## COOLING SCHEME FOR W7-X DIVERTOR CRYO-VACUUM PUMPS

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10 pieces of divertor cryo-vacuum pumps (CVP) will be installed in the plasma vessel of Wendelstein 7-X (W7-X) stellarator. The inner part of CVP is used for condensation of Hydrogen, Deuterium etc. and baffles are used to protect the inner part from the radiation and gas loads. The inner part is cooled with cold Helium and operated at 3.4 K and 3.9 K during peak power and standard modes of operation. During short standby mode these are operated at temperature <10 K. The baffles are operated at 80 K and supplied with liquid Nitrogen (LN2).

3 different Helium cooling schemes were worked out, namely, parallel flow, parallel flow with intermediate sub-cooling and series flow with intermediate sub-cooling. The forced flow Supercritical Helium (SHe) flow is foreseen for these schemes. The analysis involved the process calculations, thermo-hydraulic calculations and control philosophy considering the operational requirements of CVP.

The LN2, transported from the storage tank (30000 l capacity) located more than 100 m away is provided to CVP baffles at an optimum condition. Three cooling schemes i.e. bath cooling, forced flow two phase and single phase with pump, were worked out for this purpose. The optimisation was also coupled with the LN2 heat exchangers of the helium refrigerator to find the optimum flow scheme.

Dedicated cooling circuits have been provided in the refrigerator for CVP operation. SHe is supplied using a cold circulator with the total mass flow of 250 g/s. The regeneration of inner part up to LN2 temperatures and the complete CVP up to ambient conditions is foreseen without affecting the other cooling applications connected to refrigerator.

The basic design of integrated transfer line from Helium refrigerator to CVP valve box (~60 m), the valve box itself and 10 transfer lines connecting the valve box to the individual CVP ports were carried out. The valve box contains an incoming transfer line, 10 outgoing transfer lines, controls valves, safety valves, purge valves & manhole. The details will be presented in the paper.