Hydrogen Delivery System

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Outline

1. The installation story so far
   i. Gas Panel Enclosure and Cryostat
   ii. Transfer Line
   iii. Gas services
   iv. Electrical services
   v. Ventilation system
   vi. Hydrogen Local Control Room (HLCR)
2. Fan and vent line installation
3. Vacuum lines and pump enclosure
4. Bottle store and gas supplies
5. UPS update
6. H2 charging infrastructure
7. Schedule and milestones

Installation Preparation

- Limited headroom above the south mezzanine meant that dedicated lifting equipment was required for the Gas Panel Enclosure
- Spreader beam designed and tested by local firm (Cyclone Cranes Ltd)
- Tested with GP Enclosure frame at AS Scientific before delivery

R&D System Delivery

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Transfer Line Installation

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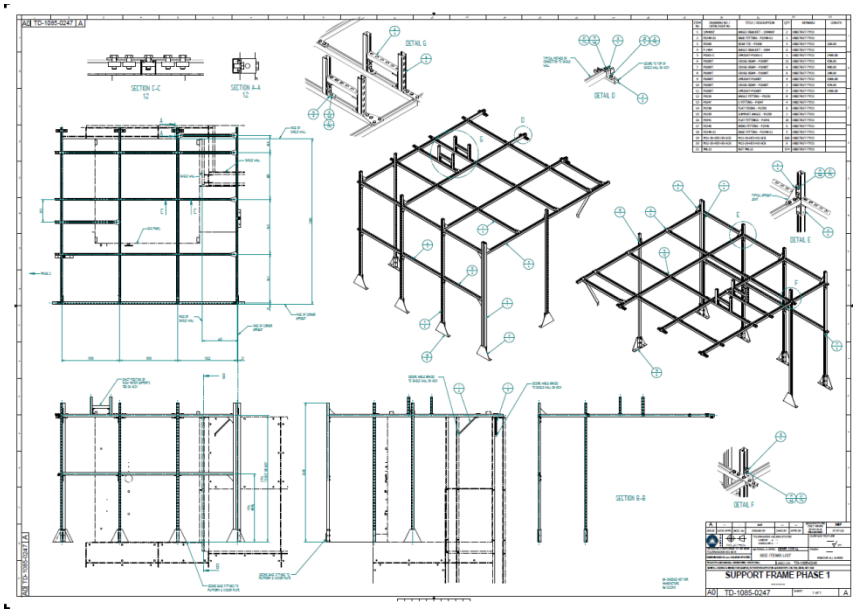
Gas Services



- He and N2 supply lines run in from external bottle store location
- Will eventually feed all three systems (and possibly other sub-systems if required...)

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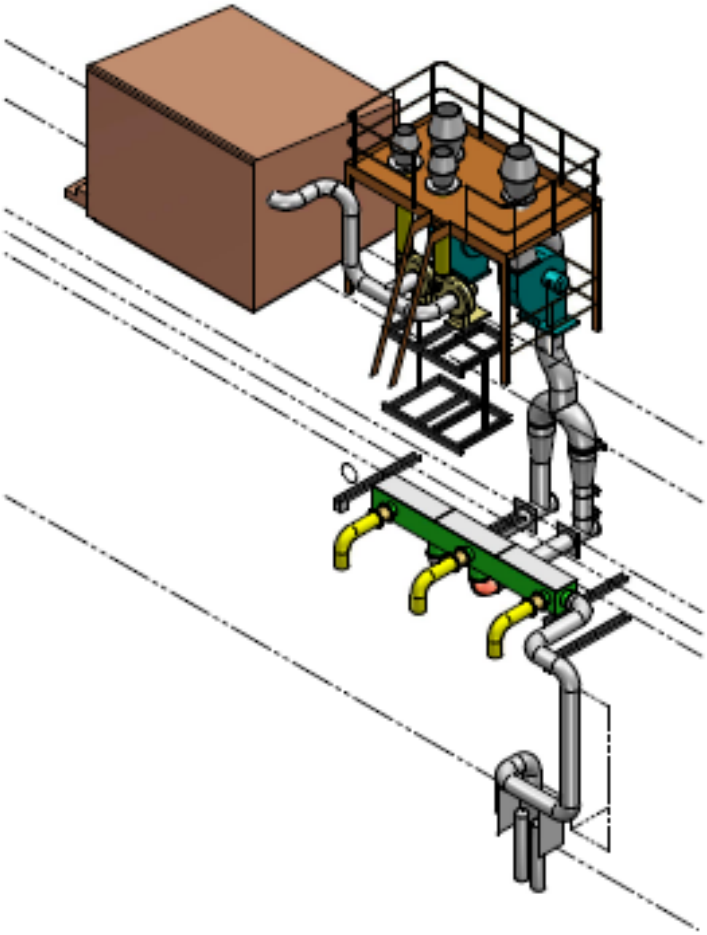
Electrical Services

- All tray work installed between HLCR and Gas Panel Enclosure
- Current route can be extended for second and third systems
- Majority of cables pulled
- Local distribution boards installed on south mezzanine for heater/chiller unit
- Cabling to Test Cryostat in progress
- 3-phase supplies for cryocooler compressor and heater/chiller unit just need connecting

Ventilation System 1



Ventilation System 2

- Ducts fitted through holes in the wall
- Complex installation of vent pipes inside ducts almost complete
- Next step to extend ducts up to roof level and connect with fans

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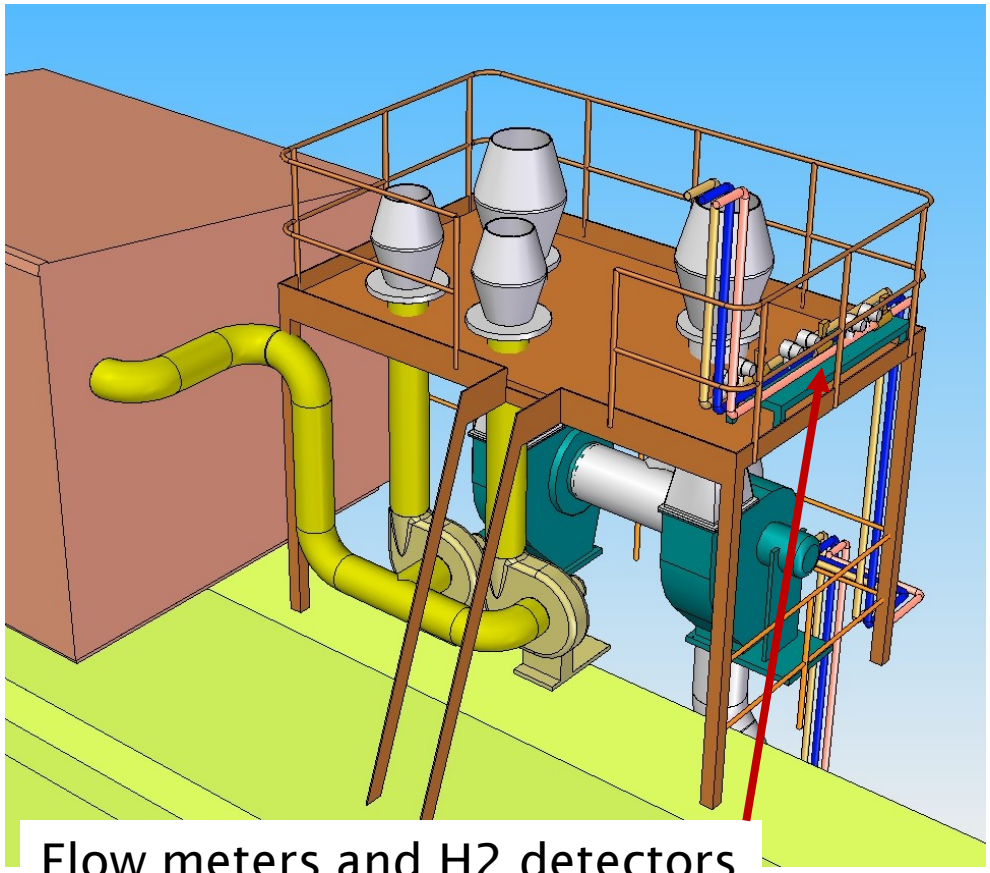
Hydrogen Local Control Room

- Control rack for System A installed
- Tray work in place for under-floor connections
- Small adjustment needed to position of air conditioning unit
- Space allocated for UPS on opposite wall
- Some further work may be needed to meet safety requirements for UPS and batteries

Fans and vent lines

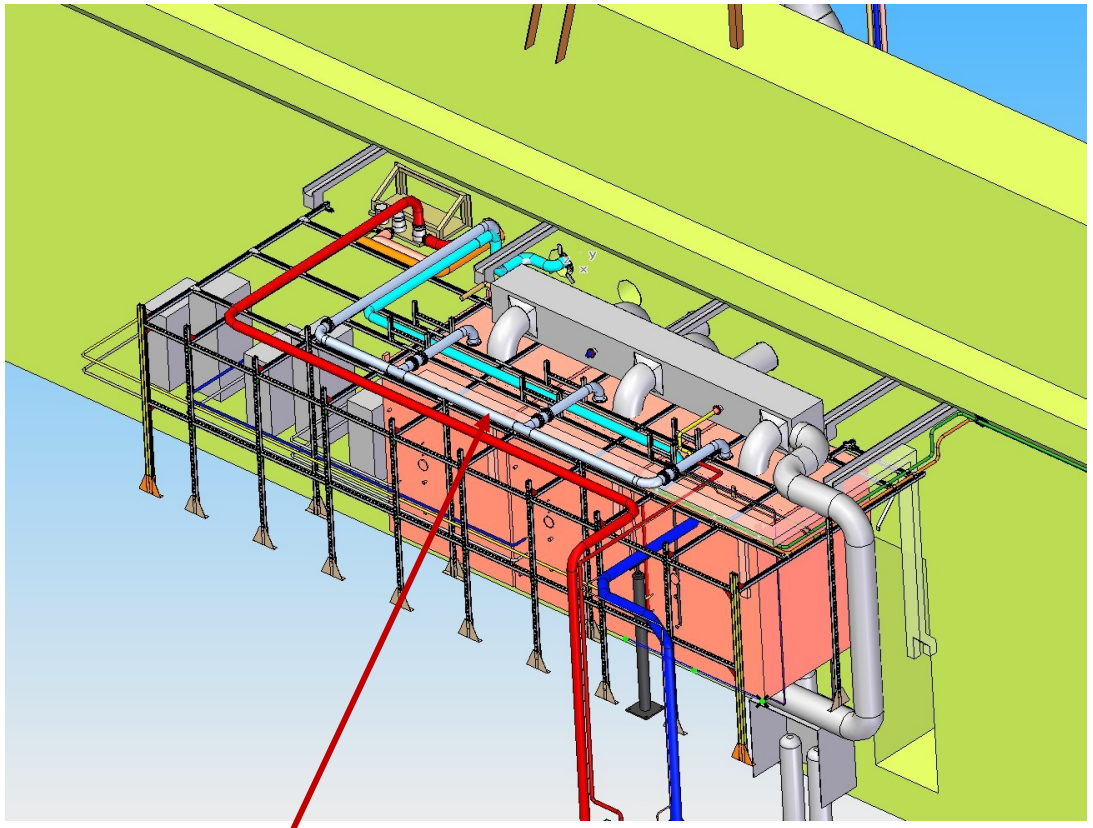
- Fan positions agreed
- Platform for stacks and vent lines designed
- Construction drawings have been issued by BPG
- Additional fans for Vacuum Pump Enclosure specified
- Vent lines will be routed to top of platform where instrumentation is also located (this keeps potential leak sites at high level)
- Installation will require parts to be lifted over the ISIS Linac. This is scheduled to take place during the Easter shutdown (mid April)



Flow meters and H2 detectors

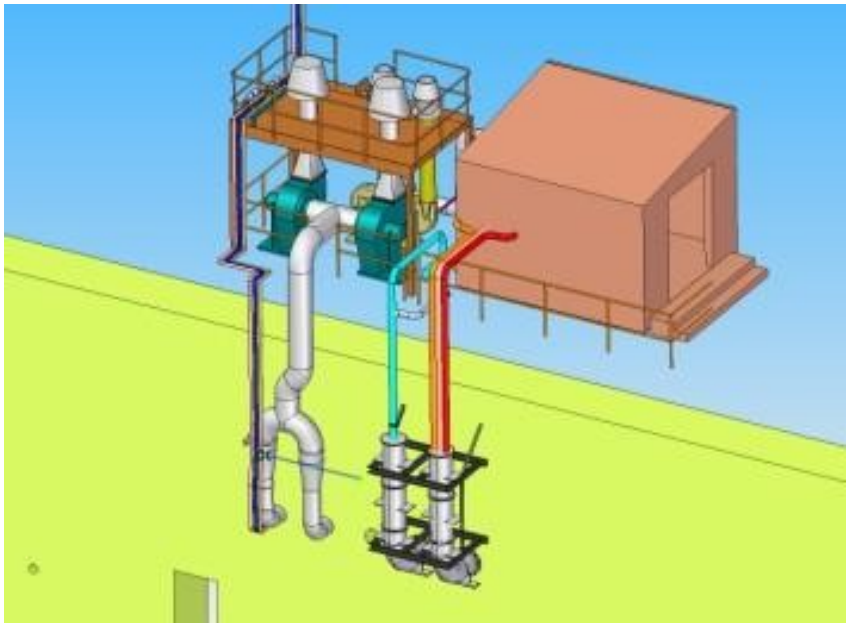
Vacuum system 1

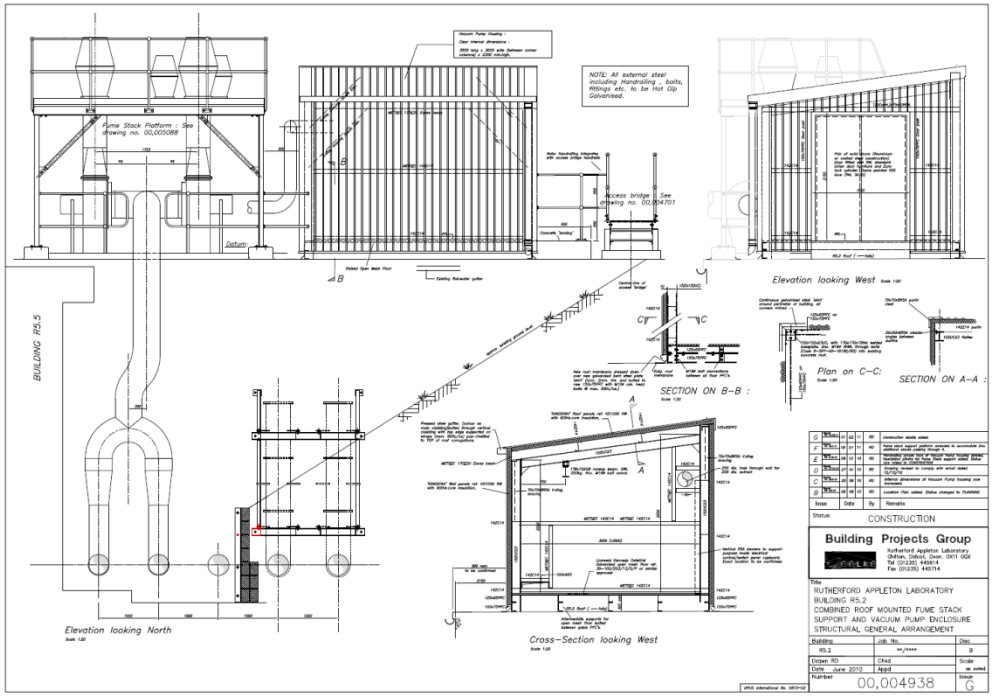
- Detail design of the pipework is well advanced with colleagues at DL and quotes are in for the first line
- Detail design of turbo pump mounting (and possible shielding) underway
- Temporary pumping rigs can be used for testing before the external vacuum enclosure is in place



Line for system purging

Vacuum System 2





- Vacuum Enclosure design is complete and drawings issued by BPG
- As a Zone 2, the Enclosure will be serviced by 2 fans (nominal and redundant) following the same principles as the Gas Panel Enclosure.

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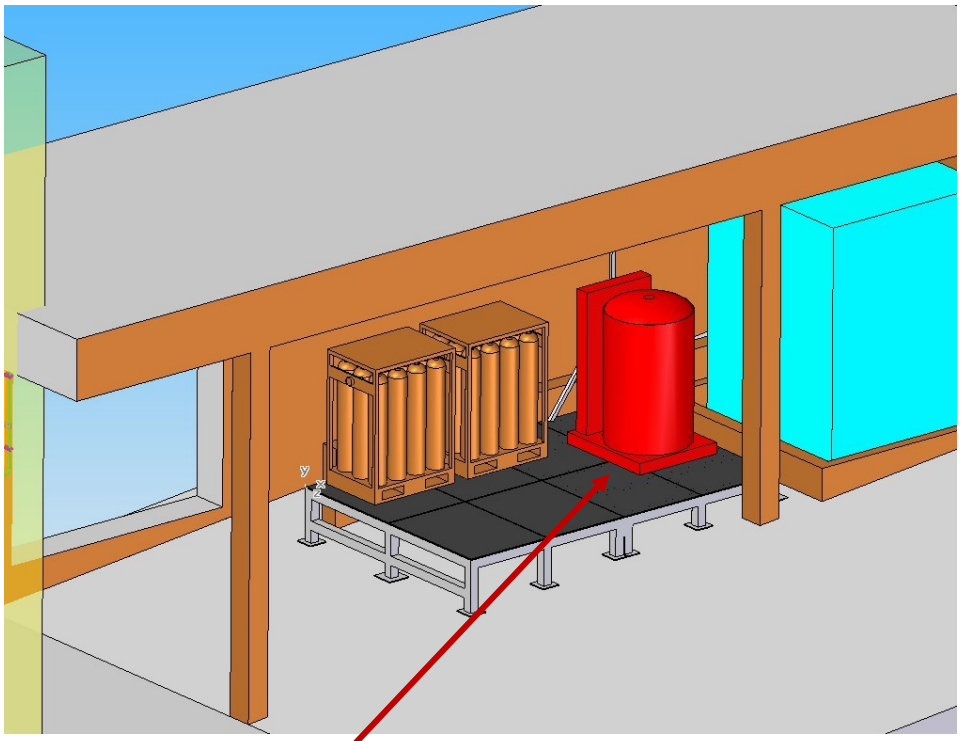
Bottle store

- Platform drawings are complete
- Fabrication to begin shortly
- Pipe runs in place
- Gas panel to facilitate pack connections and changeover currently being manufactured
- Propose to replace N2 bottle packs with Dewar to reduce awkward and potentially dangerous pack movements
- We envisage this to be a general gas supply area for the whole experiment

➢ Please come forward with your requirements so that we can size it correctly



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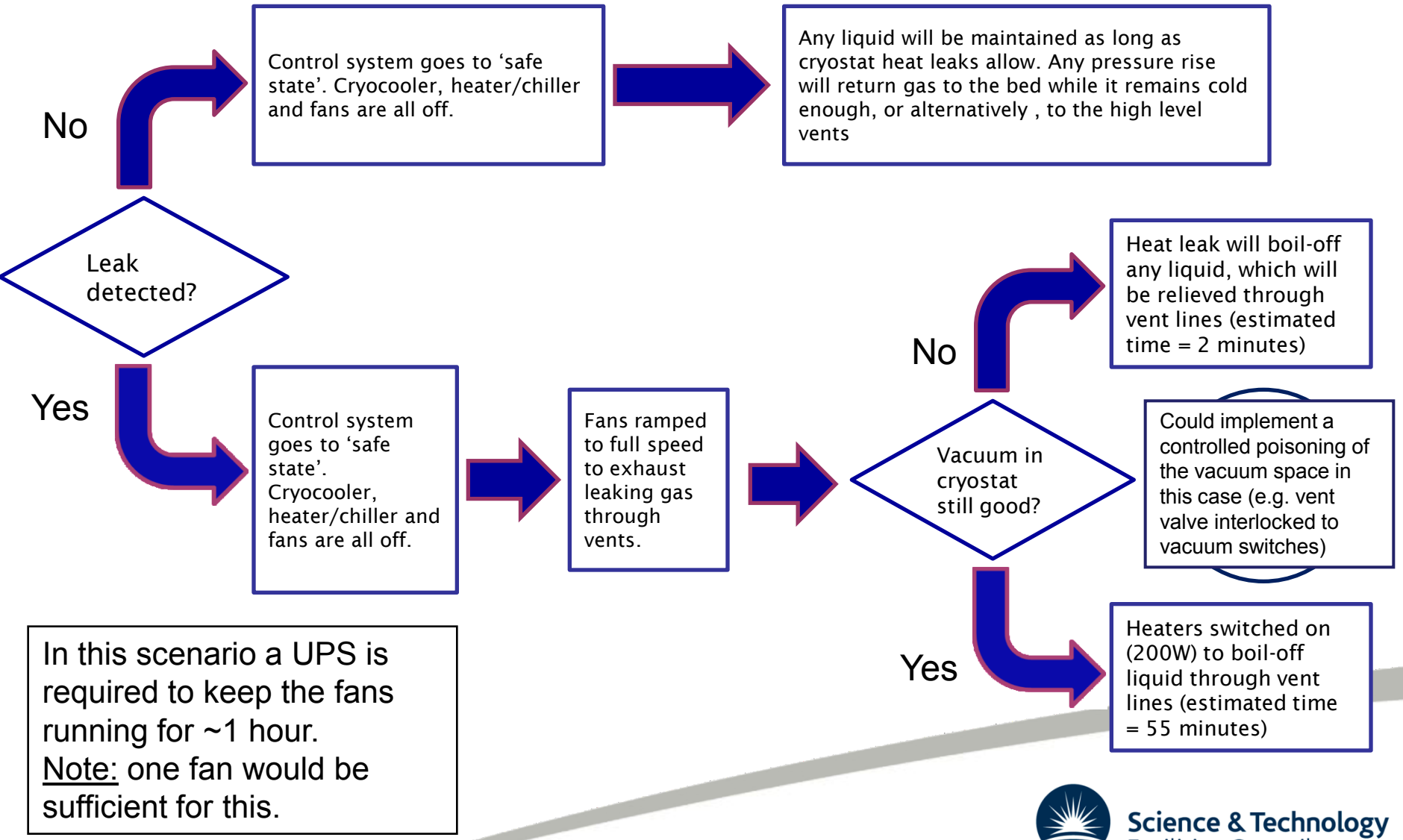
UPS Update

- Only required if a leak should be detected during, or just prior to, a power outage
- Proposal discussed during MICE TB at CM28 agreed with ISIS, with some minor changes
- System can be made safe in approx. 1hour max. Therefore, the UPS can be entirely battery backed and there is no requirement for an additional diesel generator
- Some extra work may be required to the HLCR to make it suitable for the large number of batteries to be stored there
  - 1 hour fire door fitted
  - Holes for cabling appropriately sealed
  - Improvement to ventilation?

When power goes off...



In this scenario a UPS is required to keep the fans running for ~1 hour.
Note: one fan would be sufficient for this.

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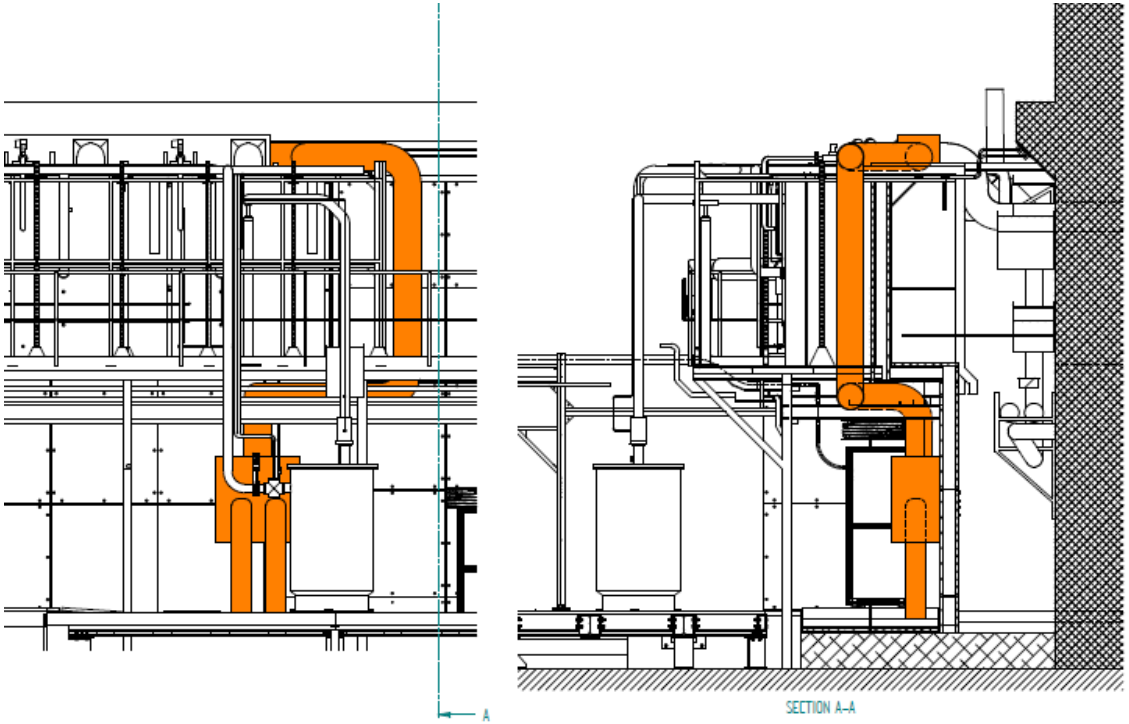
H2 Bed Charging

- Ideally a one-off operation, but at least rare
- Experience from ISIS is that an injury from moving or lifting the bottles is much more likely than a leak of H2
- Plan to install a charging station below the south mezzanine to avoid lifting operations
- Bottles will only be stored there during bed charging
- Area to be ventilated with duct extension from main plenum
- Detail design to be produced



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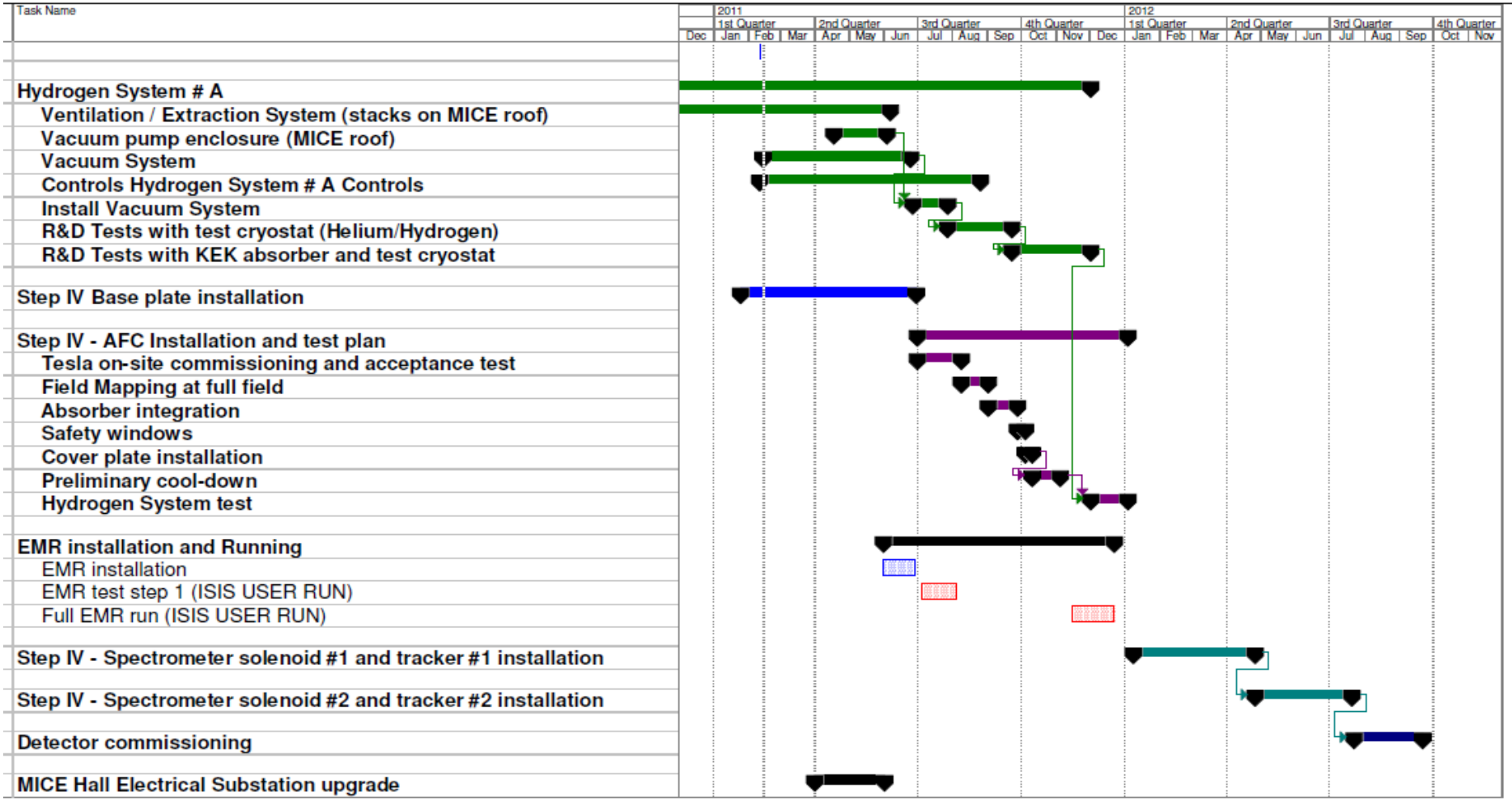
Schedule in context of the other installation tasks



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Key dates

- Jul '11: Completion of Hydrogen infrastructure (some preliminary testing with helium can be envisaged before this date)
- Jul '11: AFC Module arrives
- Aug '11: Pre-operation safety review
- Sep '11: Start R&D testing with hydrogen
- Dec '11: Commissioning Hydrogen System with AFC

Will need to look in more detail at potential clashes with the AFC and EMR schedules....

Summary

- Since delivery of Test Cryostat, Gas Panel Enclosure and Transfer Line at the end of 2010, the rate of progress has significantly increased
- All major infrastructure jobs are well advanced
- Lots still to do, but no major blocking points at present

However…

- We still haven't got to the difficult bit yet
- R&D testing needs careful planning around other activities in the hall
- AFC transfer line still to be designed and manufactured
- May not be time for testing system with KEK absorber before AFC arrives