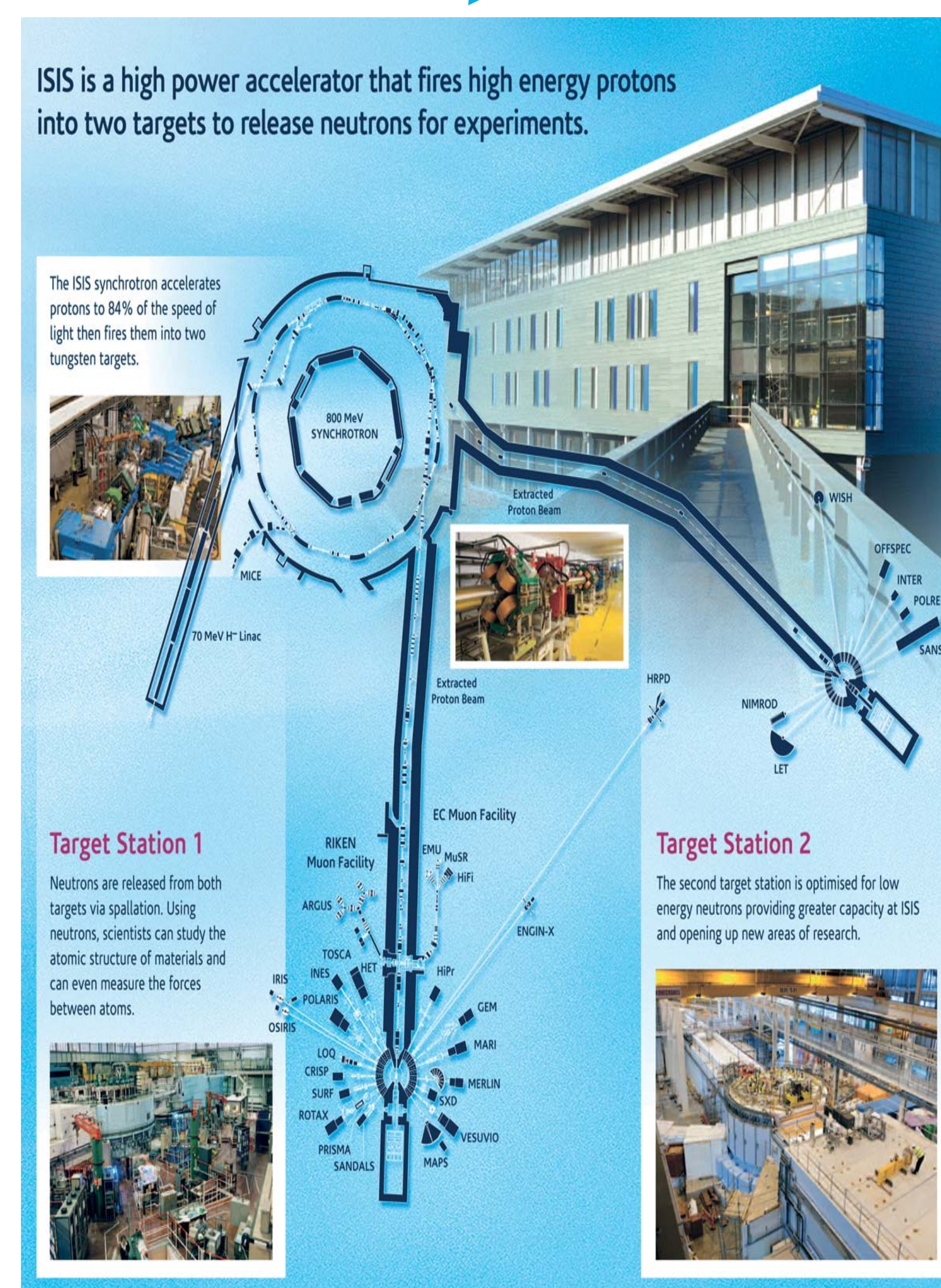# A Distributed Remote Monitoring System for ISIS Sample Environment

ISIS Neutron and Muon Source

ISIS located at the Rutherford Appleton Laboratory UK is the most productive research centre of its type in the world supporting a national and international community of more than 2000 scientists using neutrons and muons for research in physics, chemistry, materials science, geology, engineering and biology.
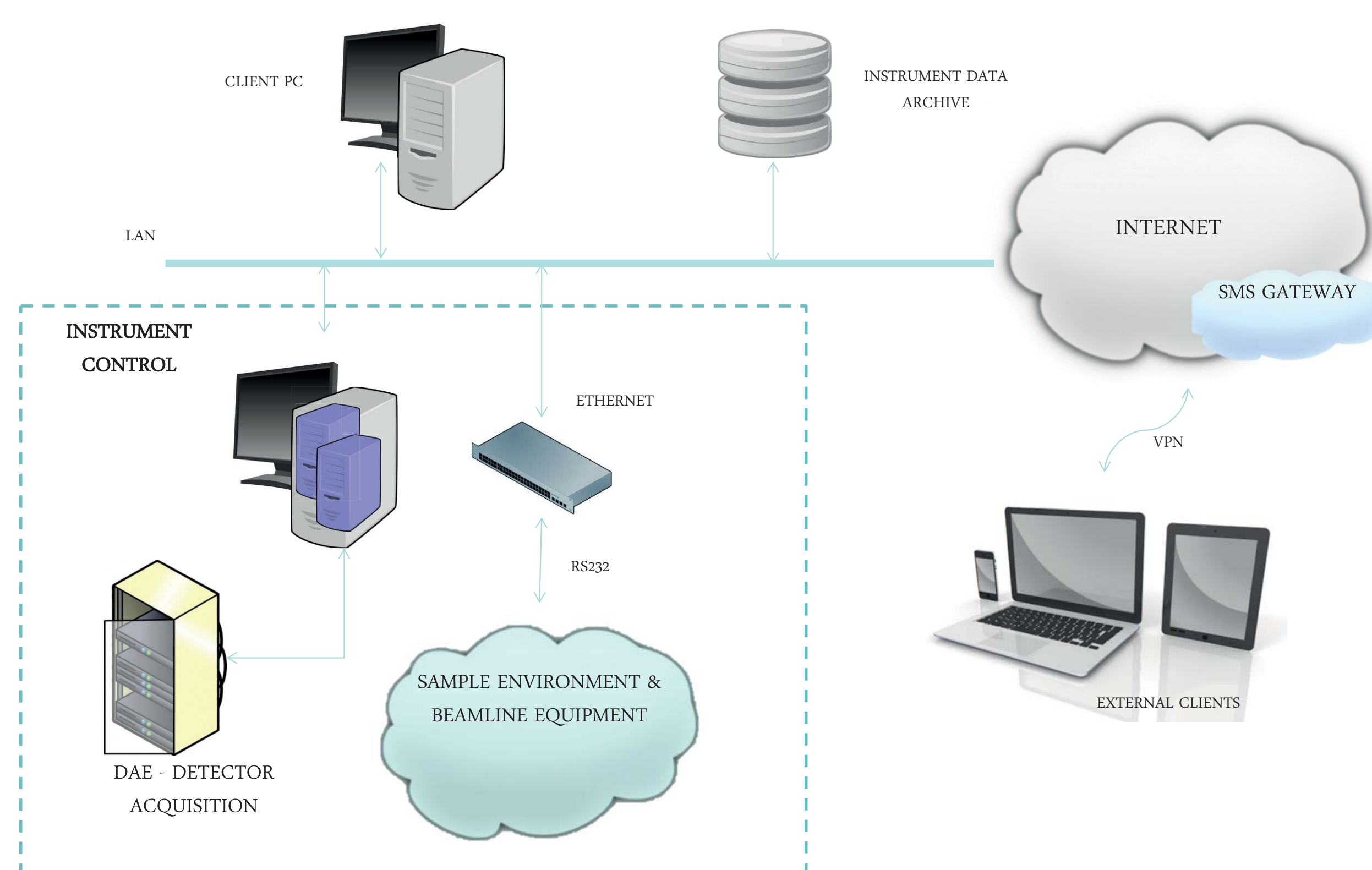
Sample Environment

- Sample Environment encompasses the equipment, instrumentation and expertise required to control the environment around a sample, enabling the analysis of atomic structure through material phase changes and transitions.

- ISIS runs c. 600 experiments per year, all of which require the deployment and support of a wide range of sample environment equipment and instrumentation.

- Using a wide range of equipment, the sample environment teams are capable of providing:

  - Temperature range 25mK to 2000K.
  - Pressures from vacuum to 25GPa.
  - Electric fields up to 20kV/mm.
  - Magnetic fields up to 14T.

Equipment configuration is driven by the experimental objectives and deployed on beamlines for the duration of the experiment.

ISIS is a high power accelerator that fires high energy protons into two targets to release neutrons for experiments.

The ISIS synchrotron accelerates protons to 84% of the speed of light then fires them into two tungsten targets.

Target Station 1
Neutrons are released from both targets via spallation. Using neutrons, scientists can study the atomic structure of materials and can even measure the forces between atoms.

Target Station 2
The second target station is optimised for low energy neutrons providing greater capacity at ISIS and opening up new areas of research.

Beamline Control Overview

SECI (**S**ample **E**nvironment **C**ontrol **I**nterface) - In house software for instrument control.

- LabVIEW - GUI & Instrument control drivers.

- OpenGENIE – Scripting, aliases & window management.

- Mantid - Data Analysis.

Why monitor sample environment?

With operational costs of c. £15k per instrument day, scheduling, resource management, technical support and maintenance effort is challenged to ensure that lost time is kept to a minimum.

Implementing a system to monitor data, automate alerts and analyse operational data increases the sample environment teams' ability to meet operational and support challenges.
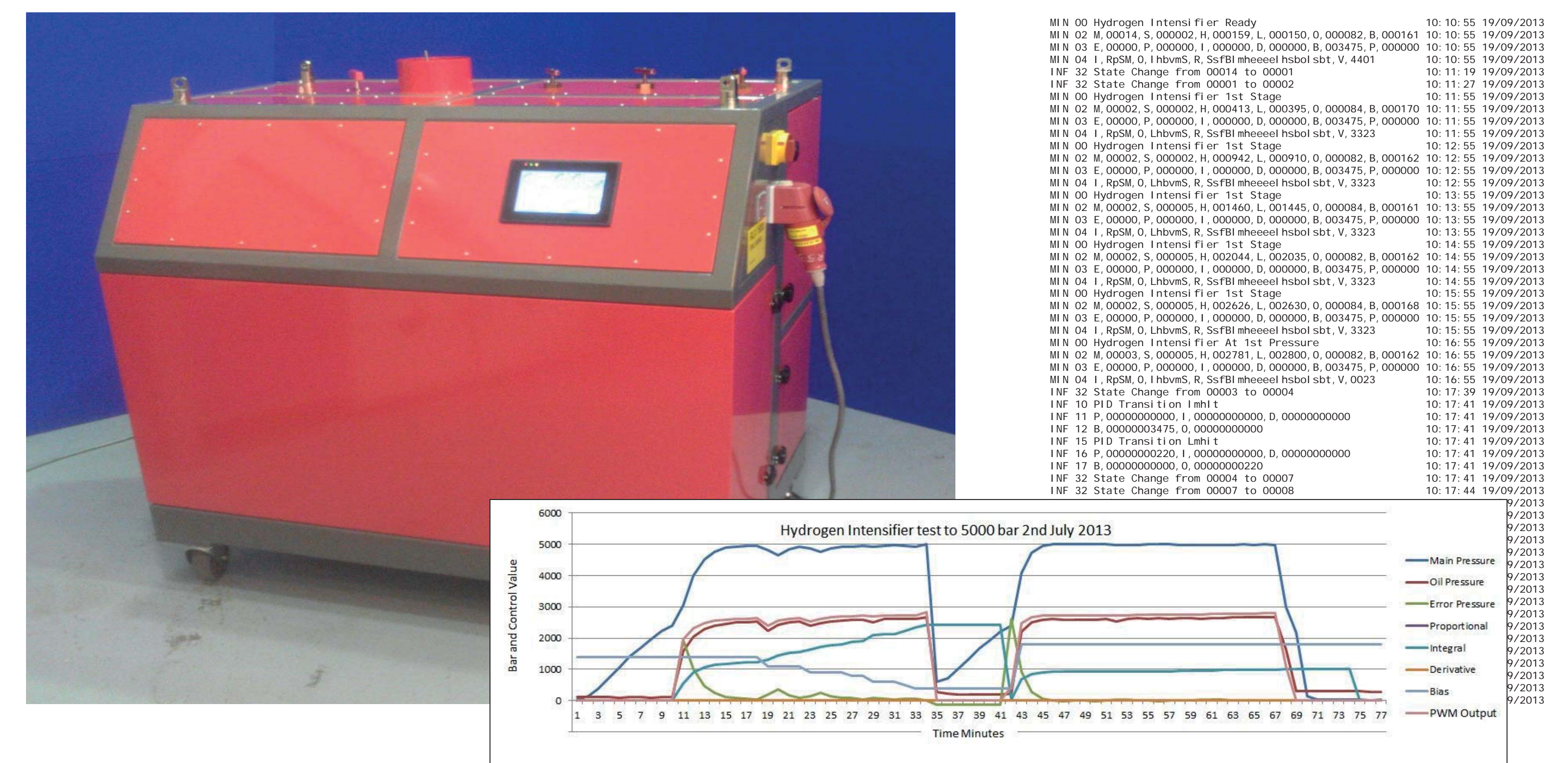
Particular benefits include:

- Highlighting operational and maintenance trends.
- Generating automated alerts for potential problems.
- Improving control algorithms and parameters.
- Reducing time to deployment for equipment development.
- Improving future designs.

Hydrogen Intensifier Development – A perfect Example.

The 10kbar automated Hydrogen Intensifier incorporated monitoring capabilities into the control system. This provided the following routines which proved invaluable throughout equipment development.

- Monitor control algorithm responses.
- Monitor key variables and inputs.
- Check and change parameters.
- Data logging for off line analysis.

Hydrogen Intensifier test to 5000 bar 2nd July 2013

Distributed monitoring system requirements.

- Monitor existing hardware with minimal outlay.
- Monitoring processes must have minimal impact on the equipment control.
- Provide a mechanism for SMS alerts.
- System access from a range of hardware platforms and operating systems.
- System access outside of the organisations computer network.
- Archive monitored data.
- Provide a user friendly interface for data analysis.
- Analyse & filter data archive by experimental variables.

Future Work

The ongoing project to develop an EPICS platform for beamline control provides an opportunity to distribute sample environment monitoring across the ISIS instruments.