Section 15 Schedule

The estimated schedule is based on installation occurring during the two (or three) month-long summer downs for PEP-II and the SLAC linac. The accelerator components for the VLER ring will be made during PEP-II running period and installed on “rafts” outside the tunnel. The rafts are then rapidly installed during the down time. The locations of the entire VLER and injector are under crane coverage.

Historically, PEP-II was installed in a similar fashion with the HER being installed first and the LER second. These accelerators were installed with an average of about 5 m of HER beamline installed per working day and 10 m of LER installed per day. To install VLER in a single nine week down, less than a meter of accelerator beamline need to be installed per day.

A rough schedule is shown in Table 15-1. The first summer installation will include the injector, VLER support floor, VLER cables, and modifications to the LER and HER rings. The second summer down concentrates on the installation of the VLER ring, the interaction region magnet, and the physics detector.

Table 15-1 Approximate PEP-N Schedule

Summer 2001	PEP-N proposal approved
Summer 2002	Injector gun, linac and transport lines installed
	VLER support floor installed
	VLER cables installed
	LER modifications
	HER modifications
October 2002	First injector beam tests
Summer 2003	VLER ring installed
	Detector magnet installed
	Detector installed
October 2003	First VLER injected beam tests
January 2004	First collisions

Section 16 Cost Estimate

A cost estimate for PEP-N is shown in Table 16-1. The estimates are divided into categories for the modifications of LER, VLER ring, injector and transport system, utilities, controls, and modifications of HER.

The sources for cost estimates are PEP-II actual construction costs including inflation, discussions with local experts on various subsystems, recent costs of Accelerator Improvement Projects at SLAC, SLAC shop rates, and recent purchases of industrial components.

For each sub-component there is an estimate for all sub-parts. For example, a dipole magnet has costs for magnet construction, supports, cabling, and power supplies. Where accelerator components already exist, costs for refurbishing are included.

As most all components are already designed and many built, the engineering, design, and layout costs concentrate on manufacturing and installation. Many of the individual costs already include the engineering and design effort.

The cost estimate is about 6.6 M$. We have placed a 50% contingency on the estimate which is 3.3 M$, for a total of about 9.9 M$.

We can compare this amount to two often used cost approximations: (1) If each meter of accelerator costs 50 k$ per meter (without the tunnel), then the PEP-N VLER and its injector (about 90 m) should cost about 4.5 M$. (2) If the two rings in PEP-II cost 177 M$ and have a length of 4400 m in total, then the cost of the 90 m of VLER and its injector should be about 3.6 M$. Both of these approximate estimates are lower than our detailed cost estimate.

Table 16-1 PEP-N cost estimate

Component	Status	Items	Cost per item	Total Cost per item
LER costs:				
IP orbit dipole (correction)	Existing dipole magnets	4	1	4
IP Orbit dipole supports		4	5	20
IP Orbit dipole cables		2	3	6
IP Orbit dipole power supplies		2	15	30
Move ring quadrupole		1	15	15
Additional ring quadrupole		1	15	15
Additional ring quad power supplies		2	15	30
Additional ring quad power cables		2	3	6
Additional low pressure vacuum cham.		20 m	2.5	50
VLER Costs:				
Dipole main ring	Die and some laminations exist	8	20	160
Dipole main ring supports		8	5	40
Dipole main ring cables		1	5	5
Dipole main ring power supply		1	30	30
Quadrupole main ring	Die and some laminations exist	20	15	300
Quadrupole main ring supports		20	5	100
Quadrupole main ring cables		10	4	40
Quadrupole main ring power supplies		10	15	150
Permanenet magnet quadrupoles		2	50	100
Permanenet magnet quad support		2	7	14
Sextupole	Some laminations exist	6	10	60
Sextupole supports		6	5	30
Sextupole cables		3	5	15
Sextupole power supply		3	15	45
Dipole corrector magnets	Ycors exist, Xcors backlegs	16	0	0
Dipole corrector supports		8	1	8
Dipole corrector cables		16	1	16
Dipole corrector power supplies		16	1.2	20
Skew quadrupole		2	10	20
Skew quadrupole supports		2	5	10
Skew quadrupole cables		2	3	6
Skew quadrupole power supply		2	10	20
RF cavity	Use existing PEP-II prototype	1	50	50
RF cavity support		1	10	10
RF power driver 2000 W		1	100	100
RF controls		1	100	100
RF phase control		1	10	10
RF temp control		1	40	40
Position monitors	Use existing PEP-II design	18	5	90
Vacuum system		35 m	10	350

Vacuum controls		1	150	150
Tune monitor		1	35	35
Synchrotron light monitor		1	60	60
Current monitor		1	40	40
Longitudinal feedback system		1	250	250
Transverse feedback system		1	150	150
Installation		1	400	400
Alignment		1	50	50
Magnets interlocks		1	100	100
Injector linac and transport:				
Gun and pulser		1	250	250
Clean accelerating structures	Eight 3-m structures exist	8	3	24
Accelerator supports		8	4	32
Relocate accelerator waveguide	Waveguides exist	8	4	32
Accelerator waveguide H2O plumbing		8	4	32
Dipoles (DR style)	Design exist	12	10	120
Dipole supports		12	5	60
Dipole cables		2	5	10
Dipole power supply		2	20	40
Quadrupoles	Old linac quads A and B exist	16	0.5	8
Quadrupole supports		16	2	32
Quadrupole power supplies		16	4	64
Quadrupole cables		16	1	16
Dipole correctors	Linac dipole correctors exist	16	0	0
Dipole corrector supports		16	1	16
Dipole corrector power supplies		16	1.2	20
Dipole corrector cables		16	1	16
Position monitors		10	3	30
Current toroid	Exist	2	10	20
Profile monitor	Exist	2	10	20
Vacuum system		20 m	5	100
Vacuum controls		1	50	50
Relocate klystron	Exists from linac sector 20	2	10	20
Relocate klystron modulator	Exists from linac sector 20	2	10	20
Relocate klystron controls		2	10	20
Klystron power supply		1	20	20
Septum		1	50	50
Kicker		3	25	75
Kicker pulser		1	50	50
Kicker cable		1	10	10
Kicker ceramics		3	15	15
Linac installation		1	300	300
Linac alignment		1	50	50
Building and Utilities:				
VLER floor		1	150	150
Water heater for linac 112 deg		1	50	50
Holes in shield wall		3	10	30

Extra radiation shielding		1	50	50
AC power installation		1	100	100
Water distribution system		1	100	100
Accelerator Controls:				
Micro-computer	Use existing PR12	1	3	3
CAMAC crates		3	7	21
PPS interlocks		1	100	100
Control-power supply racks (dou. bay)		4	11	44
Software database work		1	100	100
HER costs:				
Steering correctors	Ring correctors exist	2	0	0
Steering corrector power supplies		2	1	2
Steering corrector cables		2	1	2
Move HER quadrupole		1	10	10
Additional HER quadrupole		1	15	15
New HER quadrupole power supplies		2	25	50
New HER quad power supplies cables		2	4	8
New HER vacuum chamber		1	10	10
Engineering and Design costs:				
Engineer		2 yr	90	180
Designer		4 yr	75	300
Drafter		4 yr	70	280
Project itemized total (k$)				6617
Project contingency (50%)				3309
Total project (k$)				9926

Section 17 References

1. “PEP-II Conceptual Design Report”, SLAC –418, June 1993.
2. J. Seeman, et al, “PEP-II Performance”, EPAC 2000, Vienna, June 2000.
3. M. Sands, “ The Physics of Electron Storage Rings”, SLAC-121, May 1979.
4. P. Ivanov, III ICFA Workshop on Advanced Beam Dynamics (1989).
5. K. Hirata and E. Keil, “Coherent Beam-Beam Interaction Limit in Asymmetric Ring Colliders”, Physics Letters B, Vol 232, N. 3, p. 413, December 1989.
6. K. Hirata and E. Keil, “Barycentre Motion of Beams due to Beam-Beam Interaction in Asymmetric ring Colliders”, NIM A292 (1990) 156-168.
7. A. Piwinski, “Intrabeam scattering”, Proc. CAS CERN 87-03.
8. H. Grote, F.Ch. Iselin, “The MAD Program”, CERN/Sl/90-13(AP).
9. J.Bjorken, S.Mtingwa, “Intrabeam scattering”, Part. Accel. 13:115-143,1983.
10. J. Le Duff, “Single and multiple Touschek effects”, Proc. CAS CERN 89-01.