Vulcan computer control developments

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Introduction

The computer control and data acquisition systems on Vulcan have, over the years, continued to be developed and enhanced [1,2,3,4], but the last major upgrade of the computer control was almost 10 years ago in readiness for the then widely feared "Millennium Bug". The legacy of that upgrade [1] is that the main computer control is still on DOS based PC's with only peripheral areas having Windows PC's communicating with the main control via serial links.

The DOS systems programmed in Borland Pascal have proved to be very robust and reliable and have allowed many significant enhancements to be added as the experimental programme has become much more complex and demands have grown. However, because of memory restrictions within the DOS environment there is now very little room for further system modifications and a complete switch to Windows XP is planned.

To facilitate the transfer, a single XP computer has been used as a bridge between the remaining DOS and the newer windows control PC's and this has the primary function of a communications hub. This has one serial link to the DOS and then multiple serial and ethernet links to the other control PC's distributed around the Vulcan laser facility. This "COMHUB" PC then allows the individual serial links to be picked off one-by-one transferring them to ethernet. Fiber optic cables have been installed to accommodate the enhanced communication links.

Developments in this last year

There have been a number of significant installations not least of which is the Argus / Cerberus laser control & interlock system. This is separately reported [5] but required fundamental reprogramming of the control system to obtain the interlock data via the COMHUB ethernet route rather than from a separate DOS packet driver.

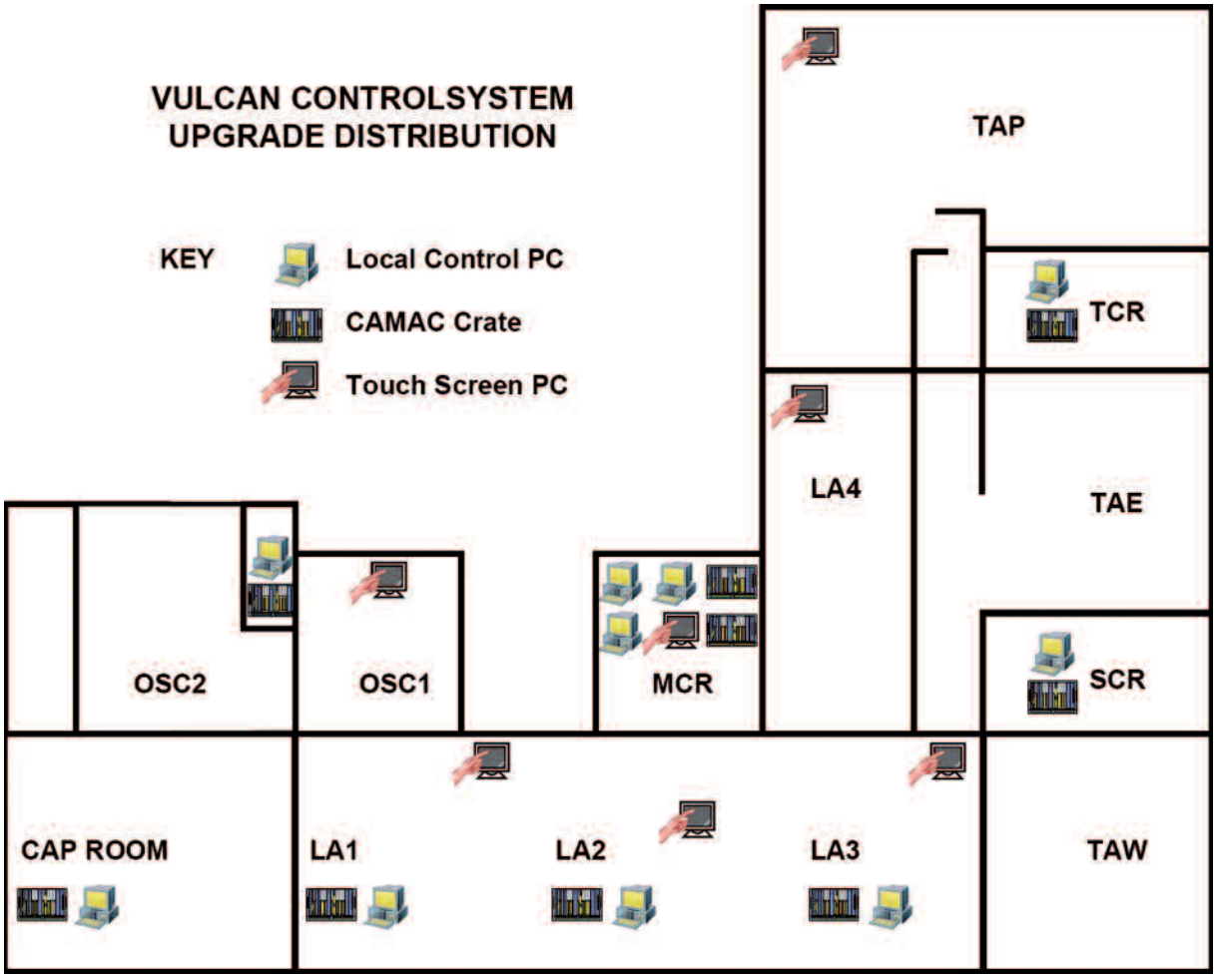

Figure 1. Schematic of the Vulcan laser facility indicating approximate locations of the upgraded computer control system PCs, touch-screen display interfaces and CAMAC crates.

There have also been a number of other enhancements in the areas of laser beam energy monitoring (calorimetry), interlocks, networking, CAMAC, pneumatics and automatic layouts.

The energy monitors on Vulcan were previously based on volume-absorbing glass calorimeters which then needed high-gain electronics to produce electrical signals at a sufficient level for CAMAC based analogue to digital converters (ADC). The calorimetry is now based on Gentec-EO's[6] QE-series of compact energy sensors with SOLO-X interface modules which are interrogated directly by the control system. After an initial period of testing and firmware upgrades to the SOLO-X's from Gentec-EO, 12 systems have been installed and are reliably capturing energy data from various locations and providing energy readings from the 100's mJ to the 100's J levels.

As both the laser configurations and the control requirements have steadily become more complex extra interlock checks have been included into the shot-sequence coding to prevent the operator from inadvertently firing shots that could potentially damage equipment or simply be wrongly configured. System failures due to operator errors have thus been kept at a very low level despite the significantly increasing complexity.

As other diagnostic systems have been installed on Vulcan (e.g. for CW or pulsed laser beam profiling[7,8]) and which have required knowledge of the laser firing sequence and the operational status of laser sources, these systems have been included in the main control ethernet network and appropriate commands sent to switch modes. This now allows the routine and automatic capture of beam profiles from CW, low energy or high energy shots with automatic ND filter corrections.

Speed of operations has also been aided by increasing the number of remotely controlled pneumatically operated mirror slides, beam blocks and waveplates with a corresponding reduction in "button-pushing". This installation has allowed greater shot-to-shot flexibility and many more configurations to be automatically applied. For example, as the control system detects that a target area has become active, a particular set of mirrors are moved into the appropriate positions ensuring the user's experimental configuration is always as required. These configurations are defined by a set of states held in a "learn table" for each area and which is operator editable (and with password protection).

In Laser Area 1 (LA1), an extra CAMAC crate has been installed with an ECC 1385 Mk 4 ethernet crate controller from Hytec Electronics Ltd[9]. This had initially appeared to have some control issues when used with an XP driver but following some firmware changes this is currently stable and is being used to drive local pneumatics.

Future developments

It is planned that the LA1 CAMAC will be further developed as part of the full XP upgrade and will provide additional pneumatic controls, local trigger signals and I/O signals for interlocks.

It is also expected that the Vulcan trigger system will be enhanced, computerized and integrated into the main control system using a commercial PCI-card precision delay generator from Bergmann Messgeräte Entwicklung KG, Germany.

The remaining serial links from the COMHUB PC will be transferred to ethernet; CAMAC crates will be switched to ethernet with accompanying PC's for local control; a touch-screen layout diagram will be developed for remote controls distributed throughout the laser; a new laser data archival and statistics server will be developed to allow web-based access; and the remaining controls will be transferred to the COMHUB PC and in January 2008, the final DOS systems will be removed. Figure 1 shows the expected distribution of controls around the laser facility following the upgrade.

References

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