PIP-II Design Meeting
Conduction Cooled Current Leads

T. Nicol – Fermilab
September 23, 2014
SSR1 Cryomodule
SSR1 Cryomodule

4 focusing solenoids
Project X

HWR Cryomodule
HWR Cryomodule

8 focusing solenoids
Concept 1: Conduction cooled leads similar to CERN and DESY leads.

Concept 2: Fin heat exchangers at 70 K and 4.5 K connected by copper conductor.

Conceptual design review committee (Feb 2013) recommended pursuing Option 1.
CERN Lead Assembly
Lead Assembly for Analysis

Project X

Braze connections

2 K

300 K

80 K

5 K
Lead Assembly

Glass and epoxy insulation

Copper conductor (RRR 100)

¼” OD, 0.020” wall stainless steel tube

2 K flange
4 lead assemblies with 11 leads each (2 @ 100 A, 8 @ 50 A, 1 ground + 2 instrumentation conduits)
4 lead assemblies with 12 leads each (4 @ 100 A, 8 @ 50 A)
Project X
SSR1 Cryomodule
## SSR1 Cryomodule Heat Load Estimates

T. Nicol - February 9, 2012

<table>
<thead>
<tr>
<th>SSR1 Cryomodule Heat Load Estimates</th>
<th>Each unit</th>
<th>Mult</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>8 cavities, 4 solenoids</strong></td>
<td>80 K</td>
<td>4.5 K</td>
<td>2 K</td>
</tr>
<tr>
<td>Input coupler static</td>
<td>5.36</td>
<td>2.82</td>
<td>0.50</td>
</tr>
<tr>
<td>Input coupler dynamic</td>
<td>0.00</td>
<td>0.00</td>
<td>0.25</td>
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<tr>
<td>Cavity dynamic load</td>
<td>0.00</td>
<td>0.00</td>
<td>1.78</td>
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<tr>
<td>Support post</td>
<td>2.76</td>
<td>0.36</td>
<td>0.85</td>
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<tr>
<td>Conduction lead assembly</td>
<td>36.80</td>
<td>13.20</td>
<td>1.24</td>
</tr>
<tr>
<td>MLI (total 70 K + 2 K)</td>
<td>30.54</td>
<td>0.00</td>
<td>1.42</td>
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<tr>
<td>Cold to warm transition</td>
<td>0.72</td>
<td>0.08</td>
<td>0.01</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
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</tbody>
</table>

**Notes:**
1. Cavity dynamic loads from Nikolai Solyak, February 2012.
2. Input coupler static loads from S. Kazakov, February 2012, no copper plating on outer conductor, intercepts at 15 K and 125 K.
3. Current lead heat loads assume 2 coils at 50 A, 1 coil at 100 A.
Project X

Test Lead

300 K end
80 K intercept
5 K intercept
Thermometers (20 total)
2 K end (4 K for test)
Analysis results

Current lead temperature along length

Case 1: 10 Ga, RRR 100 copper
Case 2: 12 Ga, RRR 100 copper