

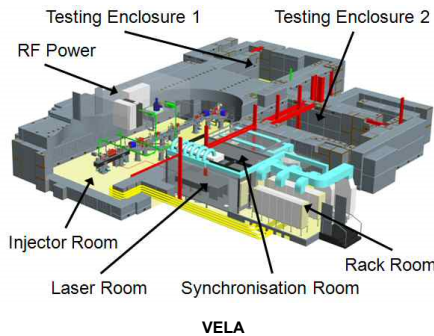
# CONTROL SYSTEM DESIGN FOR THE VELA TEST ACCELERATOR AT DARESBURY LABORATORY

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VELA (Versatile Electron Linear Accelerator) is a high performance, modular injector facility capable of delivering a highly stable, short pulse, high quality electron beam to a series of test enclosures. The new facility will deliver a capability for the cutting edge development and qualification of advanced accelerator systems, enabling industry to expedite their technology development from prototypes to market ready products in the fields of health care, security, energy and industrial processing. Initial design began in 2011 and was followed by an aggressive programme of procurement, construction and commissioning, leading to first beam in summer 2013 and operation for industrial partners in autumn 2013. The control system for this completely new accelerator was designed from scratch and is based entirely on COTS (commercial off-the-shelf) hardware such as EtherCAT, the latest generation of PLCs, Ethernet serial control and Linux rack mount IOCs. EPICS is used as the software toolkit.

## CONTROL OVERVIEW

This new control system makes use of Dell rack mount servers, a R510 RAID server is used as the main EPICS server and R210 servers with solid state disks for the IOC layer. All the servers run Scientific Linux 5. The second network port on the IOC is then used to interface to the device interface layer. The interface layer consists of Brainboxes ES279 network to RS232 converters and other network controlled devices, Beckhoff EtherCAT DACs and ADCs and the Omron CJ2M PLCs for interlocks and status control



## MOTOR DRIVES

For diagnostic screens and experimental sample positioning the Anamatics Smart Motor was chosen. These drives are a fully packaged servo drive systems requiring just power and a serial interface to operate. To prevent back driving by vacuum loads during fault or power failure each motor has an integral brake which operates automatically. Firmware code can be downloaded to the motor to customise its operation. This firmware is currently used to disable the motor on power failure and report back to the control system that power and position have been lost. EPICS can then issue a "home" command that also runs custom firmware to home the motor and restore all setting to operational.



Smartmotor Driving a Diagnostic Screen

## SERIAL IO

A separate IOC is used to interface to serial equipment via stream device. Network to serial interfaces from many manufacturers have been evaluated. It was found that most devices are unstable for continual long term operation and require periodic re-boots or do not operate reliably. The only devices to date that have been found to operate reliably are the supplied by Brainboxes. The 8 Port ES279 does not have a rack mounting kit to solve this an in house re-packaging solution for standard rack mounting has been developed.



Two Re-packaged Brainboxes ES279's

## STATUS CONTROL

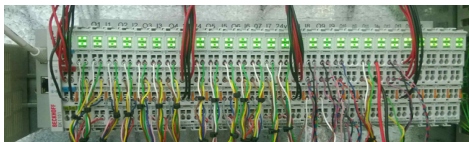
The Omron CJ2 PLCs communicate to the IOC via the network using Omron FINS protocol. A standard system of control channels is used so that templates can be used to produce the EPICS database and, at the PLC, control channels are accessed using a predetermined sets of memory addresses.



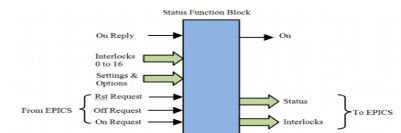
VELA Vacuum Control PLC

## ANALOGUE IO

Analogue control and read back is achieved using Beckhoff EL series EtherCAT modules. The ADC and DAC modules slot together and can therefore be customised to the requirements of the system



EtherCAT Modules



On/Off control function blocks are used within the PLC to enable easy visualisation of interlocks and control channels in the PLC programme.