Superconducting Linac (SCL) Systems

Presented at the Accelerator Advisory Committee Review

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Scope of Work (I)

Transfer lines in the tunnel (during installation)

Cryomodules in the tunnel

Empty slots for upgrade

2 K Cold Box

4 K Cold Box

GHe storage

Warm Compressor

LHe dewar

LN2

Test cave

Control room

CM rework

R&D

CTF

CM development

HPR

VTA
Scope of Work (II)

• Operation and maintenance of SCL Systems
  – Cryomodules: 11 medium beta, 12 high beta
  – Central Helium Liquefier (CHL): 2.8 kW at 2K
  – CHL control room: 1.5 shifts/day to cover CHL operation
  – Transfer lines: about 550 linear meters

• Cryomodule development and cryomodule rework/repair
  – Medium beta spare cryomodule: design under progress, ready for long-lead item procurements
  – Repair/rework in the RFTF: 0-2 cryomodules/year

• R&D for SCL system performance improvement and for STS
  – In-situ cleaning process, SRF cavity, fundamental power coupler, etc.

• SRF facilities
  – Existing: Clean room, high pressure rinse/ultra pure water system, test cave, RF system for test cave, ultrasonic cleaning, cavity tuning bench, cryomodule assembly/repair area
  – Under development: Vertical test area, Horizontal test apparatus, Cryogenic test facility, Barrel polishing system, R&D vacuum furnace
  – Future plans: Chemistry system, full size vacuum furnace
Group organization

• FY13 Budget (Labor: $3.09M, material: $1.96M)
  - Materials: spares 0.44, recurring ops 0.34, cryogens 0.43, CM repairs 0.48, others (contractor, facility improv./cleaning, M&S, travel, etc) 0.27

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<th>Position Type</th>
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<td>Management</td>
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• Weekly planning for resource management
Spare/maintenance

• Spares
  – In-line spares (ex. Warm compressor)
  – Ready to install for emergency (ex. Spare cryomodule, dummy pipes, warm section)
  – Critical spares are identified and maintained
  – Other spares are managed by system expert

• Maintenance planning
  – Preventative maintenance for CHL automatically triggered by SNS maintenance management system
  – Shut down planning starts 2 months in advance
  – Maintenance & operation coordinator position
  – Follow the SNS standard for work control
  – Predictive/proactive maintenance
Issues and Vulnerability

- Issues (performance degradation over the long term)
  - CHL: contamination $\Rightarrow$ efficiency/capacity down
    - Could result in long shut down: non-gaseous contamination in 4 K heat exchanger
    - Full time monitoring of impurities of helium (O2, N2, water, Oil)
  - SCL: SRF cavity performance degradation by gas/particulate contaminants (ex. Errant beam)
    - Processing, thermal cycle, repairs
    - Strict procedures/instructions followed and careful operation as a whole
    - Communication/consulting between subject matter expert and operation group at abnormal condition or precursors
    - Adjustment of machine proactively

- Key vulnerabilities (single point failure)
  - Carbon bed failure: 6 months
  - 2K cold compressor failure: 6-12 months
  - Transfer line failure: 6-18 months
  - Gas management failure: 3 months
  - Oil contamination in 4K cold box: 4 weeks- 3 months
  - Cryomodule: 3 weeks
Critical Spares

- SCL
  - Spare high beta cryomodule
  - Spare valves and actuators
  - Spare mechanical tuners
  - Four spare couplers for each beta
  - Part kit at least for one CM rework
  - Spare dummy pipes
  - Spare warm section (under procurement)
  - Spare medium beta cryomodule (under design)
  - Spare local pumping cart
**Critical Spares**

- **CHL**

  - **Warm compressors:**
    - in-line spare compressors in 1\textsuperscript{st} and 2\textsuperscript{nd} stages
    - One spare for each 1\textsuperscript{st} and 2\textsuperscript{nd} stage motor in storage
    - Two or three oil pumps/motors for each 1\textsuperscript{st} and 2\textsuperscript{nd} stage in storage
    - At least three shaft seals in storage

  - **4K cold box**
    - One spare turbine for each stage (5 stage)

  - **2K cold box**
    - One spare cold compressor/motor for each stage (4 stage)
    - Two spare VDFs for each stage
    - Spare card for mag bearing cabinets at least one each

- **Gas management**
  - Full set of valves