Vulcan TAW upgrade – installation

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Introduction

January 2008 saw a coordinated team of engineers and scientists begin the strip out process to upgrade TAW [1]. The new compression and interaction extension chambers were in manufacture. Design of the grating mounts and compression chamber breadboards were nearing completion and the design of the beam delay and beam transport tables would shortly be started. The first scheduled experiment was a high profile HiPER European collaboration requiring full functionality. This article describes the hardware installation of the Vulcan TAW upgrade.

TAW before

Figures 1 and 2 show an existing post experiment state in TAW with additional tables and diagnostic hardware. In the background the old grating chamber is visible with vacuum beam transport pipes and turning mirror chamber. Diagnostic and beam paths were limited by the need to have clear escape routes.

Figure 1. Existing SW corner of TAW.

Figure 2. Existing NW corner of TAW.

Figure 3. Existing TAW trenches.

Hidden from view were vacuum systems; water pipes; gas lines; control, power, interlock and signal cables. Trenches were clogged with both operational and redundant systems (Figure 3).

January 2008

All optics were removed to safe storage. All mounts except those on the main six tables were removed to safe storage. The main six tables were covered with fire retardant film. The vacuum chambers except for the interaction chamber minus its door were all removed

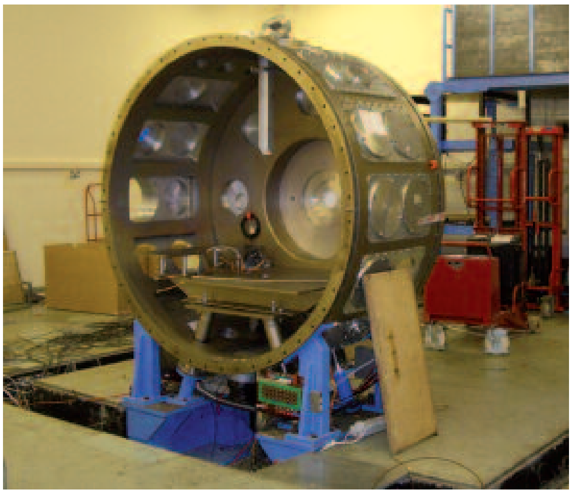

Figure 4. NW corner of TAW.

to storage. All the tables including the control desk but excluding the main six and LANSA were removed to storage. The changing booth was dismantled and entrance doors removed. All trenches were cleared; current systems were carefully disconnected and marked up, redundant systems removed. Figure 4 shows progress nearing the end of this phase.

Figure 5 shows the old interlock system and control rack on the left with control wires being identified. Multi-layer cable tray is being installed to support and segregate the different types of cables.

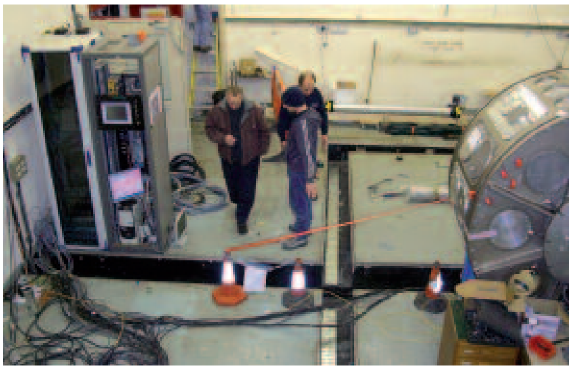

Figure 5. Changing booth removed and trenches open.

February 2008

The new interaction extension and compression chambers were delivered into R2 with the chamber supports. A dry fit was performed and templates were

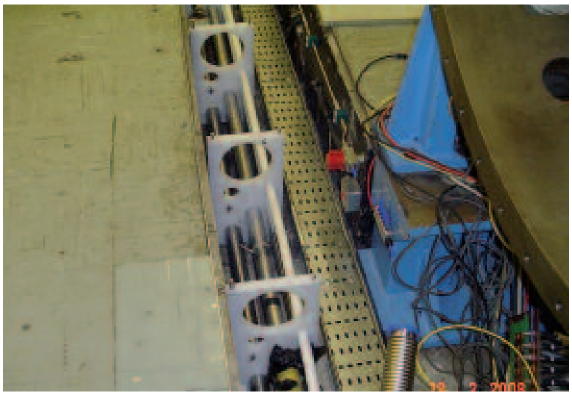

Figure 6. Water, gas and vacuum services being installed in the main trench in front of the interaction chamber.

Figure 7. The new compression chamber enters the south control room.

made to drill the floor in TAW. In TAW the new cooling water system, vacuum system, gas supplies and exhausts were installed. Systems were segregated in order to optimise the use of the trench (figure 6). New floor plates were manufactured from 6082 Aluminium plate to replace the wooden floor plates. A small section of the floor tiles were replaced where the compression chamber was to sit. The old breadboard was removed from the interaction chamber.

Quinto (a specialist lifting company) were contracted for 1-day to help manoeuvre the compression chamber and interaction chamber extension into position and fit the legs.

Figure 8. Quinto deliver compression chamber into south control room 29/2/08.

Quinto can be seen in figures 7 and 8 lifting the compression chamber into the south control room through the double doors. There was only about 25 mm clearance both sides. Skates were used to slide the chamber further into the control room then the chamber was manoeuvred back and forth until it could be wheeled into the target area. Operations in TAE were suspended for the day.

Figure 9 shows the chambers in position and in the background the last doors are being installed. The holes have been drilled in the floor and floor plates are being shimmed and bolted down.

Figure 9. New chambers installed in TAW.

March 2008

Figure 10 shows the vacuum system installed to both chambers and first manual vacuum test. Figure 11 shows the installation of vacuum and motor control cables and the ends terminated. Additional power hardware was installed to cope with the high current draw from the screw pump on start up. Vacuum control and motor control hardware continued to be installed.

Figure 10. Early vacuum testing carried out to check the O ring between interaction chamber and extension chamber.

Figure 11. First batch of drive cables are installed.

Figure 12. Quinto install compression chamber breadboards, progress is hampered by the stiffening tubes.

The compression chamber breadboards were delivered into R2 and Quinto contracted again to install. Each segment had a mass between 400-500 kg and was 4 m long. Figure 12 shows the temporary beam installed by Quinto and a slab of aluminium tooling plate being slid into the chamber. When installed each bolt was tightened in a sequence to a preset torque to ensure good clamping without risking damage to the aluminium structure or the stainless bolts.

April 2008

Figure 13 shows the breadboards installed in the compression chamber. They were cleaned again manually with tacky cloths and alcohol and the chamber was closed and pumped. The first pump took 5-days to reach 5×10^{-6} mbar due to the remaining solvent and moisture. All the beam transport tables were also installed and Figure 14 shows the beam delay table being installed using internal references which were positioned both next to the shutters and on the beam transport tables. The beam relay pipes between the chambers and pit cooling were also installed. The vacuum system was developed and leaks resolved. Pelloby installed the 500 kg SWL jib crane and tested it.

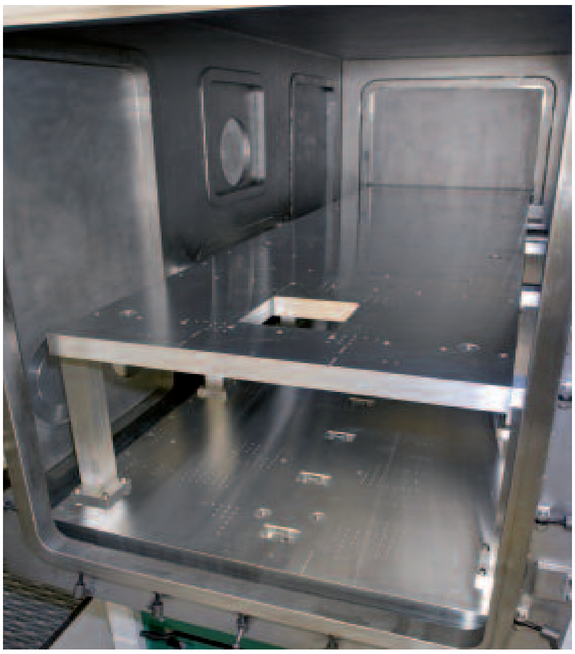

Figure 13. Compression chamber with breadboards installed.

Figure 14. Beam delay table being located in SW corner.

May 2008

May saw interleaving and multi-team work with laser and engineering work continuing. Drilling was still required and trenches were still open, but a cleaner environment was required to install and align the gratings. Figure 15 shows the pressurised tent that was constructed with a HEPA filter and fan to improve the cleanliness in and around the compression chamber. The cleanliness improved dramatically. Figure 16 shows the gold gratings installed with references to begin the alignment process. The remaining mirrors in the bottom deck were also installed.

June 2008

June saw continued interleaving of effort and the build of the roof mirror. Design and manufacture of the bespoke frame to lift the dielectric gratings into position was completed and a Genie lifting device was hired. The north grating was installed first, then the south grating. This allowed the diagnostic tables to be installed and built up. Alignment began on the top deck and continued on the surrounding tables. Final vacuum commissioning began.

July 2008

The roof mirror was installed and aligned and full laser commissioning was underway.

August-September 2008

Final commissioning and testing of all systems.

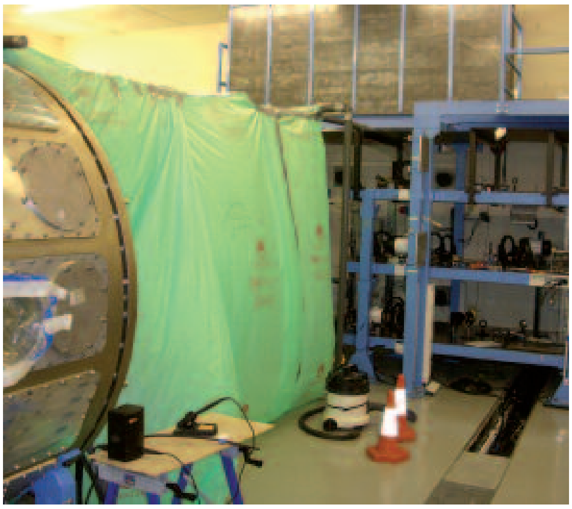

Figure 15. Pressurised tent constructed for parallel working.

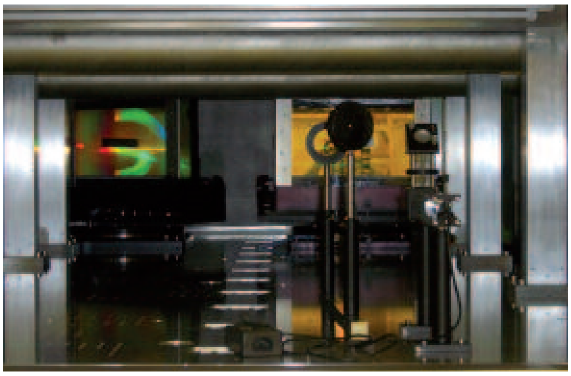

Figure 16. Existing gold gratings installed in compression chamber.

October 2008

October saw the setup and run of the first experiment in the upgraded TAW. Figure 17 shows the area mid experiment carrying out HiPER related research.

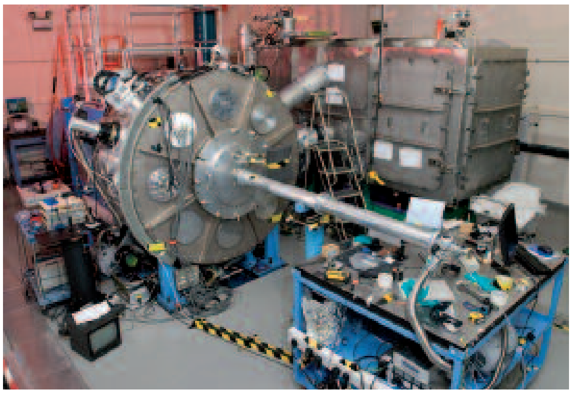

Figure 17. TAW running the first experiment.

Thanks must go to all staff that participated in the project enabling it to be brought to fruition.

References

1. C. Hernandez-Gomez, CLF Annual Report, 260-262, (2007-2008)