Helium Recovery at ISIS

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ISIS
Experimental Operations
Cryogenics

Helium Themed 9th Cryogenic Cluster Day
May 24th 2019
Helium Recovery at ISIS

- ISIS Facts
- ISIS Helium Timelines and intense areas of usage
- The ISIS Helium Recovery System
- System Measurements

“Where we are and where we’re going”

- System monitoring
- Expansion of the ISIS System & DLS gas liquefaction
- Helium management collaboration
**ISIS facility & SE facts**

- 2 Target Stations

- 27 *neutron* and 7 *muon* Instruments

- ~ 30 experiments per day

- ~ 800 experiments per year

- ~ 95% of all experiments require some kind of *Sample Environment* (SE):

- ~ 2/3 of all experiments require *cryogenic* SE
**ISIS Helium Timelines 1995 - 2012**

- **Sell off of USA BLM stock**
- **The perfect storm**
- **Move to a more secure supplier**

**Helium Cost Rockets**

**Conception of Helium Recovery 2013**

**Networking:**
- CryoUsers, ILL, HZB

**Start of Project 2015**

**ISIS Usage 1993 – 2010**
- 30 / 50K LL/Y
- £2.20 - £4.65 LL
Rapid turnaround & Intense Ultra Low Temperature Sample Environment

• About 2/3 of all ULT sample environment is used in muon spectroscopy experiments
• Remainder often in High Magnetic Field

Long shutdown in 2014
One cycle cancelled

Number of ULT / Magnet experiments per year

Helium Usage ≥60000L / Annum
ISIS Recovery system

- Orbitally Welded St / Steel tubing
- Approx. 1.75 KM of pipework
- x3 44 m³ Sauer Compressors
- 22 m³ gas bag
- Complete July 2016
July 16’ – July 17’

- Commissioning of system & recycled gas reused in TS1 & 2
- Hiring of tube trailer

July 17’

Linde TCF20 Operational

Total Project Cost ~ £2.1M
System measurements

- Ring main gas flow & pressure,
- Compression & storage pressures
- Quality & O2 Detection
- Oxygen depletion & Ventilation
- Cryogen levels
- Cryogen cost / usage
“Where we are and where we’re going”

Where we are

• Learning curve & change in culture ongoing
• He Recovery 1st year of approx. 50%
• Way forward “more resource”

Moving forward

– Full Team for ISIS Cryogenics & ISIS Helium Recovery

Where we’re going

• System monitoring
• Expansion of ISIS system
• Liquefaction of DLS gas
• Helium Management Collaboration
System monitoring

Omron PLC Control System
Sauer Metacentre Compressor PLC control
Allen Bradley Liquefier PLC control
Mobile phone & tablet visibility
Dedicated driver for “Web”

Emergency text & Email Notifications
ISIS Controls Group V System

Supplied by Omron Driver “Reliable”

R108 Gas Management
ISIS Controls Group V System

TS1 & TS2 Gas Monitoring

R80 Total (GM3200) 16851300 L
  └ R80, East (GM3202) 4282900 L
      └ WISH (GM3203) 1304960 L
      └ LARMOR and OFFSPEC (GM3205) 463340 L
      └ ZOOM, SANS2D and POLREF (GM3206) 122890 L
  └ R80 West (GM3213) 6532100 L
     └ Zoom Dewar (GM3207) 1388990 L
     └ Magnet Lab (GM3208) 1749220 L
     └ Dewar Farm (GM3209) 646800 L
     └ IMAT (GM3210) 0 L
     └ LET and NIMROD (GM3211) 865000 L

R55 Total (GM3100) 26768500 L
  └ R55 North (GM3101) 7009400 L
      └ SANDALS (GM3112) 30680 L
      └ CRISP & LOQ (GM3113) 9250 L
      └ Dewar Farm (GM3114) 1077640 L
      └ OSIRIS & IRIS (GM3115) 939880 L
      └ TOSCA (GM3116) 140730 L
      └ RIKEN (GM3117) 817340 L
      └ Dewar Farm Downstairs (GM3118) 542290 L
      └ Dewar Farm Upstairs (GM3119) 619450 L
  └ R55 South (GM3102) 19867600 L
      └ HPRED, ENGINX, PEARL, GEM & MARI (GM3105) 1045000 L
      └ Dewar Farm (GM3106) 1495720 L
      └ MERLIN & SXD (GM3108) 856430 L
      └ Dewar Farm (GM3109) 1846930 L
      └ Cryolab (GM3110) 40 L
      └ MAPS & VESUVIO (GM3111) 900 L
      └ Mice Hall (GM3103) 0 L
         └ Muon (GM3104) 1557880 L
Buffer Pressure PT203: 6.2 bar

PT2160 1.9 bar

LN2 Supply

MV110

CV103 2.8 %

Automatic

TT108 229.2 K

PT102 1.3 bar

FTX100 0.0 RPS

TT106 97.4 K

TT111 98.2 K

LTX500

68.1 %

HV100

HV100

HV118

HV118

PT2240 1.3 bar

Coldbox Log

Liquifier Compressor

Liquifier Purifier

MV174

MV108

MV178

HX1

HX2

HX3

HX4

HX5

HX13

MV120

No Movement

Automatic

CV111 6.0 %

Automatic

PT112 1857.6 mbar

CV112 5.2 %

自动

BACK

ROOT
Expansion of the ISIS system
Extra HP Storage

Proposed site close to R108 will easily house over 40 MCP’s
Extra HP Storage at ISIS

- 12 New 16 Cylinder MCP’s
- Work is with BPG
  - Awaiting design completion
  - Awaiting construction
DLS Liquefaction

Update & Status

• DLS ring main complete awaiting commissioning

• HP commissioning awaiting WSE (completion July 19’)

• DLS HP feed to ISIS installed and complete

• R108 Mechanical modifications are complete and ready to accept DLS gas

• Optical cable for ISIS / DLS PLC to PLC comm’s complete

• ISIS / DLS Comm’s and PLC testing to start June 19’
ISIS / DLS Collaboration
Manifold modifications to accept DLS gas
Helium Management Collaboration
HZB, ILL & ISIS

• Total visibility of Helium Inventory
• Using modular system based on XBee Network
  • Radio communication sender and receiver.
  • Supports multi-point network communications wirelessly

• Enable us to see all equipment in one place
  • Cryostats Levels
  • Helium Dewar Levels
  • Ring main pressure & Temperature measurement
  • Weighing Scale records of Dewar’s in & out
  • Database to collate and archive information
HZB HLM
  • Helium Level
  • Pressure
  • Auto fill
  • Portable
    • Configurable
      • Probe resistance
      • Initial quench etc.
    • Can be cryostat specific

XBee Hardware

Receiver

Sender
Use of existing hardware

Helium Management

Combine XBee and Omron values

• Cryostat and Dewar levels
• All Omron data:
  • TS1 & 2 Flow, pressure, temperature & O2 measurements
  • R108 gas management
  • Liquefier operations
  • Dewar weight

Cryostat

Dewar

Dewar

Cryostat

Server

PC

User

Received overlap

Total Helium Management
Basic ISIS Overview
Reasons to recover
Recovery System Overview
System monitoring
ISIS Expansion & DLS Collaboration
The HZB, ILL, ISIS Helium Management Collaboration

Thank you for your attention!!