

## Hydrogen Valves, Cells and Intensifiers.

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# Hydrogen Intensifier

- Specification & Schematic.
  - Specification drawn up with milestones and deadlines.
- Tender procedure.
  - Unsuccessful due to time and cost.
- $\cdot$  Re-evaluation.
  - Was it feasible to design and assemble in-house?
- Design
  - Design and Specification drawn up by Pressure and Furnace Section.
  - Design office to design and manufacture housing for system.
- Source and purchase components.
  - Pressure and Furnace Section.







## Hydrogen Intensifier

- Source components from external companies.
  - Nova Swiss.
  - Hi-Pro Pressure Products Ltd (agents for Sitec and Harwood).
  - Enerpac.
  - Stansted Fluid Power Ltd.



- Resources at Rutherford Appleton Laboratory.
  - Design Office.
  - Pressure and Furnace Section.



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### Purchase of Components



#### Transducers



Fittings & Valves



**Rupture Discs** 



Control



Intensifier Frame



3Kbar Hydrogen Pump



Oil Pump



## Intensifier Build



3Kbar Hydrogen Pump



Hydraulics Control Valve



Hydraulic Pump





HMI Controller



Pipe work and Fittings



**Intensifier Barrel** 



## Hydrogen Centrestick

- Specification.
  - Safe use with hydrogen up to10Kbar, heated capillary and wiring for heaters and sensors and able fit a standard cryostat.
- Design.
  - Design Office and Pressure and Furnace Section.
- Purchase Components.
  - Pressure and Furnace Section.
- · Assemble.
  - Pressure and Furnace Section.
- Test.
  - Pressure and Furnace Section.







# 10 Kbar Hydrogen Valve

### Problems

- 10 Kbar valve leaking just over 8Kbar.
  - Leaking from top gland packing.
  - Valve sent back to Harwood via Hi-Pro.
  - Valve retested and both glands leaking.
  - Valve inspected by Hi-Pro and RAL.
  - Gland seals not adequate.
  - Harwood agreed to give refund due to not reaching required specification.
  - Hi-Pro, Sitec and RAL to develop valve.





## 10 Kbar Hydrogen Valve

#### Sitec Be/Cu 10 Kbar Valve

- 1. Designed by Sitec and Hi-Pro Pressure Products Ltd.
  - After tests and discussions with Hi-Pro, a new valve design was produced.
- 2. Delivered March 2012.

#### 3. Tests.

• Two test were carried out both to 10 Kbar, one with the valve blanked off and the valve open and The second against the closed valve. The Valve passed both tests.

#### 4. Centrestick top bracket modification.

• Due to design differences the top bracket of the centre stick needs to be redesigned and additional fittings are required.





### Material Tests

#### Window burst tests.

 0.15mm thick windows have been manufactured from Inconnel, 17-4PH Stainless Steel, Beryllium Copper, 7075 Aluminium Alloy, Vanadium and Ti/Zr. These windows have been pressurised with Helium to burst pressure to establish a datum. •A replacement window from the same material is then pressurised to 70% of the burst pressure with Hydrogen and left for 24 and 48 hours. The sample is then burst with Helium.







### Material Tests

#### Problems.

•Further tests with thinner windows at longer hydrogenation times have shown no difference and we are now looking at the process.

•A possibility is the initial work hardening of the material when pressurising with Helium, new tests pressurising only with hydrogen are under way to rule this out.







## New Cells

Hydrogen High Pressure Cells.

•6 Kbar cell for room temperature and below.

• Cell specification was 6kbar at room temperature, it is now designed, manufactured and ready for testing. The cell should be ready for use May 2012.

•7 Kbar cell for 250 Celcius.

•Cell is now designed, manufactured and ready for testing but initial tests on the Brigman seal at elevated temperature tests ended with the failure of the seal test cell. The seal test cell is under investigation to establish what happened.







## Collaboration

Purchase of 8Kbar cell from LLB

•A scheduled experiment with requirements of 8 Kbar pressure in a magnetic field of 7 Tesla.

•Contacted Burkhard about the possible loan of his cell but after discussions decided to purchase a cell.

•Big thank you to Burkhard for his assistance in the purchase of the cell.

•The experiment is scheduled for 26<sup>th</sup> May.





### Questions?