1. Requirements:

Injector systems shall include all accelerators, damping rings and support spaces to house the polarized electron sources, positron sources/capture sections, booster linacs, damping rings, pre-linacs, and collimation as well as all associated transport beam lines, and dumps. Injector systems shall also include all support housings for the required klystron, mechanical and electrical galleries supporting the associated beam lines.

2. Technical Descriptions:

Injector systems are planned for one of two different configurations, one configuration is remote and one is centralized. The remote configuration places the electron and positron injectors at opposite ends of the NLC. The centralized configuration places both the positron and electron injectors near the center of the NLC. Both remote and centralized configurations place the injector complex beam housings at or near the ground surface with transition ramps to convey the injector beams to the alignment elevation of the main linac.

2.1 Systems

Centralized Injector Housing System Schematic:

(insert detailed graphic)

Note: Positron source vaults are shown in 1 X 4 configuration. Other positron vault layouts are possible.
Remote Positron Injector Housing System Schematic:

Note: Positron source vaults are shown in 2 X 2 configuration. Other possible layouts include 1 X 4, 4 X 1, and 2 X 1 with an accumulator ring.

Remote Electron Injector Housing System Schematic:

2.2 Parameter Table

Positron Sources and Booster System

Positron Sources and Booster shall include all housing required to house and support the following beam line components:

<table>
<thead>
<tr>
<th>Component</th>
<th>Length</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>PESRC1</td>
<td>35 Meters</td>
<td>e- Source-1 and transport to Drive Linac</td>
</tr>
<tr>
<td>PESRC2</td>
<td>35 Meters</td>
<td>e- Source-2 and transport to Drive Linac</td>
</tr>
<tr>
<td>PESRC1D</td>
<td>5 Meters</td>
<td>e- Source-1 Dump</td>
</tr>
<tr>
<td>PESRC2D</td>
<td>5 Meters</td>
<td>e- Source-2 Dump</td>
</tr>
<tr>
<td>PELIN</td>
<td>531 Meters</td>
<td>e- Drive Linac for positron production</td>
</tr>
<tr>
<td>PETL1</td>
<td>36.3 Meters</td>
<td>e- Transport for positron production -Target 1</td>
</tr>
<tr>
<td>PETL2</td>
<td>36.3 Meters</td>
<td>e- Transport for positron production -Target 2</td>
</tr>
<tr>
<td>PETL3</td>
<td>102.4 Meters</td>
<td>e- Transport for positron production -Target 3</td>
</tr>
<tr>
<td>PETL4</td>
<td>102.4 Meters</td>
<td>e- Transport for positron production -Target 4</td>
</tr>
<tr>
<td>PCAP1</td>
<td>115.3 Meters</td>
<td>e+ Capture Section-1 and transport to Booster Linac</td>
</tr>
<tr>
<td>PCAP2</td>
<td>115.3 Meters</td>
<td>e+ Capture Section-2 and transport to Booster Linac</td>
</tr>
</tbody>
</table>
Conventional Facilities Configuration - Injectors

PCAP3  49.2 Meters  e+ Capture Section-3 and transport to Booster Linac
PCAP4  49.2 Meters  e+ Capture Section-4 and transport to Booster Linac
PCAP1D 5 Meters  e+ Capture Section-1 Dump
PCAP2D 5 Meters  e+ Capture Section-2 Dump
PCAP3D 5 Meters  e+ Capture Section-3 Dump
PCAP4D 5 Meters  e+ Capture Section-4 Dump
PBSTR 186 Meters  e+ Booster Linac

Electron Sources and Booster System

Electron Sources and Booster shall include all housing required to house and support the following beam line components:

ESRC1  35 Meters  e- Source-1 and transport to Drive Linac
ESRC2  35 Meters  e- Source-2 and transport to Drive Linac
ESRC1D 5 Meters  e- Source-1 Dump
ESRC2D 5 Meters  e- Source-2 Dump
EBSTR 173 Meters  e- Booster Linac

Positron Damping Ring System

Positron Damping shall include all housing required to house and support the following beam line components:

PLTR  47.9 Meters  e+ Transport to Pre-Damping Ring Injection
PLTRD 5 Meters  e+ Transport to Pre-Damping Ring Dump
PPDR  e+ Injection into Pre-Damping Ring
PPDR  218 Meters  e+ Pre-Damping Ring
PPDRX  e+ Extraction from Pre-Damping Ring
PXFER  176.9 Meters  e+ Transport from Pre-Damping Ring Extraction
to Damping Ring Injection
PDRI  e+ Damping Ring Injection
PDR  297 Meters  e+ Damping Ring
PDRX  80.2 Meters  e+ Damping Ring Extraction to Spin Rotation
PSR  93.5 Meters  e+ Spin Rotation

Electron Damping Ring System

Electron Damping shall include all housing required to house and support the following beam line components:

ELTR  80.2 Meters  e- Transport to Damping Ring
ELTRD 5 Meters  e- Transport to Damping Ring Dump
EDRI  e- Damping Ring Injection
EDR  297 Meters  e- Damping Ring
EDRX  80.2 Meters  e- Damping Ring Extraction
Conventional Facilities Configuration - Injectors

ESR 104.35 Meters e- Spin Rotation

Positron Pre-Linac System

Positron Pre-Linac shall include all housing required to house and support the following beam line components:

- **PBC1** 93.5 Meters e+ First Bunch Compressor
- **PBC1D** 5 Meters e+ First Bunch Compressor Dump
- **PPLIN** 503 Meters e+ Pre-Linac
- **PPLIND** 5 Meters e+ Pre-Linac Dump
- **PPVTL** 150.38 Meters e+ Pre-Linac Vertical Transport Line (raised injection only)
- **PPLTL** e+ Pre-Linac Long Transport Line (centralized injection only)
- **PPCOL** 72.74 Meters e+ Pre-Linac Collimation
- **PPRBX** 214.06 Meters e+ Pre-Linac Reverse Bend Transport to Bunch Compressor 2 (centralized injection only)
- **PBC2** 163.36 Meters e+ Bunch Compressor 2
- **PBC2X** 115 Meters e+ Bunch Compressor 2 Chicane
- **PBC2D** 5 Meters e+ Bunch Compressor 2 Dump

Electron Pre-Linac System

Electron Pre-Linac shall include all housing required to house and support the following beam line components:

- **EBC1** 104.35 Meters e- First Bunch Compressor
- **EBC1D** 5 Meters e- First Bunch Compressor Dump
- **EPLIN** 503 Meters e- Pre-Linac
- **EPLIND** 5 Meters e- Pre-Linac Dump
- **EPVTL** 150.38 Meters e- Pre-Linac Vertical Transport Line (raised injection only)
- **EPLTL** e- Pre-Linac Long Transport Line (centralized injection only)
- **EPCOL** 72.74 Meters e- Pre-Linac Collimation
- **EPRBX** 214.06 Meters e- Pre-Linac Reverse Bend Transport to Bunch Compressor 2 (centralized injection only)
- **EBC2** 163.36 Meters e- Bunch Compressor 2
- **EBC2X** 115 Meters e- Bunch Compressor 2 Chicane
- **EBC2XD** 5 Meters e- Bunch Compressor 2 Dump

3. Technical Issues:

3.1 Radiation Shielding
The various beam dumps, or absorbers, in the injectors and throughout the NLC, are single ended occupancies with limited, infrequent access. They are relatively straightforward to design and construct as far as radiation containment and civil construction go. Within the injector systems however the positron source areas and the damping rings have higher radiation levels with complicated access and proximity relationships, all to make radiation containment a challenging engineering-design effort and very likely an expensive one to construct. Full solutions have yet to be derived. Housing separations and shielding may add to beam housing lengths and dimensions.

3.2 Centralized Injection Systems and Vibration Density

The centralized injection configuration seeks to place as much of the NLC facility as possible on an existing laboratory site. This adds to the already existing cultural noise and utility equipment vibration at the site. As the high and low energy experimental halls would be centrally located, and in near proximity to the injectors, and are most sensitive to ground vibration, the impact of adding the full injector complex nearby is questioned.

4. Discussion of Configuration Choices:

The central injector configuration choice is advantageous as it places as much of the total NLC complex as possible in a central location at an existing laboratory site. However the degree to which this adds increased costs is not yet fully determined. Savings would accrue from avoided land costs off-site which are thought to be high in an urban area. However additional beam housings would be needed and these would have an added cost.

The remote injection configuration requires less total beam housing compared to the centralized injector configuration. Only two 180 degree compression arcs are needed for remote injection where centralized injection requires two 360 degrees arcs.

The central injection complex is not at the same elevation as the main linac so it requires ramped housing sections to transport beam from the central injectors down to the elevation of the main linacs. The remote injector configuration does not automatically mandate the use of ramping sections to change elevation, but may only employ them to better match surface topography where a cost savings is possible. Centralized injection requires ramped housings. They are optional with remote injectors and are a cost savings option if used at all.