§79. Proposal for the Operation of CHI on QUEST

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During FY2014, the CHI design for QUEST was finalized. An important modification to the design was the improvement to the current feed section. The University of Washington procured the ceramic CHI insulators from Kyocera Corporation, and delivered them to Kyushu University. These have now been installed on QUEST, in preparation for CHI system operations.

1. Introduction

FY2014 design improvements to the CHI system on QUEST eliminated a ceramic vacuum current feedthrough, and replaced it with a custom-built feedthrough using PEEK insulator. Mechanical strength and flexibility of the insulator combined with the 2 cm dia. Stainless steel current feed rod avoids the possibility of insulator fracture when subjected to JxB forces. Because of the large size of the Alumina insulator plates (shown in Fig.1), procurement was a major challenge, but was successfully accomplished. All ST internal systems required for CHI operations are now installed on QUEST, as shown in Figures 2 and 3.

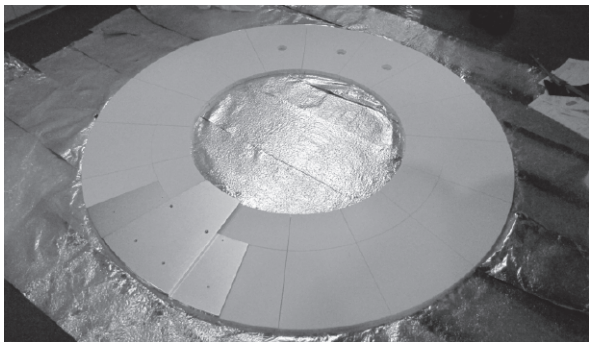

Fig. 1 CHI insulators plates required for achieving voltage isolation between the electrodes and vessel.

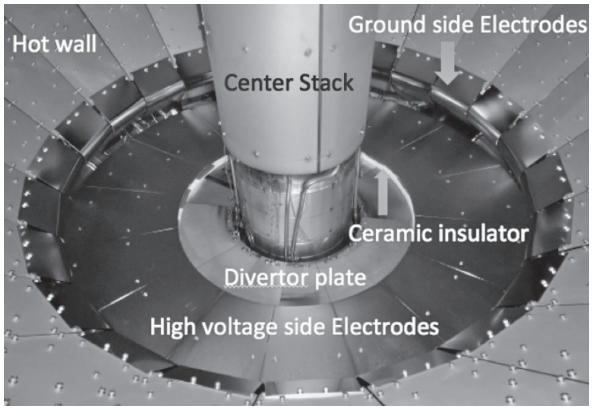

Fig. 2 Photo of the top of the CHI electrodes. The CHI insulators are located below the high voltage electrodes as shown by the arrow pointing to it.

2. Experimental Systems for CHI

CHI on QUEST will be powered by a 20 mF, 2 kV capacitor bank capable of generating up to 30 kA of peak injector current. The system triggered by two ignitrons, each connected to two capacitors. This dual trigger capability would provide greater control over the injector voltage waveform pulse, as on NSTX. The gas injection assembly is based on the system used on HIT-II and NSTX. It allows pressurized gas from a 1-2 cc plenum to rapidly empty into the vessel through ports that direct the gas from the groundside electrode to the divertor electrode plates. Gas in injected using fast acting pneumatic valves that have about a 2 ms response time, from two different toroidal locations. At each of the three current feed locations below the electrode/divertor plate assembly (Fig. 3), a low inductance snubber based on 32 μF, 5kV capacitor will

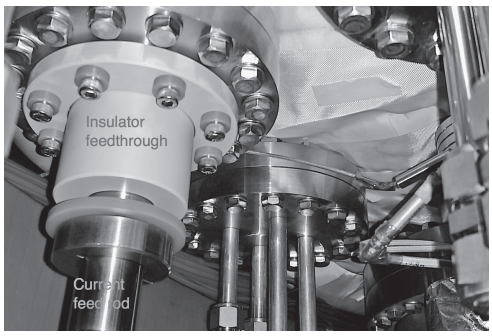

Fig. 3 Photo showing one out of the three current feed rods that are located in the lower part of the QUEST vessel. These are connected to the electrodes (Fig. 2)

be used to suppress transient voltage spikes that can occur during CHI operations. The primary ground for CHI will be the QUEST outer vacuum vessel.

3. Experimental Plans

The first part of the research plan is to test and calibrate the gas injection system followed by high voltage testing of the electrode assembly. This will be following by applying voltage to the electrodes using a capacitor bank power supply. The gas system controls and capacitor bank operation will be accomplished using Labview based control logic that is interfaced to the QUEST Control system. The second objective is to initiate the CHI discharge, initially by using high values of the injector flux. This ensures that the resulting discharge remains near the injector region, allowing other optimizations to be carried out to ensure that the discharge initiates reliably. Accomplishing these two steps will make the system capable of supporting discharges in which the CHI discharge fills the vessel to enable current drive studies.

Summary

Considerable accomplishments during FY14 include the finalization of the CHI design for QUEST, procuremnt of the CHI insulators, and the full assembly of the CHI internal ST hardware to support plasma operations.