Acceptance Criteria:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
<th>Minimum acceptable performance during test</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum usable gradient for an individual cavity</td>
<td>180 MHz</td>
<td>Inductive cavity should exceed a nominal gradient of 20.0 MHz.</td>
</tr>
<tr>
<td>Maximum gradient of a cavity</td>
<td>250 MHz</td>
<td></td>
</tr>
</tbody>
</table>

New Challenges:

At higher gradients come new challenges:

- **Cryogenic load**
  - 1.37 W spec for heat load at full vCM total voltage – a challenge for the cryogenic plant, cryo distribution system, and avoiding flow instabilities.
- **Fundamental Power Couplers**
  - Coupler vacuum outgassing events observed in SELAP, causing vacuum trips.
- **Multipacting (MP)**
  - Nominal gradient lies in MP band.
  - Budget time for MP processing is required.
- **Magnetic field sensitivity**
  - Magnetic hygiene and flux expulsion crucial.

Vertical Cavity Test Stand vs Cryomodule Test Stand

**VTS**

<table>
<thead>
<tr>
<th>VTS</th>
<th>cavity</th>
<th>gradient</th>
<th>operating point</th>
<th>cycle time</th>
<th>DCM</th>
<th>CM</th>
<th>CMU</th>
<th>premise</th>
<th>overall</th>
<th>time</th>
</tr>
</thead>
<tbody>
<tr>
<td>vCM</td>
<td>0.00336</td>
<td>0.00336</td>
<td>0.00336</td>
<td>0.00336</td>
<td>0.00336</td>
<td>0.00336</td>
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</tr>
</tbody>
</table>

**Conclusion:**

With a mature program established thanks to expertise with LCLS-II cryomodule testing, the LCLS-II-HE program is successfully underway.

- Acceptance criteria nearly fully met or exceeded:
  - Test program ongoing, runs through end of July.
- Remaining tests:
  - Extended range tuner test / off frequency operation (OFO).
  - Qs degradation studies.
  - Plasma processing.

The vCM has met or exceeded specifications. These preliminary results could not have been accomplished without numerous experts from Fermilab and partner labs.

**Preliminary Results:**

<table>
<thead>
<tr>
<th>Record setting total CW voltage</th>
<th>16 cavities in amplitude locked RF mode.</th>
</tr>
</thead>
</table>

**Cavity performance exceeds specifications:**

- Maximum Gradient to VTS usable gradient far exceeds spec (16 MV/m) |
- Qs meets or exceeds spec (2.7 - 10^13) |

**Clean cavities:**

- One cavity with low level field emission, processed fully during Unit Test.
- Radio Despite at background during normal operation.

**Related Posters & Papers at SRF'21:**

- THOTEV08
- TUPF003
- MOPTE002
- THPD005
- TPAC009
- THTPE003
- THTPE17