SSC-N-340

SUPERCONDUCTING
SUPER
COLLIDER

DESIGN SPECIFICATION

NO. SSC-MAG-D-105

TITLE: SSC MAGNET SYSTEM
DESIGN REVIEWS

ISSUE DATE Draft 5/27/87
REV. NO. _____
REV. DATE _____

- PREPARED BY _____
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- APPROVED BY _____
  M. Tigner - SSC Director

REVISION RECORD

REVISION NO.	DATE	PAGE	SUBJECT	APPROVAL

1. Scope:

This specification establishes the requirements for the performance and documentation of SSC design review activities.

1.1 Applicability

The requirements of this specification apply to:

- All SSC-CDG and seller activities for which SSC-CDG retains overall design control.
- New or revised designs
- Preliminary Design Requirements Reviews
- Preliminary Design Reviews
- Final Design Requirements Reviews
- Final Design Reviews
- Special Design Reviews
- Readiness Reviews

1.2 Definitions

1.2.1 Design Reviews - The summary review of design activities to assure that the design and its documentation conform to:

- System requirements and
- Can be fabricated, inspected and tested and
- Will operate safely and reliably

1.2.2 Preliminary Design Requirements (Conceptual Design) Review: A review held at the start of the preliminary design task to make certain the System Requirements and specification documents are current and represent the correct inputs to the preliminary design task.

1.2.3 Preliminary Design Review: A review held near the end of the preliminary design phase to verify that the design package satisfies the project requirements and fully defines the design task.

1.2.4 Final Design Requirements Review: A review held at the start of the final design task to make certain that any changes following the Preliminary Design Review are properly identified, approved, and incorporated in the final design and that all the design requirements accurately interpret the Systems Requirements.

1.2.5 Final Design Review: A review held near the end of the final design phase to determine that the final design package satisfies project requirements and represents an acceptable basis for committing the design to fabrication or procurement, and to assure the compatibility of all system interfaces.

1.2.6 Special Design Review: Conducted at the request of project management (division heads) to investigate areas of interest or need.

1.2.7 Readiness Reviews: Conducted at functional milestones as requested by project management (division heads) to ascertain system or component readiness for safe test, operation or maintenance.

2. Applicable Documents

SSC-MAG-D-103 Configuration Management Requirements

3. Requirements

3.1 Design Review Responsibilities: The design and design review tasks are the responsibility of the SSC-Central Design Group (CDG) with the magnet division head responsible for chairing the design review efforts outlined herein.

3.1.1 Review Panels: Review panel members shall be selected, as required, from the following list of functional specialists and appointed by the CDG-Magnet Division Head.

a. Materials Engineer: Assures that materials selected will perform as required.

b. Manufacturing and Tooling Engineer: Assures that the design is producible at minimum cost and schedule.

c. Reliability Engineer: Evaluates design for optimum reliability consistent with goals.

d. Electrical Systems Engineer: Evaluates design in terms of optimizing components and layouts in accordance with codes and conventional control practices.

e. System Safety Engineer: Evaluates design in terms of system safety considerations and compliance with the Master Safety Plans.

f. QA Manager: Assures that the review addresses such control functions as specification review, inspection and test planning, and open action items.

g. Systems Integration Engineer: Evaluates design in terms of interface control and documentation, and compliance with Configuration Management Requirements.

h. Plant Facilities Engineer: Evaluates design in terms of maintenance considerations and impact on SSC utilities and conventional facilities.

i. Procurement Representative: Assures that procurement plans to meet cost and schedule are compatible with required procurement procedures.

j. Technical Representative: Evaluates design in terms of compliance with established goals and assures that user considerations were included in the design.

k. Design Engineer(s): (Not associated with item under review.) Constructively reviews adequacy of design to meet its intended use.

l. Consultant(s): (Specialists on components, value engineering, human factors, etc., as required.) Evaluates design for compliance with special requirements.

m. Management Systems Representative: Evaluates design in terms of impact on project cost and schedule.

3.2 Reviews: The SSC-Magnet Design Process shall be subject to at least the four major milestone reviews outlined below and as shown in Figure I.

SSC - MAG - DESIGN REVIEW SYSTEM

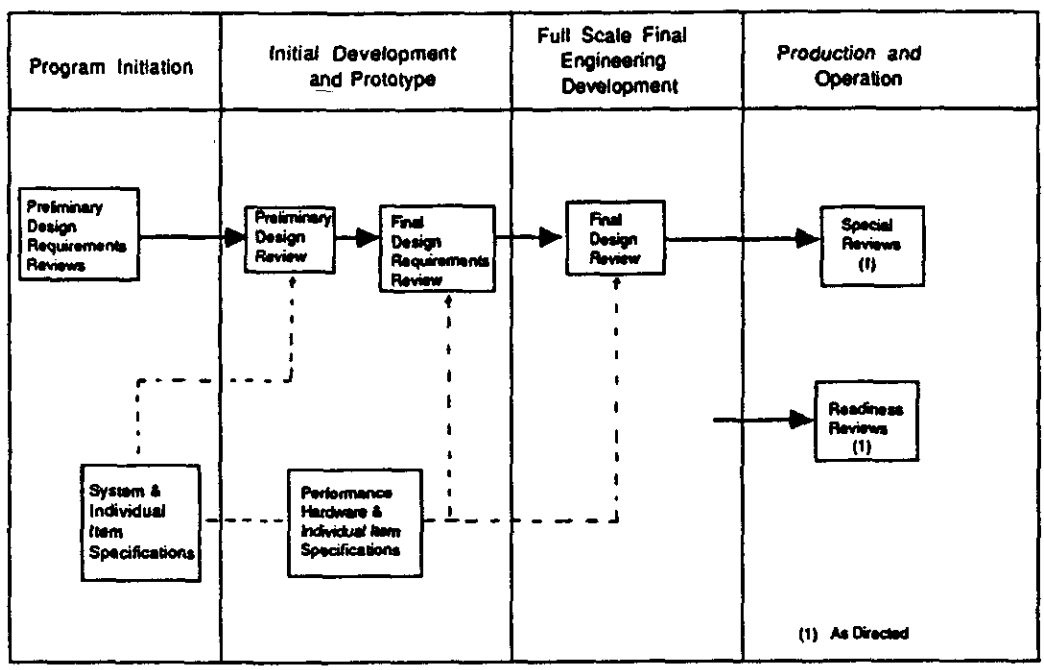


FIGURE I

3.2.1 Preliminary Design Requirements (Conceptual Design) Review Tasks: This view is conducted to determine progress in defining the system technical requirements, cost/design tradeoffs and implementing other specific engineering management activity. The preliminary design requirements review is normally performed during the system conceptual phase and should start when a significant portion of the system functional requirements have been established but before the system characteristics and specifications have been defined and the individual items identified. It should also precede the system definition effort.

3.2.2 Preliminary Design Review Tasks: This review is conducted for each item or subassembly to evaluate the progress, technical adequacy and risk resolution of the selected design approach and to determine its compatibility with the performance and engineering specialty requirements of the development specification for each item or subassembly. The preliminary design review is normally performed after the performance specification has been authenticated and should start prior to the release of packaging design for electronics. For mechanical and structural equipment, it should occur prior to release of design information to Drafting. The review shall include, as a minimum, the following:

a. Verify that the current design complies with the SSC specifications (in the case of a procurement activity being reviewed).

b. Address action items and any unresolved issues from the Preliminary Design Requirements Review.

c. Examination of the compatibility of all system interfaces.

d. Review and approval of long lead procurements to assure that future design is not unreasonably constrained by inadequately considered equipment commitments.

e. Evaluation of system test requirements necessary to approval compliance with SSC specifications (in the case of a procurement activity), and/or to prove that Systems Requirements can be met by the design under review.

f. Recap of all the subsystems and component preliminary reviews which were necessary to define the design. This recap addresses the completeness of these reviews and assesses the impacts of design decisions at the systems level.

g. Specifically address the safety aspects of the system under review. As a minimum, each "Hazardous Element" identified is to be reviewed, identified and tracked by the SSC Project Safety Manager, until satisfactorily resolved.

3.2.3 Final Design Requirements Reviews Tasks: This review is performed to evaluate the optimization, correlation, completeness, and the risks associated with the allocated technical requirements. This review should be performed in sufficient detail to insure a technical understanding among all participants on the system or system segment specification or drawing. The final design requirements review is normally performed when the system definition effort has proceeded to the point where system characteristics are defined and individual items and subassemblies have been established and prototyped. the system design review should start prior to detail equipment or software design.

3.2.4 Final Design Review Tasks: This review is conducted to determine that the final detail design of each individual item or subassembly under review satisfies the performance, design/cost goals and engineering specialty requirements of the development specifications or drawings; and to review the preliminary product specifications and drawings as appropriate. The final design review is performed for each individual item or subassembly when detail design is essentially complete. This review should start prior to release of engineering data to manufacturing for fabrication and should cover all design and development assurance tests leading to production. The review shall include, as a minimum, analysis of the following:

a. All action items and unresolved issues from previous reviews.

b. Interfaces, to assure compatibility with all systems and detailed design documentation adequacy of the interfaces.

c. Scheduling, particularly as it applies to interfaces and possible conflicts with other systems' concurrent activities.

d. Adequacy of supporting design documentation to date, verification test planning, and additional documentation required for acceptance tests and operations.

e. Failure modes and effects analysis and the conclusions affecting spare parts, maintenance, and Operating Availability of the system.

f. Results of engineering verification tests conducted in support of the design.

g. As in the Preliminary Design Review, each "Hazardous Element" is to be addressed. The Final Design Review must present the detail so how the hazard is reduced to an acceptable level and discuss the residual risk that will have to be assumed upon system test and operation.

3.2.5 Readiness Review Tasks: this review is performed to evaluate the state of system or component readiness for a subsequent critical, costly or hazardous event, i.e., functional test, major design project, etc. The review shall include, as a minimum, analysis of the following:

a. All action items and unresolved issues from prevous reviews.

b. Technical requirements documentation for completeness, availability, change status and accuracy.

c. Availability and accuracy of milestone event control procedures, i.e. test plans, data acquisition requirements, safety precautions, support provisions, etc.

d. Identification of milestone constraints, open items and resource requirements.

e. Identification and control of all equipment facility or personnel safety operations.

3.3 Review Performance: The Chairman (SSC Magnet Division Head) will conduct the review and assure that all agenda topics are discussed. He will lead the discussion, mediate and resolve differences, calling for additional studies or analyses if such are necessary. A general decision review checklist is provided in Figure II as a guide to be amplified as necessary for each applicable specialty function.

3.4 Review Documentation: The Chairman will utilize the SSC Magnet System - Stress Analysis and Measurement Review (SAMR) (Figure 3) to collect suggested action items from panel participants. Review meeting minutes shall be documented as described in 3.4.2 below. The SAMR form shall be processed as outlined in the CDG Form 8610 instruction. Action items shall be closed out as expeditiously as possible.

3.4.1 Use: Although the SAMR is principally intended to fill the needs of the formal design review as described in this procedure, its use for lower level reviews is encouraged. The completed form is a permanent SSC Project QA record used to assure the traceability of design review decisions.

General SSC Magnet Design Review Checklist

Check for:

Completeness and accuracy of product specifications

Completeness and accuracy of engineering drawings

Conformance to applicable safety standards

Accuracy of worst case design conditions

Consideration of storage and use environments

Consideration of intended use and foreseeable misuse

Adequacy of human factors engineering, safety devices and fail-safe operation

Accuracy of computations

Accuracy of manufacturing and process specifications

Adequacy of corrective actions

Adequacy of packaging, and shipping procedures

Adequacy of warnings and labels

Adequacy of instructions and manuals.

FIGURE II

3.4.2 Review Minutes: The Chairman will arrange for minutes to be taken during the meeting. As a minimum, the minutes shall consist of:

1. Date(s) of review.

2. Panel members.

3. A summary of the panel's comments and conclusions.

4. A summary of action requests generated during the review.

5. Any open (unreviewed) topics deferred to subsequent reviews.

The minutes will be typed and distributed to concerned parties within five working days of each review.

SSC Magnet System
Design Review

Origination Date: _____

Serial Number :_____

Page ___ of ___

Originator Name _____ Organization _____

Subsystem _____

Description of Suggested Action:

Comments By _____ Group _____ Assignment Date _____

Comments:

Impact Evaluation

Technical: Schedule:

Cost: Impact Level:

Forwarded to: _____ *Date Forwarded* _____

Recommended Disposition:

Technical Representative _____ *Date* _____

CDG Office Decision: Approved ___ Disapproved ___ Other___ (explain below)

Action Assigned To_____ Due Date _____

CCB Action Required? Yes___ No___ (CCB Action Number _____)

Signed: _____ *Date* _____

Close-out

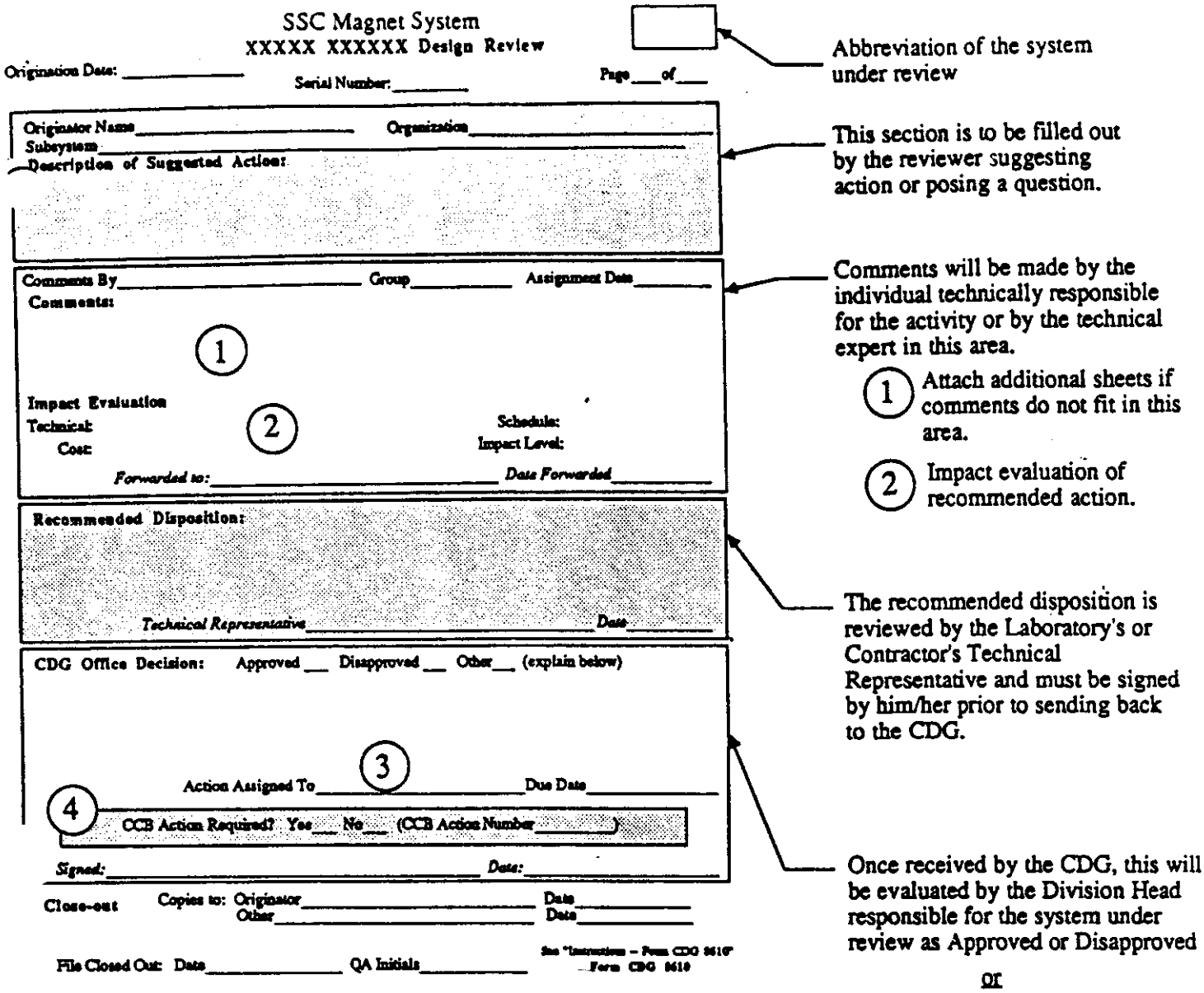
Copies to: Originator _____ Date _____

Other _____ Date _____

File Closed Out: Date _____ QA Initials _____

See "Instructions – Form CDG 8610"

Form CDG 8610-SDC



Abbreviation of the system under review

This section is to be filled out by the reviewer suggesting action or posing a question.

Comments will be made by the individual technically responsible for the activity or by the technical expert in this area.

(1) Attach additional sheets if comments do not fit in this area.

(2) Impact evaluation of recommended action.

The recommended disposition is reviewed by the Laboratory's or Contractor's Technical Representative and must be signed by him/her prior to sending back to the CDG.

Once received by the CDG, this will be evaluated by the Division Head responsible for the system under review as Approved or Disapproved

OR

(3) Returned for further action

(4) Forwarded to Change Control Board if necessary.

Instructions -- Form CDG 8610

Dipole Cryostat Design Review/SD-C

Ser #	Originator	Org.	Sub-System Under Review	Key Words/References	Assignment	Org.	Date of Asmnt.	Date of Response	Disposition	Remarks
1	V. Kanpenko	CDG	Assembly	Examn Svs Reqmts, list of reqmts not met w/itsy, A	R. Niemen	FNAL	11/10/86			
2	C. Goodzeit	BNL	Cold Mass Support	Loss Disp/band on beamtube?	R. Niemen	FNAL	11/14/86			
3	M. Tigner	CDG	Support Post	Analyses of shrink fit rings	R. Niemen	FNAL	11/14/86			
4	M. Tigner	CDG	Suspension Interface	Bending Moment from cooldown distortions	R. Niemen	FNAL	11/14/86			
5	V. Kanpenko	CDG	Brackets-Post-Coldmass Cn.	How much decumentation of stress analyses exists?	R. Niemen	FNAL	11/14/86			
6	M. Tigner	CDG	Piping	Pipe slide tub-radiation sensitivity	R. Niemen	FNAL	11/14/86			
7	M. Tigner	CDG	Support System	Analyses transnt axial stress during cool-dn	R. Niemen	FNAL	11/14/86			
8	J. Peterson	CDG	Suspension	Optmn lngth of 2" tie bars during cooldown	R. Niemen	FNAL	11/14/86			
9	V. Kanpenko	CDG	Support System	Analyses of magnitude of quench pressure.	W. Schneider	BNL	11/14/86			
10	M. Tigner	CDG	Suspension	Need measurement of quench load. Now 25 p lb by calc.	R. Niemen	FNAL	11/14/86			
11	M. Tigner	CDG	MLI - Insulation	Emissivity control and gas conduction role.	R. Niemen	FNAL	11/14/86			
12	P. Limon	CDG	Cryostat-Superinsulation	Model should be divided, Ind Rad, condtc, & gas condtc.	R. Niemen	FNAL	11/14/86			
13	J. Theilacker	FNAL	Single Phase MLI Insulation	Add MLI to single phase assemble	R. Niemen	FNAL	11/14/86			
14	J. Peterson	CDG	Insulation	Review heat leak budget & optimize to cryogenic cost	M. McAshan	CDG	11/14/86			
15	J. Theilacker	FNAL	MLI Insulation	MLI perfrmnce on horz. cylinder	R. Niemen	FNAL	11/14/86			
16	J. Theilacker	FNAL	MLI Insulation	Perfrmnce data for various levels of degraded vacuum	R. Niemen	FNAL	11/14/86			
17	P. Limon	CDG	Cryostat Superinsulation	Compare insul. between 20K & 4K surfaces	R. Niemen	FNAL	11/14/86			
18	W. Schneider	BNL	Insulation	CDG review insul heat leak budget, dist radiatn shields	R. Niemen	FNAL	11/14/86			
19	V. Kanpenko	CDG	Insulation	Selection & evalu. of insulatn based on thermal model	R. Niemen	FNAL	11/14/86			
20	J. Theilacker	FNAL	Slide Mechanism	Should slide performance tests be done in vacuum?	R. Niemen	FNAL	11/14/86			
21	V. Kanpenko	CDG	Radiation Environment	Radiation source term to be defined better.	D. Groom	CDG	11/14/86			
22	M. Tigner	CDG	MLI	Compare SSC rad. backgrnd with rad in CERN tpls	R. Niemen	FNAL	11/14/86			
23	M. Tigner	CDG	Shields	Test & analyse .spot welds vs. riveting vs. TIG	R. Niemen	FNAL	11/14/86			
24	M. Tigner	CDG	Shields	Consider .non-friction surface addition to shield	R. Niemen	FNAL	11/14/86			
25	C. Goodzeit	BNL	Shields	Investigt galling action betwn Al shlds & groove in ring	R. Niemen	FNAL	11/14/86			
26	J. Theilacker	FNAL	Shields	Obtain material properties from 4.5-300K	R. Niemen	FNAL	11/14/86			
27	D. Brown	BNL	Cryostat Piping	Standard pipe sizes so flanges are readily available	R. Niemen	FNAL	11/14/86			
28	M. McAshan	CDG	Cryostat Piping	Review sizes and pressure ratings for cryo & cold mss	M. McAshan	CDG	11/14/86			
29	W. Schneider	BNL	Support System	Calc stiffness of vac vsel supt ring to omit steel	R. Niemen	FNAL	11/14/86			
30	V. Kanpenko	CDG	Vacuum Vessel & Pipng	Reconfirm 20 Atm criteria. Press. vs. time data & ref	K. Mirk	CDG	11/14/86			
31	J. Theilacker	FNAL	Vacuum Vessel	Tunnel section isolation during soil	T. Toohig	CDG	11/14/86			
32	M. Tigner	CDG	Vacuum Vessel	Invest. steel (A537) and 2% Ni steel	R. Niemen	FNAL	11/14/86			
33	M. Tigner	CDG	Vacuum Vessel	Method of fab of vacuum vessel and its cost.	R. Niemen	FNAL	11/14/86			
34	M. Tigner	CDG	Suspension	Pinv cold mass supt & vacuum vessel supt.	R. Niemen	FNAL	11/14/86			
35	V. Kanpenko	CDG	Alignment	Re-eval number of supts to supt & align.	R. Niemen	FNAL	11/14/86			
36	V. Kanpenko	CDG	Vacuum Vessel Support	Eval cassins, steel weldment & ferarig fab alternates	R. Niemen	FNAL	11/14/86			
37	V. Kanpenko	CDG	Cryo Assembly	Svs rqmts - what limits current cryo asmbly cool rate	R. Niemen	FNAL	11/10/86			
38	M. Tigner	CDG	Alignment	Est error in reference plane	R. Niemen	FNAL	11/14/86			
39	E. Willin	BNL	Alignment	Eval data on accy & repetcblty of angle measuring device	R. Niemen	FNAL	11/14/86			
40	E. Willin	BNL	Alignment	Residual angle locked into mag.	R. Niemen	FNAL	11/14/86			
41	J. Theilacker	FNAL	20K and 80K shields	Design considerns to remove cooldown rate limitatns	R. Niemen	FNAL	11/14/86			
42	V. Kanpenko	CDG	Cold Mass shell	Provide evidnce "hanging" can be obtained	R. Niemen	FNAL	11/14/86			
43	P. Limon	CDG	Beam Tube Connections	Position accuracy does not meet offset criteria	E. Willin	BNL	11/14/86			
44	G. Taylor	LBL	Cryostat	Prepasm rqt for proper distrb of axial loads	R. Niemen	FNAL	11/14/86			
45	D. Brown	BNL	Cryostat	Shield & Pipe supports with no common elec ground	R. Niemen	FNAL	11/14/86			
46	C. Taylor	LBL	Cryostat	A "conventional" axial restraint design	R. Niemen	FNAL	11/14/86			
47	J. Theilacker	FNAL	Single Phase - Cold Mass	Removal of cooldown rate limitation	C. Goodzeit	BNL	11/14/86			
48	V. Kanpenko	CDG	Safety - Vacuum Vessel	Safety studies that contains Tunnel safety & cryo safe	T. Toohig	CDG	11/14/86			Assign V. Kanpenko
49	W. Gilbert	LBL	Interconnection Region	When & how heat-leak tests carried out in IC region	R. Niemen	FNAL	11/14/86			
50	W. Gilbert	LBL	Axial restraint	Carrying of cryostat on the vertical to lower into tun	R. Niemen	FNAL	11/14/86			
51	W. Gilbert	LBL	Vacuum - 4K to 20K	Design for a system with helium leaks? Vac insu?	R. Niemen	FNAL	11/14/86			
52	W. Gilbert	LBL	Dipole Vertical Plane	Specs, Cradle-relationship & measmnt, Interface	Chen/Peterson	CDG	11/14/86			Assign W. Schneider, R. Niemen