

A High-field Solenoid for Targetry R&D

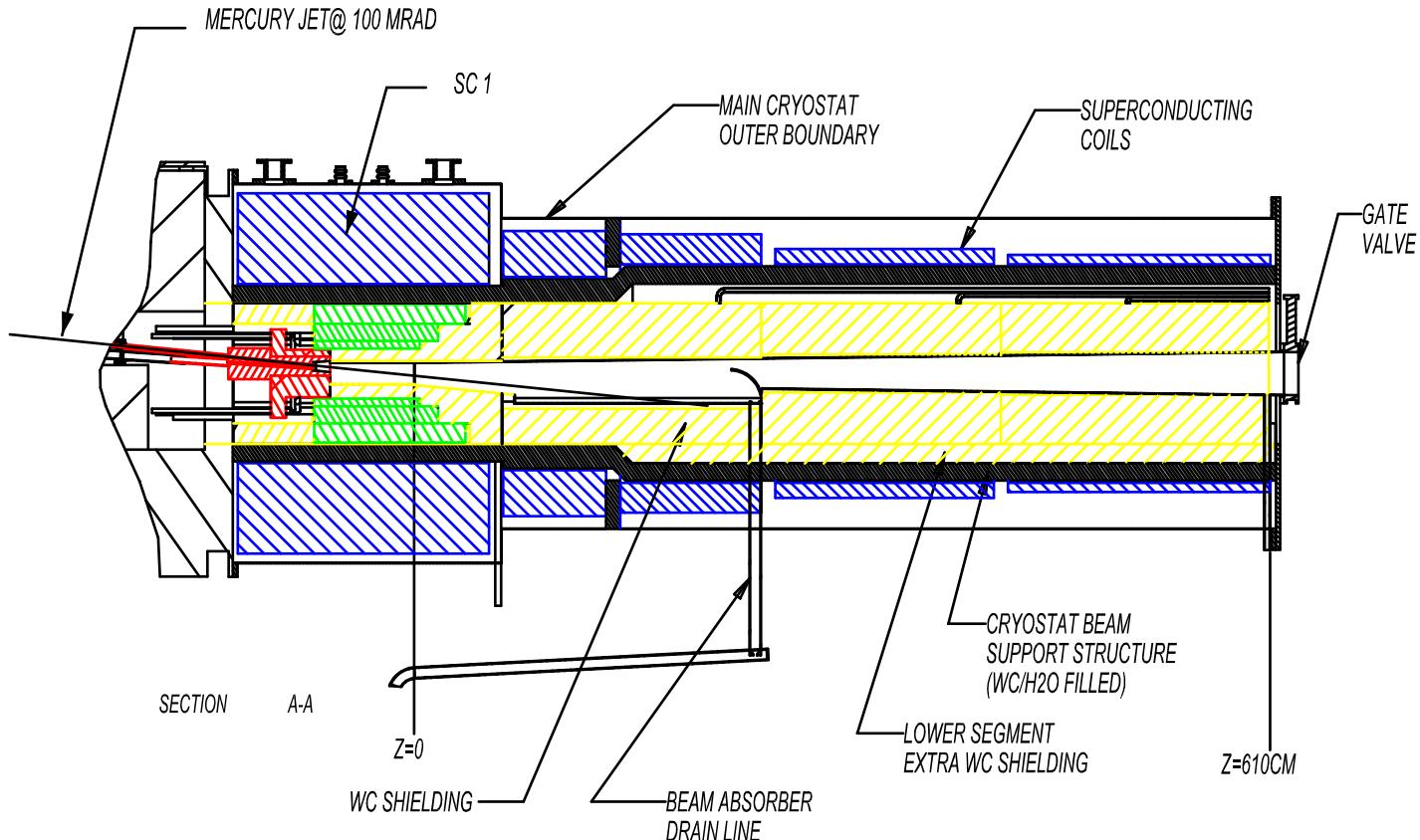
Harold G. Kirk
Brookhaven National Laboratory

MUTAC Presentaion
FNAL
January 15, 2003

Presentation Summary

1. Targetry Concept
2. High-field pulsed solenoid
 - Magnet System
 - Power Supply
 - Cryogenic System
3. Costs
4. Contingency Schemes

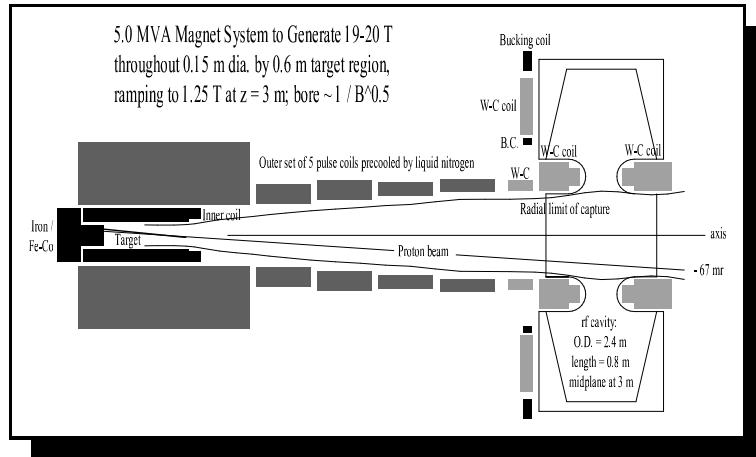
The Targetry Concept



- Capture low-energy soft pions
- Use high-Z liquid mercury target
- Capture in a 20T solenoid field

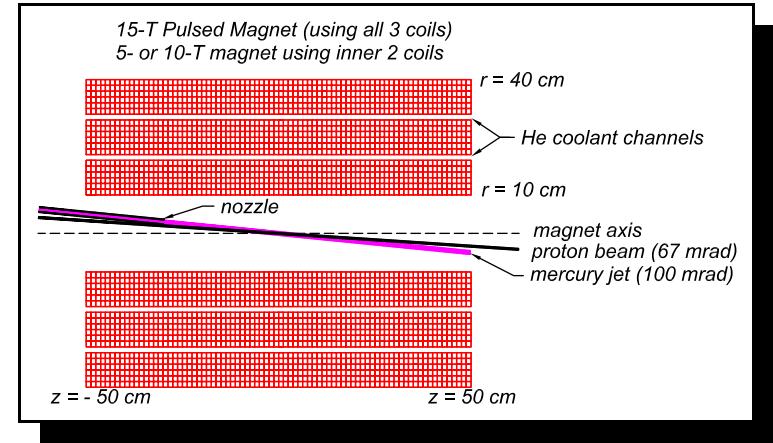
Pulsed High-field Solenoids

Original Concept



- 20T Peak Field
- 5 MVA Pulsed PS
- 15 Metric Tonnes Coil Package
- 80° K operation

Revised Concept



- 15T Peak Field
- 2.2 MVA Pulsed PS
- 3.6 Metric Tonnes Coil Package
- 30° K operation

The engineering solution

Magnet System: Bob Weggel, BNL ; Peter Titus, MIT

1. Cryogenic Operations
2. Thermal Management
3. Mechanical Stresses

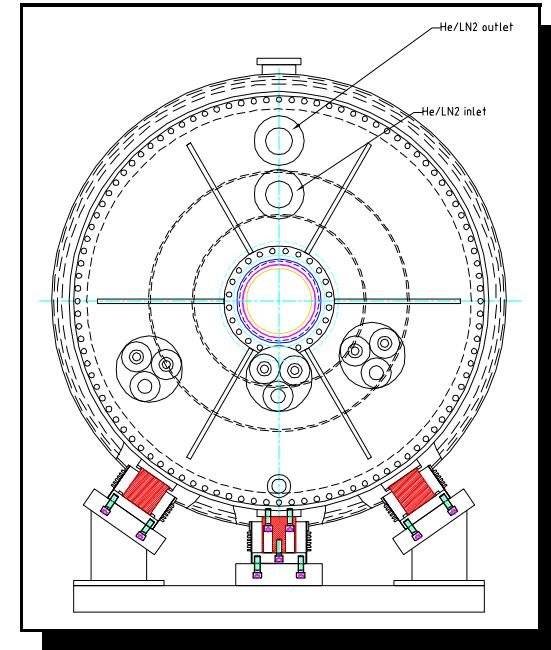
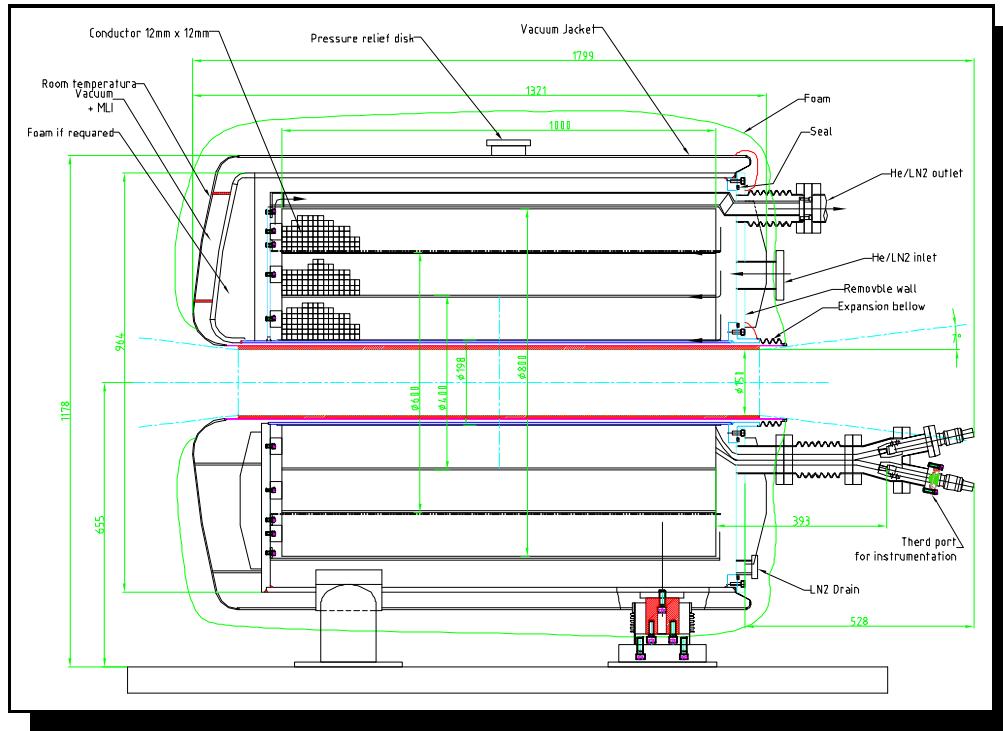
Power Supply: I. Marneris, BNL

1. Pulsed Operation
2. Controls

Cryogenics: M. Iarocci, BNL ; G. Mulholland, ACT

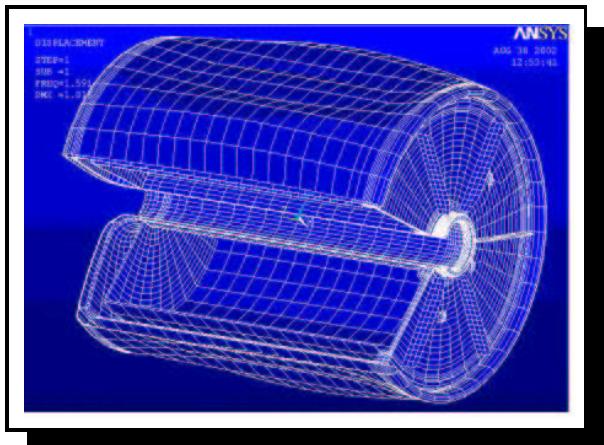
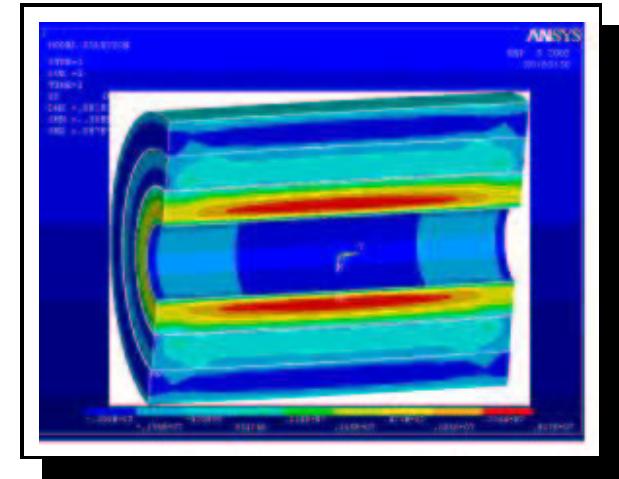
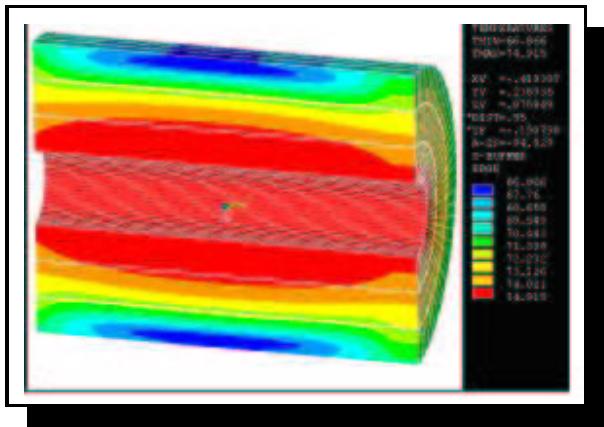
1. 30° Operations
2. Safety

High-field Pulsed Solenoid

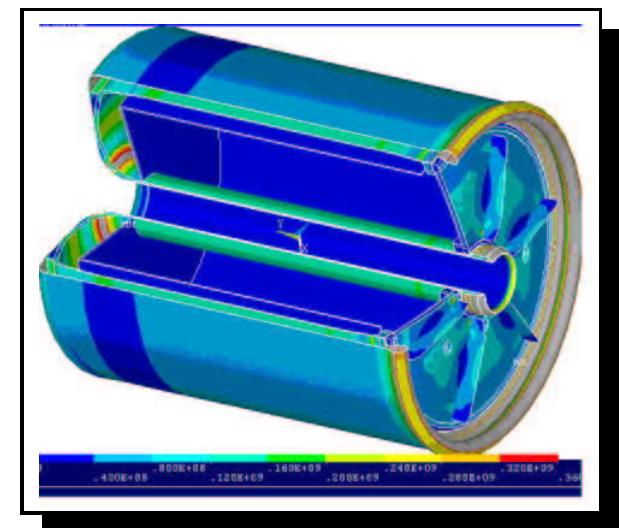


- 5T Peak field with 2 inner coils; 550 KVA PS; 80°
- 10T Peak field with 2 inner coils; 2.2 MVA PS; 72°
- 15T Peak field with 3 coils; 2.2 MVA PS; 30°

ANSYS Analysis

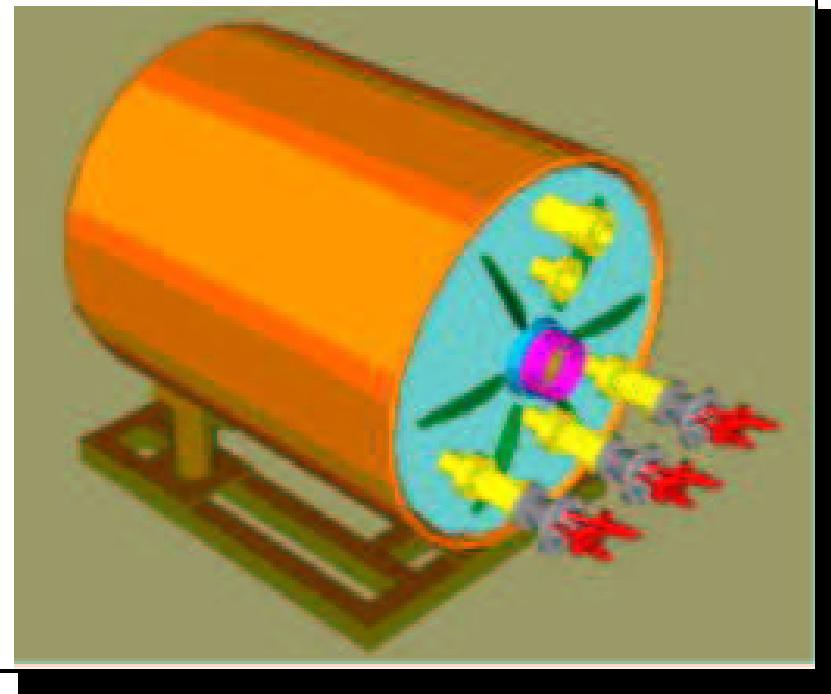


Buckling Analysis

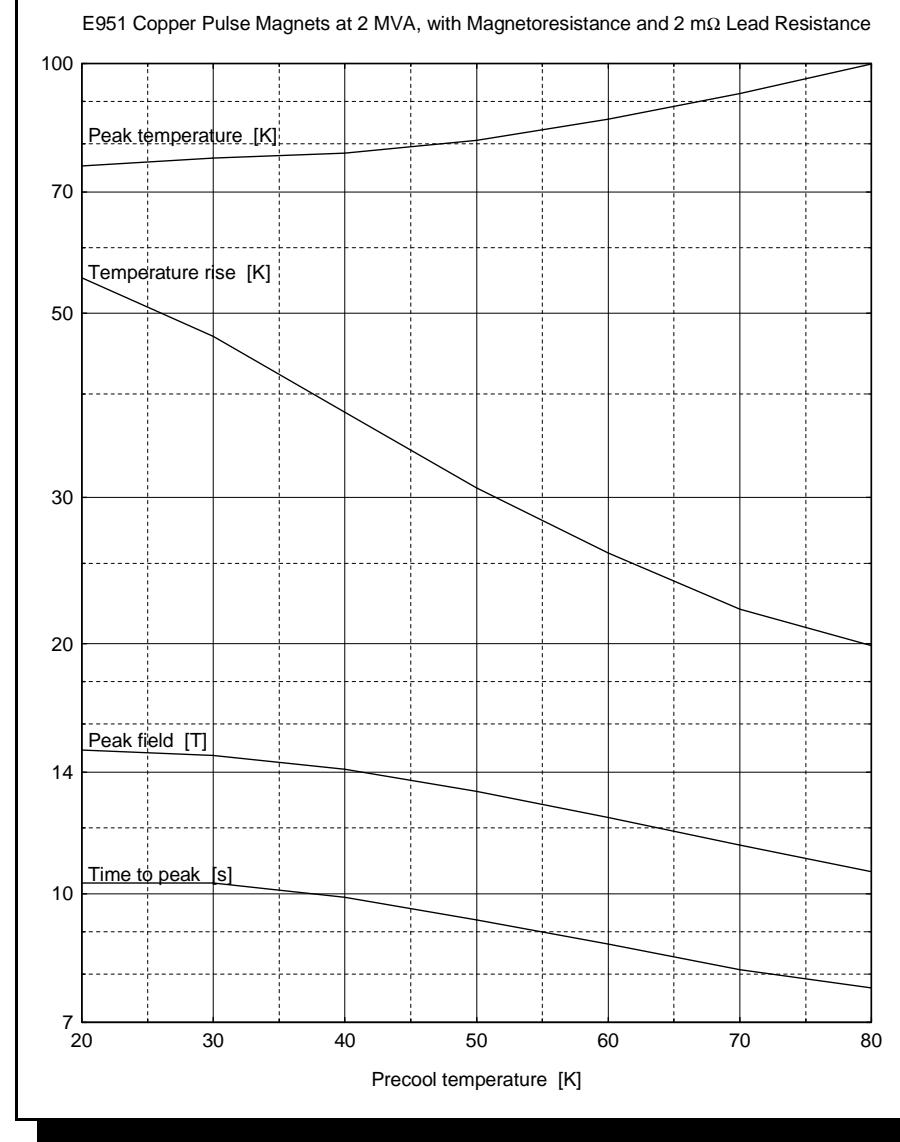


Rib Stengthened Cryo Vessel

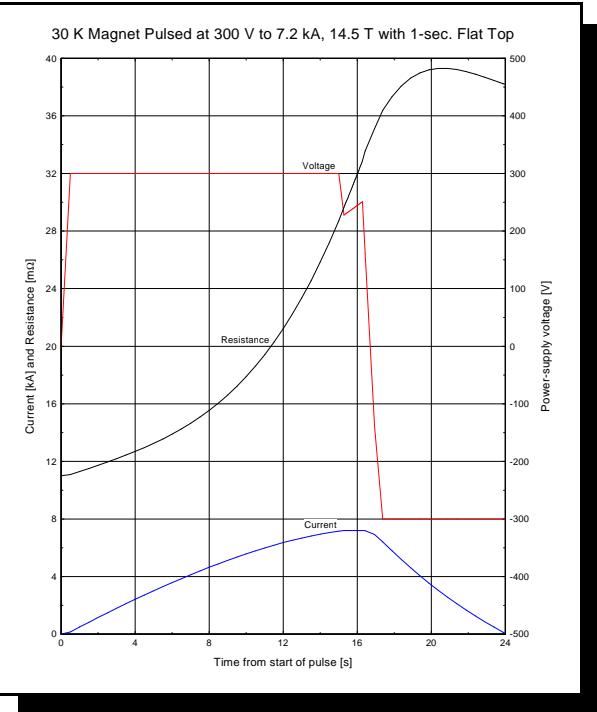
Solenoid Performance



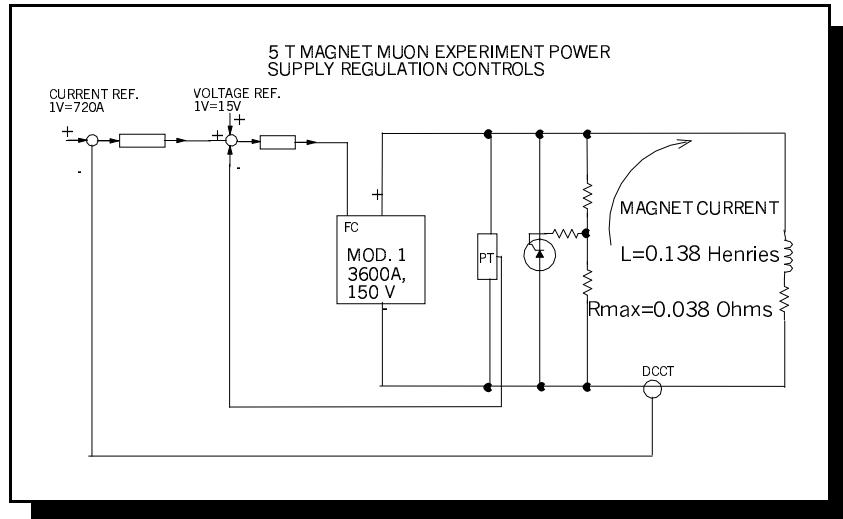
Performance Summary					
Peak Field	Coil Sets	Stored Energy	Initial Temp	Final Temp	Rep Rate
5T	2	3MJ	84°K	90°K	3 Min.
10T	2	9MJ	74°K	96°K	13 Min.
15T	3	15MJ	30°K	78°K	25 Min.



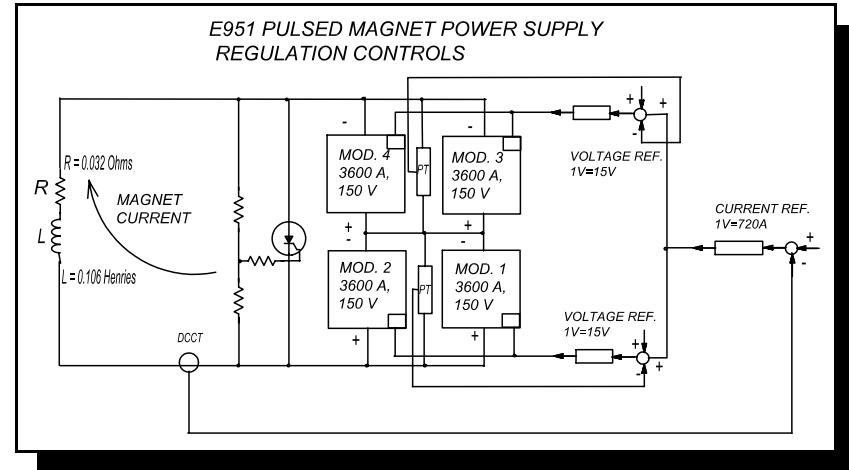
Power Supplies



PS Performance

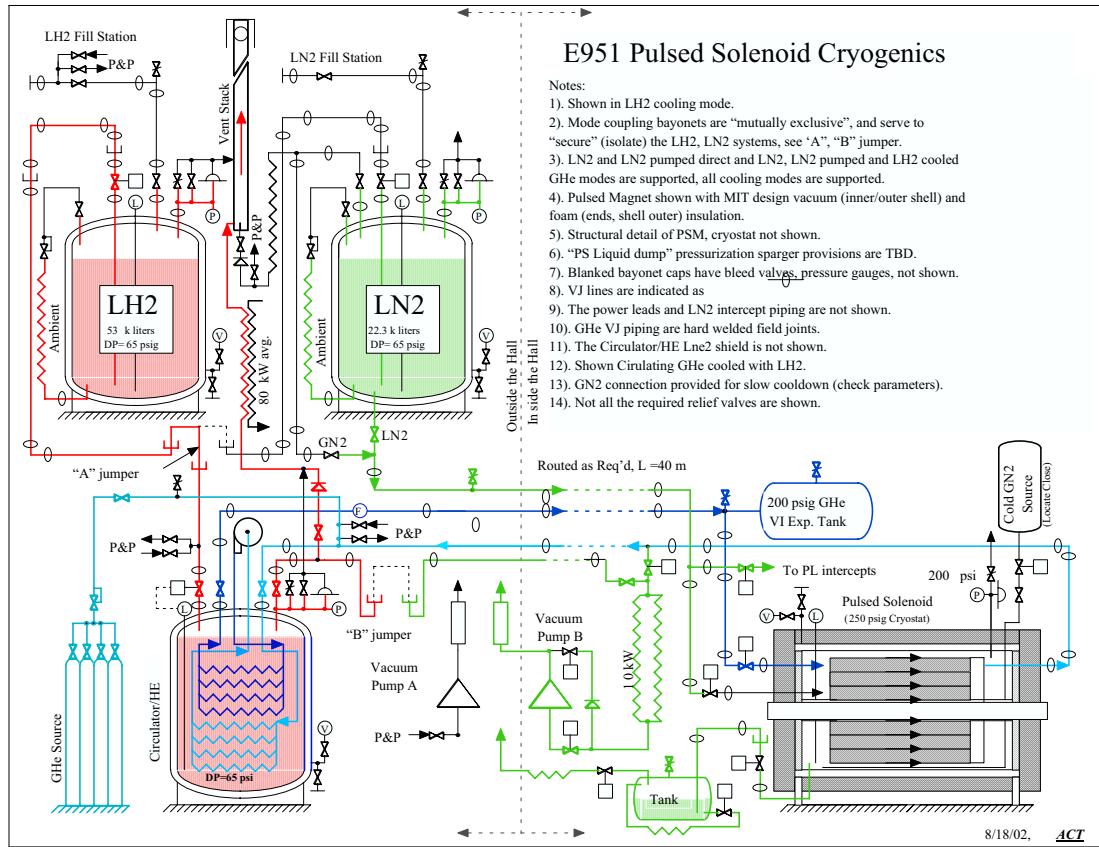


Single PS



Four Ganged PS

Cryogenic System



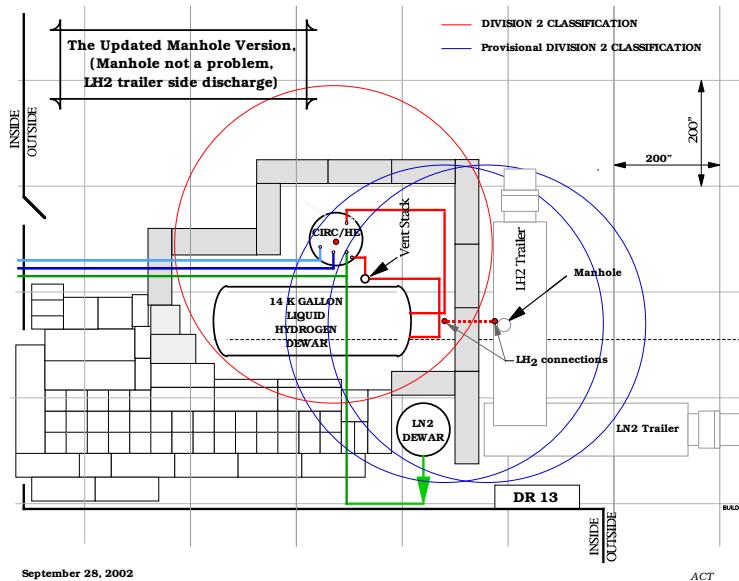
Heat Exchanger



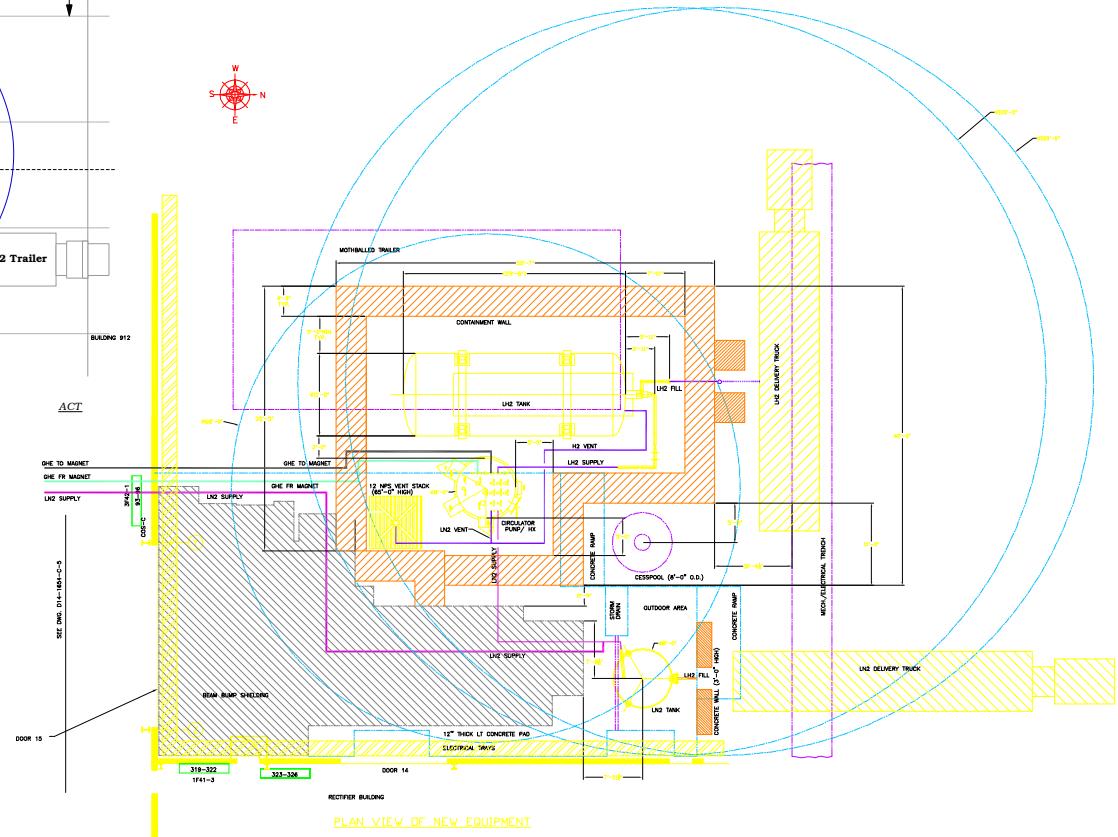
14K Gal. LH₂ Dewar

Cryogenic System Layout

The Concept



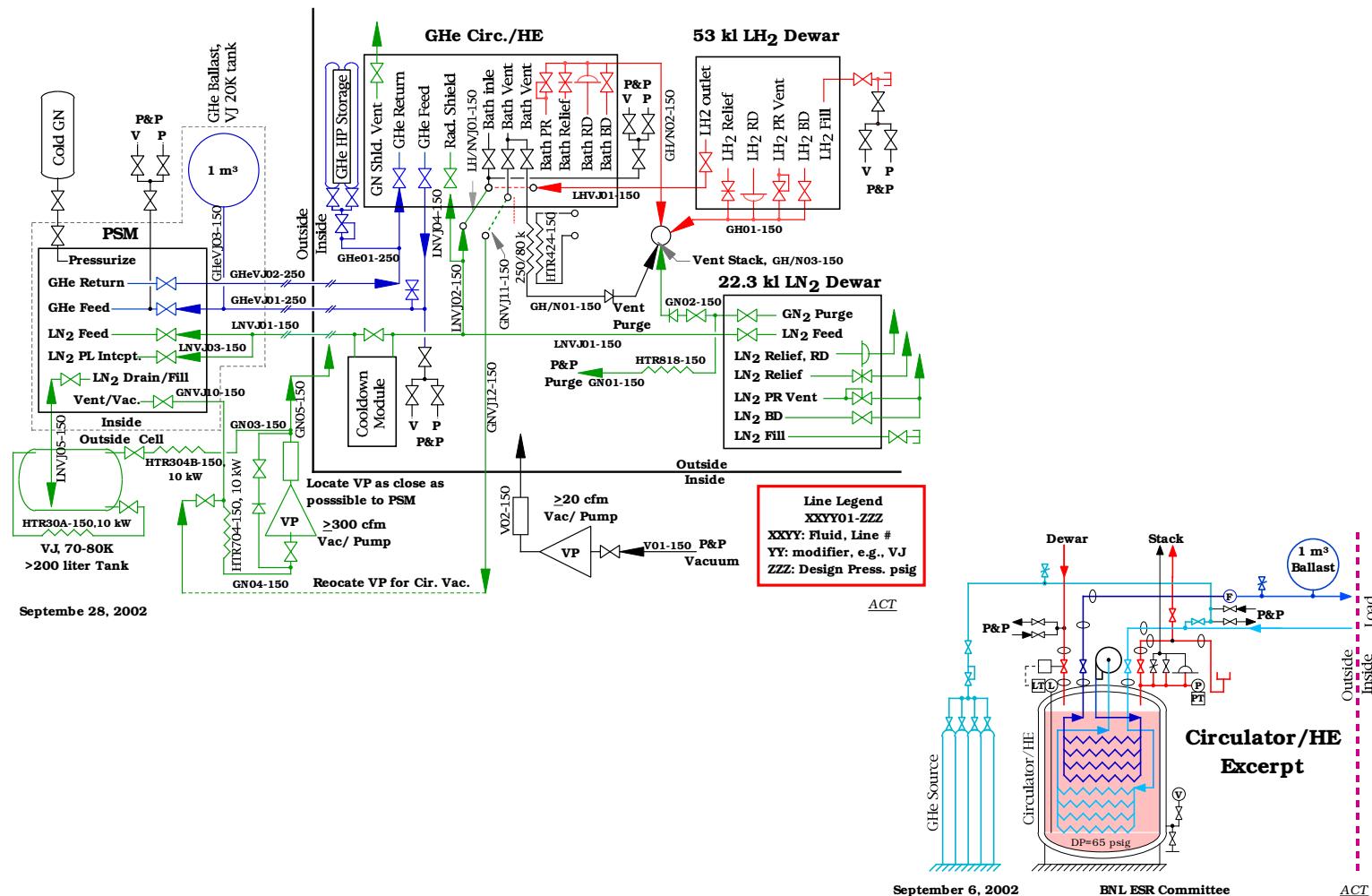
September 28, 2002



The Reality

Cryogenic Plumbing

E951 Line Summary Diagram

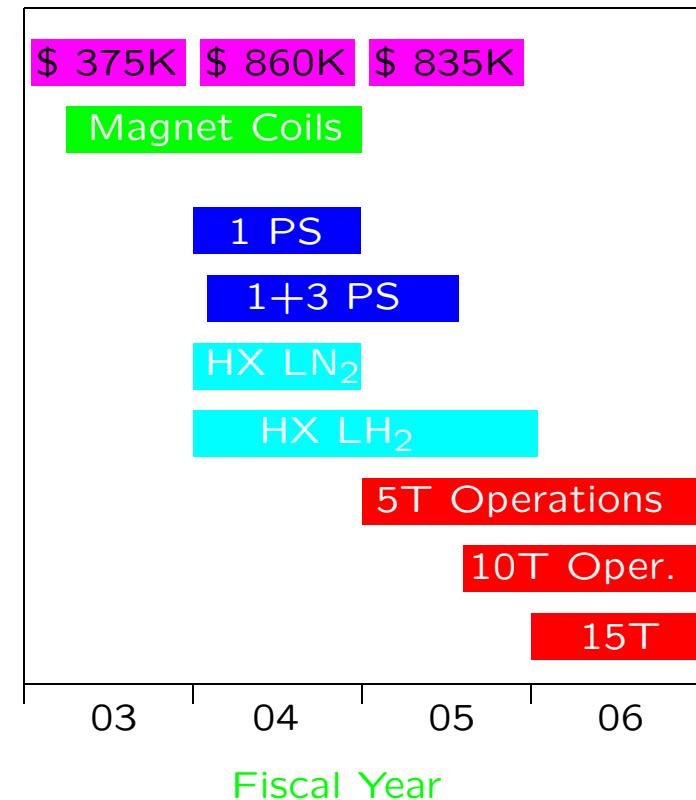


Heat Exchanger Schematic

Costs and Schedule

Cost Schedule	
	Cost \$ K
Magnet System	
Fabrication/Purchase	425
Oversite/Monitoring	55
Testing	60
Sub-Total	540
Power Supply	
Engineering	33
Fabrication	434
Installation	88
15 % Contingency	83
Sub-Total	638
Cryogenic System	
Engineering	20
Fabrication	511
Installation	48
Burdens	314
Sub-Total	893
Total	2071

E951 Pulsed Solenoid Task and Funding Profile



Contingency Schemes

Alternative Scenarios

Explore solutions without LH₂

Case A

Limit Peak Field to 10T

Case B

Retain 15T

Double PS

Case B

Retain 15T

Utilize HFBR Refrigerator

Poor Rep-rate

Contingency Schemes

	Base	Case A	Case B	Case C
Peak Field	15T	10T	15T	15T
Cryo	LH ₂	LN ₂	LN ₂	Frid.
Power	2MW	2MW	4MW	2MW
Magnet System	540	378	540	540
Power Supply	638	638	788	638
Cryogenic System	833	556	556	633
Total	2071	1572	1884	1811