3.2.1.2.1.1 Timeline for Coil Cool-down to Cryogenic Temperature

The cryo-resistive coils (TF, PF, modular, and external trim coils) shall be capable of being cooled down from room temperature (293K) to their operating temperature (80K) within 96 hours.

3.2.1.2.1.2 Cool-down and Warm-up Cycles

The design of the cryo-resistive coils shall allow for at least 150 cool-down and warm-up cycles between room temperature and cryogenic temperature.

3.2.1.2.1.3 Pre-Run Temperatures

a. The device and facility shall be designed to be capable of operating the coils at cryogenic temperature (80K).

b. The device and facility shall be designed to maintain the vacuum vessel and all in-vessel components at a minimum temperature of at least 20ºC when the coils are at cryogenic temperature and the machine is not being pulsed.

3.2.1.2.2 Vacuum Requirements

3.2.1.2.2.1 Base Pressure

a. The device shall be designed and facility shall be upgradeable to produce, through design and the use of baking and wall conditioning, high vacuum conditions with a global leak rate of less than or equal to $2x10^{-5}$ torr-l/s at 293K and a base pressure of less than or equal to $2x10^{-8}$ torr, when equipped with its full pumping complement.

b. The base pressure shall be measured with a standard, magnetically shielded, nude ion gauge. The device shall accommodate additional nude ion gauges and at least one fast neutral pressure gauge as future upgrades. The partial pressure components of the base pressure shall be measured with a Residual Gas Analyzer (RGA) mounted at a location on one of the pump ducts near the turbo-molecular pumps.

3.2.1.2.2.2 Pumping Speed

a. The device shall be designed and the facility shall be upgradeable to accommodate the six PBX-M style 1500 l/s turbomolecular pumps (or equivalent) to provide a total net pumping speed at the torus of at least 3900 l/s.

b. The device shall be equipped with two of the four PBX-M 1500 l/s turbomolecular pumps (or equivalent) , configured to provide a total net pumping speed at the torus of at least 1,300 l/s.

3.2.1.2.3 Bakeout

Background

The temperature of the vacuum vessel shell will be capable of being elevated to a nominal temperature of 150ºC for vacuum vessel bakeout operations and to a nominal temperature of 350ºC to support bakeout of an in-vessel carbon-based liner (to be installed as an upgrade) at that temperature. Initially, there will not be any limiters installed in the vacuum vessel for first plasma or field line mapping. However, later in the program, the liner will be installed inside the vacuum vessel with a surface area that is a substantial part of the vacuum vessel surface area to absorb the high heat loads and to protect the vacuum vessel and internal components. Components that will become hot during bakeout operations must be compatible with their elevated temperatures in terms of strength, compliance for expansion, and vacuum integrity.