of a load. The diversity factor is the reciprocal of the coincidence factor. Coincidence factors can be applied to known consumer demands for estimating the loading of distribution transformers, lines, and other facilities. Coincidence factors for residential consumers can vary over a wide range for different types of consumers. The coincidence factor for a large group of consumers with no major appliance might be as low as 30%, whereas a group of electric-heating consumers might be as high as 90%.

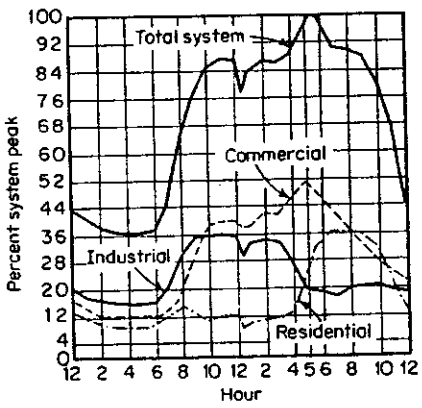


FIG. 18-66 Characteristic metropolitan load pattern.

263. Diversity between Classes of Users. The daily-load curve of a utility is a composite of demands made by various classes of users. The load curve on the day of maximum total system peak occurs when class loads gang up to create this maximum demand for the year. This is not necessarily the day, and usually is not the day, of any particular class peak. Class load curves on the day of system peak are illustrated in Fig. 18-66.

Air-conditioning loads have shifted these curves for many systems to cause daytime peaks during hot weather in the summer. Electric house heating builds heavy morning and evening loads during cold weather in the winter.

TABLE 18-24 Diversity Factors

Elements of system between which diversity factors are stated:	Diversity factors for			
	Residence lighting	Commercial lighting	General power	Large users
Between individual users	2.0	1.46	1.45	
Between transformers	1.3	1.3	1.35	1.05
Between feeders	1.15	1.15	1.15	1.05
Between substations	1.1	1.10	1.1	1.1
From users to transformer	2.0	1.46	1.44	
From users to feeder	2.6	1.90	1.95	1.15
From users to substation	3.0	2.18	2.24	1.32
From users to generating station	3.29	2.40	2.46	1.45

264. Diversity in the Feeder System. The diversity of demands by transformers on a radial feeder makes the maximum load on the feeder less than the sum of the transformer loads. The diversity factors of a feeder vary greatly depending upon load conditions. Some typical diversity factors are given in Table 18-24. The diversity factor of lighting feeders ranges from 1.1 to 1.5, while that of mixed light-and-power feeders is likely to be 1.5 to 2 or more. At the substation there is also a diversity factor of 1.05 to 1.25 between the sum of feeder maxima and the substation maximum. A large system has a further diversity factor between substations of 1.05 to 1.25.

265. Total diversity factors in a large system are somewhat as in Table 18-24.

DISTRIBUTION ECONOMICS[1]

266. Economic Comparisons. The most straightforward and generally applicable technique to use in distribution-system investment problems is that of making economic comparisons on the basis of the present value of all future annual costs. That is, the economic choice is the one with the lowest present value of all future costs. With this as a criterion, the procedure for making an economic comparison between alternatives is a simple two-step operation, that is,

a. Estimate for each alternative the annual costs for each year.

b. If annual costs are not uniform, calculate their present value.

267. Time Value of Money. Money does have time value, and rent or interest on its use has to be paid. It is obvious that an alternative which requires the least expenditure immediately would be best, everything else being equal.

The process of taking money and finding its equivalent value at some future time is called a "future worth" or "future value" calculation. This calculation is the same as that used in determining the effect of compound interest.

If 8% is the established interest rate, then \$100 today is equivalent to $\$100(1 + 0.08)$ or \$108 a year from now, and $100(1 + 0.08) + 100(1 + 0.08) \times 0.08 = 100(1 + 0.08)^2$ 2 years from now, and $100(1 + 0.08)^{10}$ 10 years from now. The expression $(1 + i)^n$ is called the single payment compound amount factor, where i is the interest rate and n is the number of years. These factors and others are readily available for various interest rates and number of years in economic books such as *Principles of Engineering Economy* by Eugene L. Grant.

It should be noted that the use of 8% for the interest rate is for illustrative purposes only. The actual interest rate to use will be determined by the economic conditions at the time.

Hence, to find the future worth of \$100, 10 years later in the above example, first, look up the compound amount factor in the 8% interest table for year 10, then multiply it by 100. The compound amount factor for this case is 2.159 and the future worth calculates to be $100(2.159) = \$215.90$.

The process of finding the equivalent value of money at some earlier time is called a "present worth" or "present value" operation.

The present worth calculation is the reverse of the future worth calculation. If \$100 today has a future worth a year from now of \$108, then we can also say that \$108 a year from now has a present worth of \$100 today. The present worth factor is the inverse of the future worth factor, and it also may be found in interest tables. Since the future worth factor for n years is $(1 + i)^n$, where i is the interest rate, the present worth factor is $1/(1 + i)^n$.

To determine the present worth, as of today, of a \$100 cost anticipated to be incurred 2 years from now where the interest rate is 8%, first the present worth factor of 0.8573 is obtained from interest tables. Then multiplying this factor by \$100 gives the present worth of $\$100(0.8573) = \$85.73$.

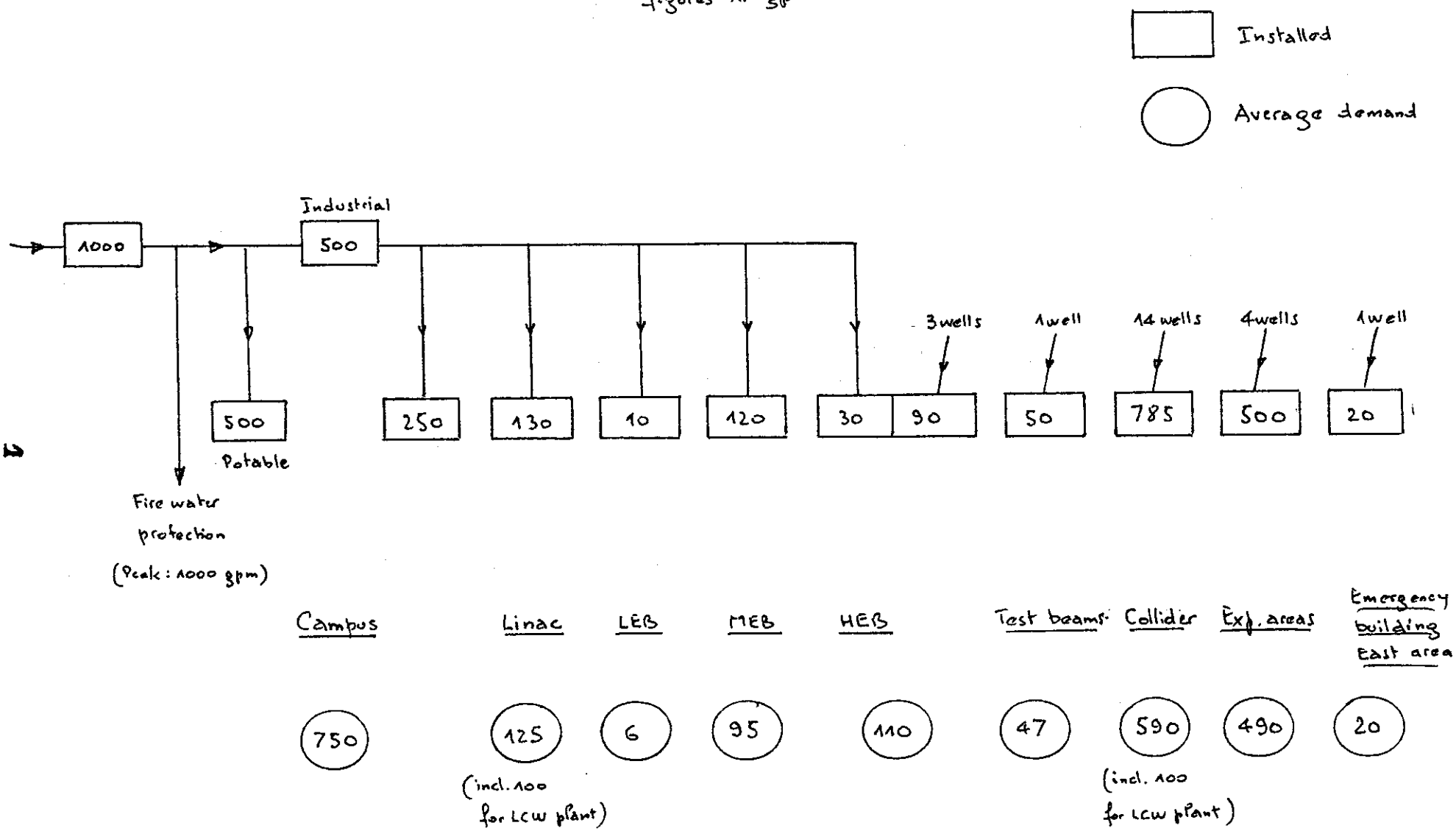
Formulas for calculating the compound interest factors and a graphical interpretation of these factors are shown in Fig. 18-67.

268. Annual Charges. It is desirable to have a convenient method of calculating the annual costs of capital investments made in an alternative scheme. Fortunately, this can be done by using a level carrying charge which is expressed as a percentage of the original investment.

[1] Also see Sec. 13.

Schematic of the water network

figures in gpm.



Annex 3

SSC
Tentative Staffing Distribution and Location (FY99)

	SSC-N-191 Tables 4&11	Central Lab & Offices D/A*	Central Lab & Offices Total	Heavy Works Bldgs	Shop Bldgs	Ware-houses	Mics Bldgs D/A	Mics Bldgs Total	Injector D/A	Injector Total	Collider D/A	Collider Total	Experimental Areas D/A	Experimental Areas Total	Total D/A	Remarks
Director's Office & Project Support	66	66	66												66	General: Day/average means the number of people needing office or lab or shop space during day time taking also into account those who work by shifts.
Division Office	18	18	18												18	
Planning & Budget	28	28	28												28	
Reporting	10	10	10												10	
Q/A	5	5	5												5	
Safety	5	5	5												5	
Accelerator Oper Division	563	293	413						10	50	20	100			323	
Division Office	18	18	18												18	
Injector	170	80	120						10	50					90	50 shifts of 10 people (injector) 10 people (control room)
Collider	275	95	175								20	100			115	5 shifts of 20 people (collider) 20 people (control room)
Magnets	35	35	35												35	
Accelerator Sys	35	35	35												35	
Acceler Physics	30	30	30												30	
Accelerator Equip	125	75	75	25	25										125	
Accelerator Imp.	100	50	50	25	25										100	
Conventional Syst.	355	73	215		50		18	90							141	
Division Office	10	10	10												10	
Plant Engineering	45	45	45												45	
Buildings/Grounds	110	10	60		50										60	Gardeners don't need office space
Security	40	8	40												8	5 shifts of 8 people
Fire Protection	40						8	40							8	5 shifts of 8 people
Custodial	110		60				10	50							10	Janitors don't need office space 5 shifts of 10 people (gate-keepers)

* Day/Average

SSC: Tentative Staffing Distribution and Location (FY99)
Page 2

	SSC-N-191 Tables 4&11	Central Lab & Offices D/A*	Central Lab & Offices Total	Heavy Works Bldgs	Shop Bldgs	Ware-houses	Mics Bldgs D/A	Mics Bldgs Total	Injector D/A	Injector Total	Collider D/A	Collider Total	Experimental Areas D/A	Experimental Areas Total	Total D/A	Remarks
Tech Support Div	650	87	167	323	50	55	5	55							520	
Division Office	12	12	12												12	
Eng. Services	110	50	50	60											110	
Technicians	110	10	50	60											70	5 shifts of 10 people
Shops: computer	55	15	55												15	5 shifts of 10 people
E/M Shops	110			110											110	
Craft Shops	110			60	50										110	
E/M Equipment	33			33											33	
Warehouse	55					55									55	
Transportation	55						5	55							5	50 persons don't need office space
Administration Div	230	222	230												222	
Division Office	4	4	4												4	
Procur./Contracts	30	30	30												30	
Payroll/Acct	35	35	35												35	
Personnel	30	30	30												30	
Staff Services																
Visitors/PR	22	22	22												22	
Travel/Transport	34	34	34												34	
Communication	10	10	10												10	
Contract Service	10	10	10												10	
Env./Health	20	12	20												12	5 shifts of 2 people
Tech Information	35	35	35												35	
Physics Sup Div	400	100	100										170	300	270	
Division Office	10	10	10												10	
Physics	130	30	30										100	100	130	
Technical Support	130	30	30										20	100	50	5 shifts of 20 technicians
Comp,Data Anal.	130	30	30										50	100	80	2 shifts of 50 physicists, data analysts
Visiting Scient.	500	50	50										290	450	340	
Physic Res & Comp.	50	50	50												50	
Experiments	450	50	50										240	400	290	2 shifts of 160 physicists (40/experiment)
Total	2989	1016	1366	373	150	55	23	145	10	50	20	100	460	750	2107	

* Day/Average