SLAC MEMORANDUM

February 18, 1999

TO:  
M. Ross  M/S 66  
C. Spencer  M/S 12  
P. Krejciik  M/S 18  
C. Corvin  M/S 21  
J. Ives  M/S 21  
R. Ruland  M/S 21  
H. Schwarz  M/S 33  
P. Bellomo  M/S 49  
J. Lipari  M/S 49  
R. Cassel  M/S 49  
C. Pappas  M/S 49  
A. Donaldson  M/S 49  
R. Humphrey  M/S 50  
S. Smith  M/S 50  
R. Fuller  M/S 50  
P. Rodriguez  M/S 51  

D. Burke  M/S 66  
J. Cornuelle  M/S 66  
J. Sheppard  M/S 66  
K. Jobe  M/S 66  
K. Millage  M/S 66  
M. Woodley  M/S 66  
T. Raubenheimer  M/S 66  
P. Emma  M/S 66  
R. Larsen  M/S 66  
J. Sevilla  M/S 66  
B. Prentiss  M/S 90  
R. Tankersley  M/S 90  
J. Corlett  LBNL  
R. Rimmer  LBNL  
J. Rasson  LBNL  
S. Marks  LBNL  

FROM: Bobby McKee,  Mech Engr  
x 2835,  M/S 12  

SUBJECT: NLC Damping Ring System Design Kick-off Meeting

The NLC damping ring system design kick-off meeting was held at 9:00am Wednesday, February 17, 1999 in the computer center video conferencing room. Enclosed are some of the presentation materials.

In brief summary we would like to make the following points:

1. Any questions on the damping ring system design should be directed to either Marc Ross or Bobby McKee.

2. Look to the “Statement of Work” for project definitions such as interfaces.

3. Our next major system design thrust is the Preliminary Design Review (PDR) (To be held towards the end of this year).

We would like to thank everyone who participated in this meeting. Information exchange is the utmost importance on a project of this size and to this end we hope this kick-off meeting served this purpose. If there are any questions please contact Bobby McKee at x2835. Thank you.

Bobby McKee  
Project Engineer

Marc Ross  
Project Manager
<table>
<thead>
<tr>
<th>Time</th>
<th>Session</th>
<th>Presenter(s)</th>
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<tbody>
<tr>
<td>9:00</td>
<td>INTRODUCTION</td>
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<td></td>
<td>Project description</td>
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<td></td>
<td>CD1 configuration</td>
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<td>Organization</td>
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<td>NLC system integration</td>
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<td>R&amp;D</td>
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<tr>
<td>9:10</td>
<td>SYSTEM SPECIFICATIONS</td>
<td>ROSS</td>
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<td>9:15</td>
<td>OVERALL SCHEDULE</td>
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<td>9:20</td>
<td>ENGINEERING PLAN</td>
<td>MCKEE</td>
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<td>Objectives &amp; tasks</td>
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<td>9:45</td>
<td>DESIGN STATUS/COMMENTS</td>
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<td>Systems configuration</td>
<td>McKee</td>
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<td></td>
<td>Vacuum</td>
<td>Corlett</td>
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<td>Wiggler</td>
<td>Pappas</td>
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<tr>
<td></td>
<td>Kicker</td>
<td>Schwarz</td>
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<td>RF</td>
<td>Bellomo</td>
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<td>DC Power</td>
<td>Fuller</td>
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<td>Electrical instrumentation &amp; controls</td>
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<td></td>
<td>Cabling</td>
<td>Corvin</td>
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<td></td>
<td>Facilities</td>
<td>Ruland</td>
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<tr>
<td></td>
<td>Survey &amp; alignment</td>
<td>Ross</td>
</tr>
<tr>
<td></td>
<td>Safety &amp; hazards</td>
<td>MCKEE</td>
</tr>
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</table>

**NO ACTIONS ITEMS PLEASE. I ALREADY HAVE TOO MUCH STRESS.**
Damping Ring System Engineering

Goal: Ensure the proper ring functioning; make sure that system components work properly together.

Ring operation is pivotal for the collider. Its many subsystems must work in a variety of extreme conditions. The purpose of the ring system reviews is to provide a mechanism for ensuring this.

Ring subsystems are unique within the linear collider. Cost advantages based on large scale mass production may not be possible and cost tradeoffs will be difficult to estimate.

The purpose of the Design Reviews, to be conducted by the Ring chief engineer, is to evaluate the component designs with respect to each other and with respect to the ring as a whole. There will be three such reviews, on a timeline to be presented. Component and subsystem designs will be presented and critically looked at in the ways to be outlined. Following NLC project-wide design review guidelines, the review will be documented.

CD-1

Our CD-1 baseline Damping Ring complex consists of 3 rings and 5 associated transport lines. The status of the bypass lines and the number of beam dumps will be decided soon.

The CD-1 MDR optics were completed 12/98 by P. Emma. The PPDR optics work is in progress now. An updated PPDR draft design should be available in a month.
Work remaining to be done on the design of both rings include beam dynamics evaluation of collective effective, optical optimization including dynamic aperture. The results of these will provide input to subsystem tolerances and design rules. Discussions are underway on the strategy for getting this work done.

Organization

T. Raubenheimer     Accelerator Physics
B. McKee            Project Engineer
M. Ross             Project Manager
J. Sheppard          Injector Systems Manager
K. Millage           Injector Project Planner
J. Corlett          Manager of LBNL NLC effort

Electrical Systems
Mechanical Systems
Conventional Facilities
<table>
<thead>
<tr>
<th></th>
<th>Pre-DamRing</th>
<th>Main Damping Rings</th>
</tr>
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<tbody>
<tr>
<td><strong>Energy</strong></td>
<td>1.9-2.1 GeV</td>
<td>1.9-2.1 GeV (nom. 1.98)</td>
</tr>
<tr>
<td><strong>Circ.</strong></td>
<td>214 meters</td>
<td>297 meters</td>
</tr>
<tr>
<td><strong>Revolution period</strong></td>
<td>1.401 MHz (Trev=714ns)</td>
<td>1.01 MHz (Trev=991ns)</td>
</tr>
<tr>
<td><strong>RF</strong></td>
<td>714 MHz</td>
<td>714 MHz</td>
</tr>
<tr>
<td><strong>Harmonic number</strong></td>
<td>510</td>
<td>708</td>
</tr>
<tr>
<td><strong>Inter-bunch spacing</strong></td>
<td>2.80 ns (2/.714 ns buckets)</td>
<td>2.80 ns (2/.714 ns buckets)</td>
</tr>
<tr>
<td><strong>Beam fill pattern</strong></td>
<td>2 trains 95 bunches; 2 gaps 100 ns</td>
<td>3 trains 95 bunches; 3 gaps 68 ns</td>
</tr>
<tr>
<td><strong>X,Y Damping time</strong></td>
<td>&lt; 5.21 ms</td>
<td>&lt; 5.21 ms</td>
</tr>
<tr>
<td><strong>N&lt;sub&gt;max&lt;/sub&gt;/bunch</strong></td>
<td>1.9e10</td>
<td>1.6e10</td>
</tr>
<tr>
<td><strong>I&lt;sub&gt;max&lt;/sub&gt;</strong></td>
<td>0.80 Amp</td>
<td>0.75 Amp</td>
</tr>
<tr>
<td><strong>Emittance (x/y)</strong></td>
<td>&lt;1e-4 m-rad (normalized)</td>
<td>&lt;300/3 x e-8 m-rad (normalized)</td>
</tr>
<tr>
<td><strong>Total gap voltage</strong></td>
<td>2 MV (4 cavities; 1 klystron)</td>
<td>1.5 MV (3 cavities; 1 klystron)</td>
</tr>
<tr>
<td><strong>Total losses per turn</strong></td>
<td>400KeV</td>
<td>750 KeV (increased 10% from ZDR)</td>
</tr>
<tr>
<td><strong>α&lt;sub&gt;p&lt;/sub&gt;</strong></td>
<td>0.0051</td>
<td>6.6e-4 (increased 20% from ZDR)</td>
</tr>
<tr>
<td><strong>Acceptance</strong></td>
<td>&gt; 0.06 m-rad geometric</td>
<td></td>
</tr>
<tr>
<td><strong>RF System</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Energy spread</strong></td>
<td>0.09%</td>
<td>0.09%</td>
</tr>
<tr>
<td><strong>Bunch length</strong></td>
<td>8.4mm</td>
<td>3.8mm</td>
</tr>
<tr>
<td><strong>Energy acceptance</strong></td>
<td>+/- 1.3%</td>
<td>+/- 1.9%</td>
</tr>
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</table>

The single bunch intensity is somewhat higher than that used in the luminosity table to allow for performance flexibility and margin.
<table>
<thead>
<tr>
<th>Lattice (P. Emma)</th>
<th>MDR</th>
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<tbody>
<tr>
<td>vx</td>
<td>5.17</td>
</tr>
<tr>
<td>vy</td>
<td>23.85</td>
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<tr>
<td>TME cells</td>
<td>30</td>
</tr>
<tr>
<td>Cell length</td>
<td>6.01m</td>
</tr>
<tr>
<td>Phase adv. / half</td>
<td>108/45</td>
</tr>
<tr>
<td>Straight length</td>
<td>58m</td>
</tr>
<tr>
<td>Wiggler length</td>
<td>44m</td>
</tr>
<tr>
<td>Wiggler period</td>
<td>0.27m</td>
</tr>
<tr>
<td>Wiggler field</td>
<td>2.15T</td>
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KEK - SLAC ILC Injection beam current comparison

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<thead>
<tr>
<th>Polarized electron side</th>
<th>e-/bunch</th>
<th>losses</th>
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<tr>
<td></td>
<td>KEK</td>
<td>SLAC scaled</td>
</tr>
<tr>
<td></td>
<td>KEK</td>
<td>2.9x10^10</td>
</tr>
<tr>
<td></td>
<td>SLAC</td>
<td>x2</td>
</tr>
<tr>
<td>e-gun</td>
<td>KEK</td>
<td>2.0x10^10</td>
</tr>
<tr>
<td></td>
<td>SLAC</td>
<td>x2</td>
</tr>
<tr>
<td>Buncher</td>
<td>KEK</td>
<td>1.4</td>
</tr>
<tr>
<td>30% ~30%</td>
<td>SLAC</td>
<td>1.4</td>
</tr>
<tr>
<td>1.98 GeV Linac</td>
<td>KEK</td>
<td>1.4</td>
</tr>
<tr>
<td>10% ~10%</td>
<td>SLAC</td>
<td>1.4</td>
</tr>
<tr>
<td>Main DR</td>
<td>KEK</td>
<td>1.2</td>
</tr>
<tr>
<td>8 GeV Linac</td>
<td>SLAC</td>
<td>1.2</td>
</tr>
<tr>
<td>Arc</td>
<td>KEK</td>
<td>1.1</td>
</tr>
<tr>
<td></td>
<td>SLAC</td>
<td>1.1</td>
</tr>
<tr>
<td>BC1</td>
<td>KEK</td>
<td>1.1</td>
</tr>
<tr>
<td></td>
<td>SLAC</td>
<td>1.1</td>
</tr>
<tr>
<td>BC2</td>
<td>KEK</td>
<td>1.1</td>
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<tr>
<td></td>
<td>SLAC</td>
<td>1.1</td>
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</tbody>
</table>

KEK losses: 10/6.2 GeV Linac ~10% 1.98 GeV Linac ~20% Pre DR ~20% 60%
SLAC losses: e+ target

ILC/NLC Inj. Sys Params/99
This project will cover the mechanical systems engineering and design of the three NLC damping rings and their 8 connecting transport lines. The mechanical components to be included in this effort are magnets, supports, vacuum system, diagnostics and all related interfaces. The tasks to be performed are hardware engineering and design, mechanical systems engineering, overall systems coordination including RF, facilities, controls, instrumentation, and power conversion. Also included is project cost and schedule management for the total system. Tradeoff studies addressing risk management, reliability, and cost will be conducted along with sub-component testing to support a final configuration. This effort will consist of two internal mechanical systems design reviews (PDR and IDR (Preliminary Design Review and Intermediate Design Review), as well as DOE required reviews CD1 and CDR. The objective of this project is to have a fully integrated damping ring system configured and ready for final design work at the end of CDR.
E. PROJECT TASKS

So WHAT IS THE PLAN?

Happiness and harmony in the Damping Rings. Is this a contradiction or what?
SYSTEMS! A Forgotten Child.

DR SYSTEM PROJECT

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
REGT SYS SOFT MECH CIVIL VAC ELEC RF FAC SAFE INSTRU DESIGN SUB-C MANUF ALIGN BUILD TEST INSTALL QUAL COST

sub tasks

Plan Analysis Mech Elect RF Safety Integrat Doc Sub-co Interface Verif

sub tasks

Optics Imped Mad Para Contr Spec

sub tasks

Comp Relia FM&E Logis QC Sub-co Human Safe
DR SYSTEM PROJECT

tasks

REQT SYS SOFT MECH CIVIL VAC ELEC RF FAC SEFE CONT DESIGN SUB-C MANUF ALIGN BUILD TEST INSTALL QUAL COST

sub-system

eidr pidr pipdr eiltr piltr pixfer eibcl pibcl eidrx pidrx pipdrx

component

Bends Quads Sext Special RF Vac Diagn Support

task

Engr Design Fab Assy Test Inspect Meas
DR SYSTEM PROJECT

tasks

1 2 3 4 5 6 ELEC 7 6 9 10 11 12 13 14 15 16 17 18 19 20
REQT SYS SOFT MECH CIVIL VAC RF FAC SAFE INSTRU DESIGN SUB-C MANUF ALIGN BUILD TEST INSTALL QUAL COST

sub-system

eidr pidr pipdr eiltr piltr pixfer eibcl pibcl eidrx pidrx pipdrx

procedure logistics installation checkout Documentation

sub-tasks

Prep Survey Install Vac Process Connect
4. SYSTEMS ENGINEERING

The following is a list of tasks identified as part of systems engineering. These tasks will be addressed at each design review.

- **PLANNING AND SCHEDULING**
  - Develop, implement, and update engineering plans and schedules
  - Critical path
  - Identify long lead items
  - Budget interface
  - Overall personnel requirements

- **SYSTEMS ANALYSIS EVALUATION**
  - Effect of beam dynamics
  - Impedance calculations
  - Parametric studies
  - Feedback, controls, and interlocks
  - Update specification

- **SYSTEMS INTEGRATION**
  - Integrate component and sub-system designs into overall system
  - System and subsystem reliability
  - Failure modes and effects
  - Logistics: transportation, handling, scheduling, storage, shipping, and inventory
  - Maintenance
  - Quality control
  - Management of specifications for subcontractors
  - Human factors
  - Safety and hazards coordination

- **INTERFACE CONTROL**
  - Interface Specifications and drawings

- **DESIGN REVIEWS**
  - Support DOE required design reviews (CD1 and CDR)
  - Conduct internal system design reviews (PDR and IDR)
  - Monitor component design reviews

- **DOCUMENTATION AND CONFIGURATION**
  - Layout drawings
  - Design changes management
  - Sub-contractor drawing and documentation management
  - CAD management

- **TEAM COLLABORATION**
  - Prepare and review Statement of work (SOW)
  - Manage SOW
  - Manage meetings and reviews
  - Monitor collaboration budget and schedule

- **TESTING AND REQUIREMENTS VERIFICATION**
  - Prepare and or review test plans: evaluation, qualification, acceptance
  - Witness tests
  - Validate test data and data reduction codes
  - Review data analysis: predictions, simulations, and final reports

NLC e-/e+ DAMPING RING SYSTEM CDR EFFORT • February 2, 1999
5. ENGINEERING AND DESIGN

Attached are the layouts of the damping ring system presented at the November 5, 1998 "CD1 Progress Review". The layouts show the 3 damping rings, the 5 transport lines, and the 3 bypass lines. For CD1, one of the major engineering objectives is to identify as many components and tasks as possible in order to establish a viable baseline system configuration that is fully integrated, reliable, and cost effective. The following is the engineering task structure.

ANALYSIS
- Thermal: Vacuum chamber, magnets, other components
- Vibration: Magnet movers, water system, environment, klystrons, etc
- Fluid flow: LCW circuit, pressure drops, flow rates, cooling capacity
- Electromagnetic: Coils, field strengths, fringing, magnet types
- Structural: Support stability, alignment
- Radiation: shielding, beam spray, ray trace,
- Fatigue: Thermal, handling
- Reliability: reliability analysis, redundancy, safety factors, backups
- Failure modes and effects: probabilities, impact on system, criticality, resolutions
- Critical issues: plan of action, options, trade-off studies

MATERIALS AND PROCESSES EVALUATION
- Certifications
- Corrosion: Prevention, failures
- Radiation resistance: Materials to be avoided, dosage predictions
- Process procedures: Development, available, verification
- Material properties
- Availability: long lead, stock,

FINITE ELEMENT STUDIES
- Electromagnetic: Poisson and 3-D models
- Heat transfer: ANSYS
- Stress: ANSYS

ALIGNMENT PROVISIONS DESIGN
- Design provisions into hardware: fiducials, datum, adjustments, and line-of-sight
- Active adjustment system
- Inactive adjustments

HARDWARE DESIGN
- Magnets - Bends, quads, sexts, kickers, septa, etc.
- Supports: Active, passive
- Vacuum system - Chambers, pumps, gauges, etc.
- Diagnostics - Laser wire scanners, synchrotron light monitors, etc.
- Electrical system: power supplies, instrumentation, and controls
- Interfaces - Electrical, facility, ES&H, etc.
- Fixtures: Assembly, handling, testing, and processing
- Design process - trade-off studies, evaluation criteria
- Layouts: component, subsystem, system, and schematics
- Parts lists and drawing trees
- Design review: Concept, intermediate, and final
- Identify tests: destructive, nondestructive

AUXILIARY HARDWARE CO-ORDINATION
- Cooling system: LCW circuit, heat exchangers, manifolds, tanks, etc.
Electrical system: Buss-bars, junction boxes, terminal blocks, conduits, etc.
Controls and instrumentation
Facility

TOLERANCING
GD&T = Standard and tight tolerances
Stack-up

COST ESTIMATING
Component, parts, and task count
Critical function study
Historical data: Existing designs, past performance
Off-the-shelf designs and hardware: Standard parts, vendor designs
Trade-off studies: performance and cost
Value engineering
Estimate costs
Input cost data into NLC cost structure

DEFINING WORKING UNITS
Standard designs
Standard parts
Vendors

INTERLOCK COMPONENTS DESIGN
PPS: latches, shield, sensors, doors, switches
MPS: latches, shield, sensors, doors, switches

SAFETY SYSTEM COMPONENTS DESIGN
Shields
Sensors: Radiation, oxygen, heat, and smoke
Signs, covers, and barriers
<table>
<thead>
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<th>NO.</th>
<th>TASK</th>
<th>1999</th>
<th>2000</th>
<th>2001</th>
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<td>MAJOR REVIEWS AND REPORTS</td>
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<td>CD-1 (Mission need)</td>
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<td>CD-2 (CDR baseline)</td>
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<td>CD-3 (Construction start)</td>
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<td>CD-4 (Operation starts)</td>
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<td>DOE CONCEPTUAL DESIGN REPORT (CDR)</td>
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<td>SLAC PRELIMINARY DESIGN REVIEW (PDR)</td>
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<td>SLAC FINAL DESIGN REVIEW (FDR)</td>
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<td>SLAC RF CAVITY REVIEWS</td>
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<td>LBNL WIGGLER REVIEWS</td>
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<td>WIG</td>
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<td>SLAC MAIN DR KICKER REVIEWS</td>
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<td>KIC</td>
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<td>SLAC PRE-DAMPING RING KICKER REVIEWS</td>
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<td>SLAC VACUUM CHAMBER REVIEWS</td>
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<td>CHM</td>
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Component Stuff as Required
## DR CDR work

### RD

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<tr>
<th>CDR Milestone</th>
<th>Review milestones</th>
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<th>Decision points</th>
<th>Decision Dates</th>
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<tr>
<td>RF cavity</td>
<td>Cold test</td>
<td>Cavity design; System design</td>
<td>12/99 12/00</td>
<td>HP proto req? 12/00</td>
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<tr>
<td>Wiggler</td>
<td>detailed design</td>
<td>Magnet design</td>
<td>8/99 12/00</td>
<td>EM/PM Vac chm matl 4/99 6/99</td>
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<tr>
<td>Main DR kicker</td>
<td>prototype fully beam tested</td>
<td>Magnet design Prototype design</td>
<td>6/99 12/00</td>
<td>Z/kick enough? 4/99</td>
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<tr>
<td>PPDR kicker</td>
<td>same</td>
<td>Magnet concept</td>
<td>6/00</td>
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<tr>
<td>Septa (current sheet and lambertson)</td>
<td>fully measured model</td>
<td>Model designs</td>
<td>12/99</td>
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<tr>
<td>Vacuum chamber all areas that have &lt;1e-9 torr spec</td>
<td>detailed vacuum design and general design rules</td>
<td>Design rule prop.</td>
<td>6/99</td>
<td>Ring chm matl 6/99</td>
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<tr>
<td>Special systems (MPS emittance dilution, ring size monitor...)</td>
<td>Detailed design and tests</td>
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<td></td>
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<tr>
<td>BPM</td>
<td>development unit</td>
<td></td>
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<tr>
<td>Instrumentation design work (collimators LTR/pre-linac, laser wire scanners, synch light)</td>
<td>Detailed design and tests</td>
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Rine Comolex design work:

Ring design

Transport line designs

Tolerance studies - magnet, vibration, alignment, RF, alignment, BPM's, thermal, special systems, device controller monitors

Skew correction

Operational optimization (e.g. BBA) studies

Redundancy evaluation - impact of losing a single magnet

Radiation exposure mitigation
12. DELIVERABLES

The following items are to be completed as described. All documents should be made available to the project engineer and manager according to the time line specified. The NLC damping ring system project manager and or project engineer will schedule and conduct all meetings and internal reviews.

1. ENGINEERING PLANS:
   1.1 Engineering plan for CD1 including schedule (due in January 1999)
   1.2 Engineering plan for CDR including schedule (due at CD1)

2. TABLE OF REQUIREMENTS AND SPECIFICATIONS (due before each design review):
   2.1 Tables of system, subsystem, and component specifications with documented changes
   2.2 Table of requirements and specifications for each major assembly and subassembly
   2.3 Table of interface requirements including space, utilities, and controls and interlocks

3. ANALYSIS (due before each design review):
   3.1 Magnetic field analysis including flux plots
   3.2 Thermal analysis including finite element results
   3.3 Vacuum analysis with conductance calculations and pumping speeds
   3.4 Materials analysis of magnets, chambers, and radiation absorbers
   3.5 Tolerance analysis identifying critical and tight conditions
   3.6 Tradeoff study reports of critical component
   3.7 Value engineering evaluation report on cost, functionality, and reliability
   3.8 PPS and MPS interlock system

4. DRAWINGS (due before each system design review)
   4.1 Complete set of layout drawings including alignment fiducials
   4.2 Complete set of interface drawing
   4.3 Complete set of 3d assembly and critical subassembly drawings (optional)
   4.4 Electrical schematic and layouts including power supplies and movers
   4.5 Controls and instrumentation schematic including movers
   4.6 Facility interface plan layout
   4.7 PPS and MPS interlock system logic diagram
   4.8 Cooling circuit schematic
   4.9 Synchrotron radiation beam trace

5. TESTING
   5.1 Test plans for evaluation testing of critical technologies including materials and processes (due for CD1)
   5.2 Test plan for design verification testing (due for CD1)
   5.3 Copies of both raw and reduced test data (due after each test)
   5.4 Copies of all test reports (due one month after completion of tests)

6. SUB-SYSTEM AND COMPONENT DESIGN REVIEWS
   6.1 Issue review schedule 1 month prior to review
   6.2 Issue agenda 1 week prior to each review
   6.3 Issue 1 complete drawing package to each review team member (minimum of 3 members) at least 2 days before the review
   6.4 Prepare written responses to all action items after each review
7. SYSTEM DESIGN REVIEWS

7.1 Support CD1 (a DOE design review) in spring of 1999
CD1 will primarily cover cost estimates of baseline configuration, technical risk mitigation, and overall project feasibility.

7.2 Support CDR (a DOE design review) in spring of 2001
CDR will primarily cover cost estimates of final baseline configuration with the objective of establishing funding for final design effort and initial materials procurement.

7.3 Support PDR (internal NLC Preliminary Design Review) in fall 1999
PDR is a technical design review to establish concept design configuration with emphasis on tradeoff studies and value engineering as well as risk management.

7.4 Support IDR (internal NLC Intermediate Design Review) in winter of 2000 before CDR
IDR is a technical design review to establish final design configuration with emphasis on integrated designs, technical risk mitigation, and accurate hardware and task accounting for CDR costing effort.

7.5 Support all necessary progress reviews and practice runs.

*Design review support will include the following deliverables one week prior to each review:
- Presentation of applicable information according to review format
- Specified number of copies of presentation materials
- Minimum of one copy of all supporting work including test data

8. REGULAR MEETNG

8.1 Conduct regular 1 hour weekly meetings (meeting location options are SLAC, LBNL, or teleconferencing)

8.2 Conduct monthly cost and schedule status meetings at SLAC (this meeting can coincide with the weekly meeting)

9. HARDWARE DELIVERY PLAN (due one month before DOE CDR)

9.1 Hardware delivery proposal that includes manufacturing plans, quality control, qualification testing, acceptance testing, list of deliverable hardware, and a clear identification and definition of interfaces. See section 11.

9.2 Cost and schedule for production and delivery

READ THE FINE PRINT
YOU MAYBE LIABLE.
QUESTIONS

1. What is baseline?
2. What is your approach?
3. What is your format?
4. What are some issues?
5. What do you need? (other than money and people)
6. Who will do the work?
7. Suggestions?
8. What don't you like?
9. Your personal part
10. ARE YOU HAPPY?
NLC Damping Ring System Design

Kickoff Meeting
February 17, 1999

M. Woodley

- general overview of NLC layout
- review of ZDR optics models
- NLC global coordinate system
- overview and status of optics models for CD1
WBS Beam Lines
## ZDR-level TRANSPORT decks on WWW

### JLC / NLC Accelerator Physics at SLAC

#### Index of /accel/nlc/local/lattice/zdr/decks/

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NLC Global Coordinate System

\[ X, Y, Z, \theta \text{ (yaw)}, \phi \text{ (pitch)}, \psi \text{ (roll)} \]

\[ +Z \text{ (NORTH)} \]

\[ X > 0 \]
\[ Z > 0 \]

\[ e^+ \]

\[ Y \text{ parallel to gravity} \]

\[ c^- \]
\[ X > 0 \]
\[ Z < 0 \]
General modifications to NLC optics decks for CD1

All decks will be modified as follows:

- convert from old-style TRANSPORT input format to extended Standard Input Format (XSIF)

- modify physical parameters of magnets (effective length, aperture, gap, etc.) to conform to Dieter Walz’s *NLC Magnet Families and Flavors* catalog†

- include engineering type designations in element definitions

- add explicit callouts for beam instrumentation and diagnostic devices

- add explicit callouts for collimators, scrapers, stoppers, etc.

- add explicit callouts for correction devices (steering magnets, feedback actuators, correction quadrupoles, etc.)

- each NLC area will have a single XSIF file containing only element and beam line definitions; in addition there will be one or more separate files for each area containing program-specific commands (MAD, DIMAD, etc.) which will reference, by the “CALL ... RETURN” mechanism, the corresponding XSIF file

- generate NLC Formal Device Names (FDNs)

† Soon to be updated... see John Comuelle’s talk.
NLC e- Damping Ring System Areas

ELTR : spin rotator and transport to damping ring
EDR  : damping ring
EBC1 : ring extraction, spin rotator, and first bunch compressor (“wiggler”)
EDRX : damping ring bypass line
Specific modifications to e- damping ring area optics decks for CD1

**ELTR:** spin rotator and transport line to main damping ring  
[ends at bend magnet for bypass/extraction]
- remove redundant matching section at entrance to LTR
- add space for concrete block shielding and beam stoppers (for BCS/PPS)
- change energy compressor rf from S-band to L-band

**EDRIN:** main damping ring injection system  
[ends at exit of injection kicker]
- split off from ZDR LTR deck
- match geometry to new main damping ring design

**EDR:** main damping ring
- ✓ increase circumference; add more wigglers
- ✓ new TME lattice (?)

**EDREX:** main damping ring extraction system  
[ends at bend magnet for bypass/extraction]
- split off from ZDR BCI deck
- match geometry from new main damping ring design

**BC1:** ring extraction, spin rotator, and first bunch compressor ("wiggler")
- add chicane for laser wire γ detection (after 4-wire e diagnostic section)

**EDRX:** main damping ring bypass line
- match optics into BCI D dump line

**ELTRD:** separate LTR dump line (?)
- no design exists

**BC1D:** post-BC1 dump line
- no design exists
NLC e+ Damping Rings System Areas

PBSTR : L-band booster linac (to 2 GeV)
PLTR  : transport to predamping ring
PPDR  : predamping ring
PXFER : pre-ring extraction and transport to main damping ring
PDR   : main damping ring
PBC1  : main ring extraction and first bunch compressor (“wiggler”)

PPDRX : pre-damping ring bypass line
PDRX  : main damping ring bypass line
Specific modifications to e+ damping ring area optics decks for CD1

**PLTR:** transport line to pre damping ring
[ends at bend magnet for bypass/extraction]
- remove redundant matching section at entrance to LTR
- add space for concrete block shielding and beam stoppers (for BCS/PPS)
- change energy compressor rf from S-band to L-band
- geometry changes for spin preservation for possible polarized e- operation

**PPDIN:** pre damping ring injection system
[ends at exit of injection kicker]
- split off from ZDR LTR deck
  - match geometry to new pre damping ring design (?)
  - revisit vertical (Lambertson septum) injection

**PPDR:** pre damping ring
- new lattice (?)

**PPDEX:** pre damping ring extraction system
[ends at bend magnet for bypass/extraction]
- split off from ZDR XFER deck
  - revisit vertical (Lambertson septum) extraction
  - match geometry from new pre damping ring design (?)

**PXFER:** transport line from pre damping ring to main damping ring
[ends at bend magnet for bypass/extraction]
- geometry changes for spin preservation for possible polarized e- operation

**PDRIN:** main damping ring injection system
[ends at exit of injection kicker]
- split off from ZDR XFER deck
  - match geometry to new main damping ring design

**PDR:** main damping ring
- increase circumference; add more wigglers
  - new TME lattice (?)

**PDREX:** main damping ring extraction system
[ends at bend magnet for bypass/extraction]
- split off from ZDR BCI deck
  - match geometry from new main damping ring design

**PBCI:** ring extraction, spin rotator, and first bunch compressor ("wiggler")
- add chicane for laser wire γ detection (after 4-wire ε diagnostic section)
PPDRX:  pre damping ring bypass line
  - no design exists
  - geometry changes for spin preservation for possible polarized e-operation

PDRX:  main damping ring bypass line
  - no design exists
  - match optics into BC1D dump line
  - geometry changes for spin preservation for possible polarized e-operation

PLTRD: separate LTR dump line (?)
  - no design exists

PBC1D: post-BC1 dump line
  - no design exists
## NLC Damping Ring System Total Parts Count

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**BPMs**
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- 2041020075
- 56
- 118
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- 118

**PUMPS**
- Ion pump 25 l/s
- Ion pump 75 l/s
- Ion pump 200 l/s
- Ion pump 300 l/s
- Ion pump 400 l/s
- Titanium 600 l/s
- Titanium 1200 l/s
- Titanium 1500 l/s
- Turbo V3000F VARION

**PUMP TOTALS:**
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- 295
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- 295

**GAUGES**
- Stainless steel gauges
- Hot filament gauges
- Pressure gauges

**GAUGES TOTALS:**
- 96
- 96
- 96
- 96
- 96
- 96
- 96
- 96
- 96
- 96
- 96

**VALVES**
- Valve valves
- Manual valves

**VALVES TOTALS:**
- 24
- 24
- 24
- 24
- 24
- 24
- 24
- 24
- 24
- 24
- 24

**AUXILIARY**
- Leak checker

**AUXILIARY TOTALS:**
- 1
- 1
- 1
- 1
- 1
- 1
- 1
- 1
- 1
- 1

**GRAND TOTALS:**
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- 674
- 470
- 178
- 190
- 189
- 338
- 338
- 131
- 131
- 153
- 3464
## NLC DAMPING RING BEAMLINE COMPONENTS COUNT

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| **GRAND TOTALS** | 1213 | 1213 | 947   | 283  | 291  | 313    | 457   | 457   | 198   | 198   | 165    | 5734  |
NLC DR RF Status

17 Feb. 1999 Heinz Schwarz

- Low-level RF system, includes interlock, monitor system, ring master oscillator: Proposal was for 2 cavity system, have to update. Simulations of beam stability and gap transients have been made. Gap transient in Pre-damping ring need more study.

- 1 MW high power CW klystron. Need to simulate possible klystron bandwidth.

- 2 MW High Voltage Power Supply. Pipple reduction schemes need more detailed plans.

- WR1500 waveguide network with 1 MW circulator, hybrid and magic-tee power splitters terminated into 1 MW waveguide loads.

- Cavities: Evaluation of improved design going on in Berkeley, also R&D cost and schedule.

- System cost: Cost estimate was made but could use rework with new info from SSRL costing.
NLC DAMPING RING SYSTEM
Electrical Instrumentation & Controls Status

R. Fuller
Feb. 17, 1999

2/16/99
NLC DR Status, Kick-off Meeting
NLC DR Systems

- Global Control Systems
  - Software
  - Controls Backbone
  - MPS
  - BCS
  - PPS
  - Timing System

- Instrumentation
  - BPMs
  - Profile Monitors
  - Laser Wires
  - Wire Scanners
  - Collimators
  - Movers
  - Vacuum System
Software

- Some requirements extracted from outline per briefing by M. Ross, ‘Controls Requirements for NLC Damping Ring complex”, 2/10/99.
  - Feedbacks
    - Coupled Bunch Transverse
    - Nominal ‘SLC’ Type Slow (20Hz)
    - Intra-ring Global (few kHz)
  - Feedforward
    - Intensity information to downstream systems
  - Ring Circumference Control
    - Compensation thru circumference chicane(trombone) and RF frequency control.
  - Thermal Stabilization
    - Water Heaters
    - Feedfoward
    - RF Stabilization and Trip Triggers
Controls Backbone

- Global Control System Architecture
  - Central Campus Control Cluster
  - Fiber distribution to local area nodes.
    - Node count being developed.
  - VME/VXI Crates, IOCs, and general support modules will be part of the Global Control System Backbone. System specific modules will be accounted for in each sub-system’s estimate.

- Baseline cost model for the Global Control System is being developed.

- Rack and cableplant systems to be developed.

- Schedule to be developed.
NLC DR MPS Status

- Baseline cost model and buildup in progress for MDR and PPDR areas
  - Thermocouples, 90%
  - PICs, 90%
  - PLIC, 90%

- Baseline cost model buildup to be started for:
  - LTRs, BCs, and XFER lines

- Continued work required to define system specifics for all areas on:
  - MAID
  - SPIF

- Rack and cableplant systems to be developed.
- Schedule to be developed.

2/16/99  NLC DR Status, Kick-off Meeting
NLC DR BCS Status

- Baseline cost model for Pre-Linacs and DRs completed for:
  - Toroid system
  - PIC system

- Rack and cableplant systems to be developed.

- Schedule to be developed.
NLC DR PPS Status

- Baseline cost model has been developed using the Main Linac Access Module as the basis:
  - DR model assumes two entry modules per ring (MDRs, and PPDR)
  - Hazard control is via PLC interface.

- Specific requirements and assignments to be developed with DR Project Engineering.

- Rack and cableplant systems in process.

- Schedule to be developed.
NLC DR Timing System Status

- Baseline cost model has been developed for the Global timing system to include Sector Optical Fanouts at each area.
  - Timing channel count and assignments to be identified.

- Specific requirements in development with Sub-system Engineers and System Coordinators.

- Rack and cableplant systems in process.

- Schedule to be developed.
NLC DR BPM Status

- Performance requirements and specifications being developed with DR Project Engineering.
- Rack and crate layouts in process for the MDRs, and PPDR.
- Rack placement and cableplant layout in process with PCD.
- Baseline cost model and schedule in process:
  - Current cost roll-up based on Main Linac QBPM
  - First pass R&D/Production schedule predicts delivery for installation of all BPM types required for e-, e+ Source to Main Linac areas by May 2005.
NLC DR Profile Monitor Status

- Performance requirements and specifications to be developed with DR Project Engineering.
- Baseline cost model to be developed.
- Rack and cableplant systems to be developed.
- Schedule to be developed
NLC DR Laser Wire Status

• Requirements and specifications to be developed with DR Project Engineering.

• Baseline cost model to be developed.

• Rack and cableplant systems to be developed.

• Schedule to be developed
NLC DR ‘SLC’ Wire Scanners Status

- Requirements and specifications to be developed with DR Project Engineering.
- Baseline cost model to be developed using ‘SLC’ type model.
- Rack and cableplant systems to be developed.
- Schedule to be developed
NLC DR Collimator Status

- Requirements and specifications to be developed with DR Project Engineering.
- Baseline cost model to be developed.
- Rack and cableplant systems to be developed.
- Schedule to be developed
NLC DR Mover System Status

- Baseline cost model being developed using Main Linac Mover System as the model.

- Specific requirements and counts for mover system being refined with DR Project engineering.

- Rack and crate layouts in process for the MDRs, and PPDR.

- Rack placement and cableplant layout in process with PCD.

- Schedule to be developed.

2/16/99 NLC DR Status, Kick-off Meeting
NLC DR Vacuum System Status

- Baseline cost model being developed using Main Linac Vacuum System as model.
  - Current device counts:
    - Ion pumps (25 l/s thru 300 l/s) = 589
    - Titanium Sublimation Pumps = 452
    - VAT Valves = 52
    - Manual Valves = 42 (Digital Status?)
    - Guages = 404

- Rack and crate layouts completed for the MDRs. PPDR in process.

- Rack placement and cableplant layout in process with PCD.

- Schedule to be developed.
NLC Conventional Facilities

Presenter: Javier Sevilla

I. Presentation and Discussion

- The presentation’s focus was to examine and discuss the parameters and variables, which affect the designs of the LCW cooling systems for the magnets. The goal was to find out: what we know now about magnet cooling, what variables and parameters affect the magnet cooling systems from the conventional facilities point of view, and what information is needed from NLC technical systems.

1. In general, there will be air-cooled magnets and water-cooled (LCW) magnets.
2. The main variables affecting the design of the LCW systems are: differential LCW temperature (\(T_{in} - T_{out}\)), water flow (GPM) and pressure drop (AP) across the magnet (PSI).
3. C. Rago, B. McKee, A. Ringwall and C. Spencer provided the design data about the heat load of the magnets. The water flow calculations presented include the lessons learned and guidelines followed here at SLAC.
4. Table No. 1 summarizes the design parameters discussed and modified during and since the meeting:

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<tr>
<td>Nominal water flow [GPM] per magnet at max. load [kW]</td>
<td>-7</td>
<td>-1.55</td>
<td>-0.70</td>
</tr>
</tbody>
</table>

\(^1\) B. McKee NLC Damping Ring system magnet count, dated 10/16/98

Page 1 Rev. 1, Printed on: 01/22/99
NLC Conventional Facilities

WATER COOLING SYSTEMS

1. Magnets, LC W systems
2. Cooling system for the racks:
   - Power supplies
   - Control/electronics
     Refer to drawing TR-399-170-05-C0
3. Interface to technical systems
NLC Conventional Facilities

BUILDING COOLING AND VENTILATION SYSTEMS

- Chilled water plant (chillers, pumps, tanks, etc) located inside the damping ring area at ground level.
- Chilled water to be used for rack cooling system and HVAC systems.
- HVAC systems to provide cooling to support buildings.

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NLC Conventional Facilities

WHAT ARE THE OPTIONS?

- LOW CONDUCTIVITY WATER (LCW) < 200 PSI
- HIGH PRESSURE LOW CONDUCTIVITY WATER (LCW)+ 250 PSI
- RACK COOLING WATER (RCW)
NLC Conventional Facilities

WHAT WE NEED TO KNOW:

- HEAT REJECTED INTO AIR AND LOCATION.
- HEAT REJECTED INTO WATER AND LOCATION.
- INPUT PARAMENTERS (see detail)
NLC Conventional Facilities

Some thoughts for your consideration into the Rack design:

- Space for heat exchangers depending on the individual rack load (see picture)
- Space for internal piping and hoses (see picture)
- Raised floor for piping and drainage of racks
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**OUR QUESTIONS:**
WHAT OTHER WATER SYSTEMS REQUIRE COOLING:

Air cooled?
Water cooled?

• HCW
• OTHER

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**LCW system:** Damping Rings

Location: ______________________   [ ] Electron  [ ] Positron

Responsible person: _______________  Phone: _______________

Equipment name: _______________  Number of units: __________

Minimum required (LCW) Low Conductivity Water flow [GPM] __________

Nominal required LCW flow [GPM] __________

Maximum pressure drop [PSI] across the equipment @ nominal flow __________

Maximum allowable inlet LCW temperature in [°F] __________

Minimum allowable inlet LCW temperature in [°F] __________

Required water temperature stability [± °F] __________

Maximum allowable water velocity in [FPS] - if applicable __________

Heat rejected to LCW water in [kW/Hr or BTU/Hr] __________

Any other requirement (specify) __________

**INTERFACE DIAGRAM**

<table>
<thead>
<tr>
<th>TECHNICAL SYSTEM RESPONSIBILITIES</th>
<th>CONVENTIONAL FACILITIES RESPONSIBILITIES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Connection to flanges or fittings hookup</td>
<td>Hoses w/ fittings in <strong>english</strong> units</td>
</tr>
<tr>
<td>Provide the diameter of connections in inches</td>
<td>Hose sizes specified by technical systems</td>
</tr>
<tr>
<td>Operational testing of equipment</td>
<td>Flow, temperature and pressure</td>
</tr>
<tr>
<td>Interface to EPICS and/or other controls (wiring and termination if applicable)</td>
<td>Interface to SCAOA systems</td>
</tr>
<tr>
<td>Installation of equipment</td>
<td>Centralized monitoring of flow and temperature</td>
</tr>
<tr>
<td></td>
<td>Balance of water flow</td>
</tr>
</tbody>
</table>

Form number: NLCMECH02.doc

Updated on: 12/15/98

JAS, x3899
INPUT PARAMETERS-MINIMUM

- HEAT (Kw)

- PRESSURE DROP (psi)

- TEMPERATURE (range and stability) °F

- FLOW (gpm), IF MINIMUM IS REQUIRED

FLUID TYPE (LCW, Chilled Water, Pure water, electronic liquid cooling, other, etc)

VELOCITY- (FPS) maximum or minimum if applicableotherwise default to standard design criteria values
7. DESIGN REVIEWS

There will be two technical reviews (PDR and IDR) and two DOE project reviews (CD1 and CDR). See attached schedules. The technical reviews will follow the guidelines set forth in “NLC GUIDELINES FOR DESIGN REVIEWS Rev. 2 02/02/99” (attached).

A Preliminary Design Review (PDR) is scheduled for fall 1999. This review will cover the technical status of the CD1 damping ring system design. Objective is to assess technical risks and select options for follow-on work. Emphasis should be on trade-off studies, resolution of critical issues, project plans, and the selection process.