**Performance test of the cryogenic cooling system for the superconducting fault current limiter**

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**Introduction**

**Background**
- SFCL is an electric power device which limits fault currents immediately in a power grid.
- Cryogenic cooling system are an essential prerequisite to safely operate HTS modules.
- When fault currents occurs, the heat is generated in a short time but the amount is very large.
- Liquid cooling using subcooled LN2 are widely used for the cooling of SFCL.
- Critical current of HTS modules is increased at low temperature, and an elevated pressure can suppress the generation of bubbles.
- Also, the LN2 in subcooled temperature and elevated pressure can evade the cavitation in cooling system.

**Objectives**
- In Korea, due to higher demand in a transmission level, 154 kV/ 2 kA SFCL have been developed.
- Verification of the design of the cooling system and cool-down process

**Cooling system configuration**

<table>
<thead>
<tr>
<th>Cooling sys. component</th>
<th>Specification</th>
</tr>
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<tbody>
<tr>
<td>Main cryostat (MC)</td>
<td>71 K (500 kPa), Heat load &lt; 800 W</td>
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<tr>
<td>Coolant</td>
<td>Subcooled LN2 (500 kPa, 71K, 23 Ton)</td>
</tr>
<tr>
<td>Pressure builder (PB)</td>
<td>Automatic pressure control (500 kPa), Heater (2 kW)</td>
</tr>
<tr>
<td>Subcooling cryostat (SC)</td>
<td>Hydrocyclone (50μm) / Heat exchanger (4 kW)</td>
</tr>
<tr>
<td>Cryocooler</td>
<td>Stirling cryocooler (RL type ; 4.0 kW@77 K/ 48 kWmax)</td>
</tr>
</tbody>
</table>

**Performance of the cooling system for 154 kV SFCL**

**Summary**
- In this study, we tested the performance of the cooling system for the prototype single phase 154 kV SFCL, which consist of a stirling cryocooler, a SC, a PB and a MC for the SFCL module, to verify the design of the cooling system and the cool-down procedure.
- Cooling processes are composed of a purging process, a cleaning and precocooling process, a LN2 filling process, a subcooling process and a pressurizing process.
- The cooling system and process are designed to ensure the normal operation condition of 71 K, 500 kPa.
- Temperature variations of the LN2 in the MC are less than 1 K in normal operation.

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