

SST-1 Cryogenics Requirements and the Way Forward

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The SST-1 Machine consists of sixteen TF and nine PF superconducting coils. The cryo stable operation of these coils demand the operation temperature of 4.5 K. This technical requirement is met by 1350 W at 4.5 K helium cryogenic system and is operational since 2003. The SST-1 cryogenics systems include, helium as well as nitrogen cryo systems along with its storage, distribution and recovery systems facilitated to the SST-1 cooling requirements. The cryo system mainly comprises of helium cryogenic system and liquid nitrogen management system.

Recent operational experience on SST-1 cryo system has revealed that there is higher heat loads than the installed cryo capacity observed while carrying out simultaneous cooling of the TF and PF coils of the SST-1. It was able to cool down the TF coils along with the current leads and PF3 coils without current leads. Higher pressure drops observed are attributed to higher heat loads in the PF coils. It has been observed that the higher pressure demand of at least 40 g-s-1 at 2.7 –2.8 bar (a) at 4.5 K with stand-alone cooling of PF coils.

That will finally cause the higher pressure demand of at least 40 g-s-1 at 2.7 –2.8 bar (a) at 4.5 K.

In order to provide the simultaneous cooling of the TF and PF coils, we have addressed few short term and long term plans by which we will be able to cool the SST-1 coils as mentioned below,

(i) Cryo heat loads minimization within the SST-1 by identifying the possible sources of heat loads and its feasibility to minimize them

(ii) Introduction of efficient design of the current leads as “cold capacity saver”

(iii) PF3 (U/L) coils operation with the VF coils to get elongated plasma in SST-1 by using NBI cryo plant of capacity 140 W at 4.5 K (short term). However, other PF coils will be cooled down to its best achieved low temperatures using existing 1350 W at 4.5 K helium plant.

(iv) Full-fledged PF coils operation with the TF coils by additional similar capacity helium plant (1500 W at 4.5 K) or

(v) Designing a cold process using helium compressor / or may be blower (when the heat load mitigation is achieved) and array of heat exchangers pre-cooled by readily available liquid helium (long term).

In this paper, a brief review of the installed cryo sub-systems as well as the plans of simultaneous cool down of the TF and PF coils of SST-1 will be discussed.

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