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Abstract

Within the general TESLA collaboration the Laboratoire de l'Accélérateur Linéaire has the responsibility for the development of high power input couplers for the super-conducting cavities. To this end we have assembled the required infra-structure necessary for the preparation, conditioning and tests of proto-type couplers. This infra-structure will be described along with brief results of the first proto-type tests.

INTRODUCTION

Super-conducting (SC) RF activities at LAL-Orsay are centred on the development of RF input couplers for the cavities of the TESLA linear collider study. This program of work is performed in the framework of a DESY/LAL collaboration. At the time of writing, four different versions of power couplers have been tested at the TESLA Test Facility (TTF) in DESY-Hamburg (three designed by DESY and one from the Fermi National Accelerator Laboratory) [1,2]. The latest DESY design, the so-called TTF-III coupler, appears to be capable of handling the required power for the present parameters of the 500 GeV stage of the TESLA project. However, improvements to the design may still be possible. In particular it is hoped that further development work at Orsay may result in enhanced performance and cost reductions.

INFRA-STRUCTURE

All coupler tests at Orsay are performed at room temperature due to the absence of cryogenic facilities. Nevertheless, it was anticipated that couplers conditioned at Orsay might eventually be mounted on modules containing SC cavities at DESY (see below). As the cold part of the coupler is an integral part of the cavity vacuum it is necessary to treat and prepare the couplers to the same degree of cleanliness as the cavities in order not to limit the cavity performance. Thus it was deemed necessary to have class 10 clean room facilities for coupler assembly. In addition it was decided that we would build a vacuum furnace allowing bake-out of the coupler parts before assembly.

The Clean Room

The clean room consists of a 27 m^2 zone of class 1000 and a 13 m^2 zone of class 10. The class 1000 area includes an ultra-sonic bath in which the couplers are cleaned using ultra-pure (UP) water. The UP water is produced using a commercial system which provides 200 litres per day (electrical resistivity = 18 MΩ.cm), filtered to remove all particulates above 0.22 μm in size. The ultra-sonic bath allows cleaning with up to 8 kW of power at 40 kHz. The class 10 area is used to assemble the cold parts of the coupler to their RF test bench. The couplers enter directly into the class 10 area from being baked out in the furnace. Once assembled, the couplers are leak-checked in the clean room before exiting through an ante-chamber into the RF test area. The leak test is performed using a helium detector positioned outside the clean room. The helium gas and leak detector cables traverse the clean room wall via a special feed-through.

The RF Power Source

The modulator and klystron (THALES type TH 2104C) are provided by DESY. The modulator was delivered to Orsay in June of 2002 and, following connections to, and tests with, ancillary equipment was ready to produce RF power in November of that year. All auxiliary equipment control racks have been built at LAL. The source provides output pulses of up to 5 MW for 2 ms at 10 Hz repetition rate. The power is fed to the coupler via an RF wave-guide distribution system which includes directional wave-guide couplers for measurements of incident, reflected and transmitted power. A four port differential phase-shift circulator protects the klystron in case of excessive reflected power. The data acquisition system records the levels of the above mentioned RF powers, the vacuum level during each pulse and the signals from electron "pick-ups" in both the warm and cold coupler parts. The reflected power, transmitted power, electron signal, coupler temperature and vacuum levels are all used as interlocks to the RF system.

The Vacuum Furnace

Experience at DESY has shown that, to reduce conditioning times, the cold coupler parts should be baked out to 400 °C. In order to do this we have had a furnace built in industry corresponding to our specification. The furnace is cylindrical in form and is designed to have a uniform temperature over a length of 60 cm and a diameter of 25 cm, sufficient to contain either the warm or cold coupler parts (see Fig 1). The pressure obtained during coupler bake-out at 400 °C is < 10^{-6} mbar. Both end flanges of the oven can be opened which allows parts to be introduced/extracted either in