



Science and  
Technology  
Facilities Council

Central Laser Facility

# Introduction to Vulcan 20-20 Laser

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# Vulcan

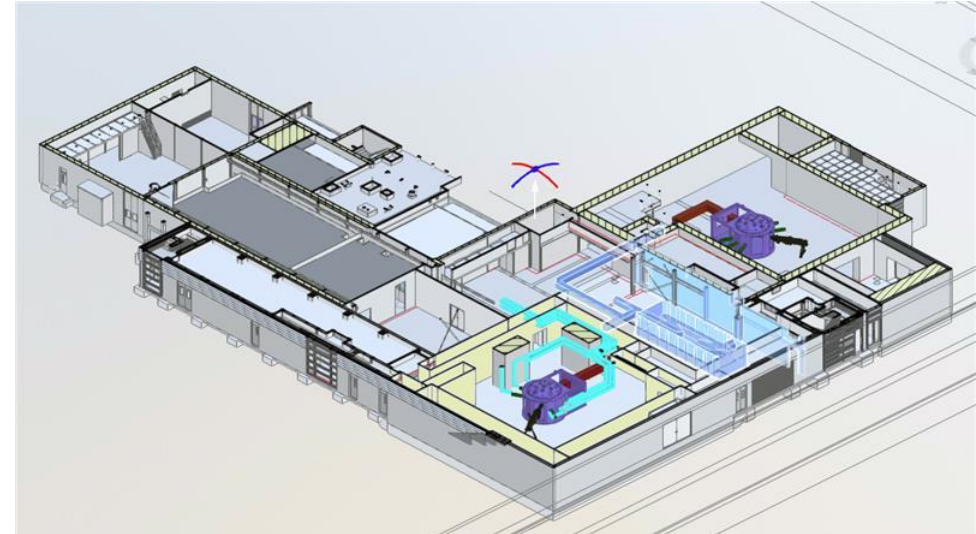
- High powered Nd:glass amplifier, CPA laser system
- Built late 1970s, numerous upgrades
- 8 beam lines:
  - 6 Long pulse beams (nano seconds)
    - 50 to 300J per beam
  - 2 Short pulse beams (femto seconds)
    - 1PW beam, 500J in 500fs
- 2 target areas
- Guinness Book of World Records 2005 highest-intensity focussed laser in world



*Existing Vulcan facility layout*

# Vulcan 20-20

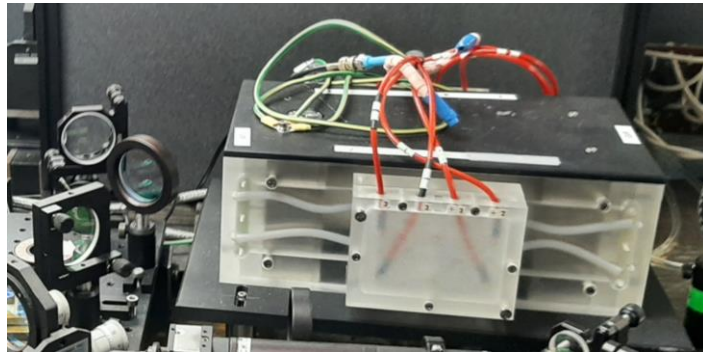
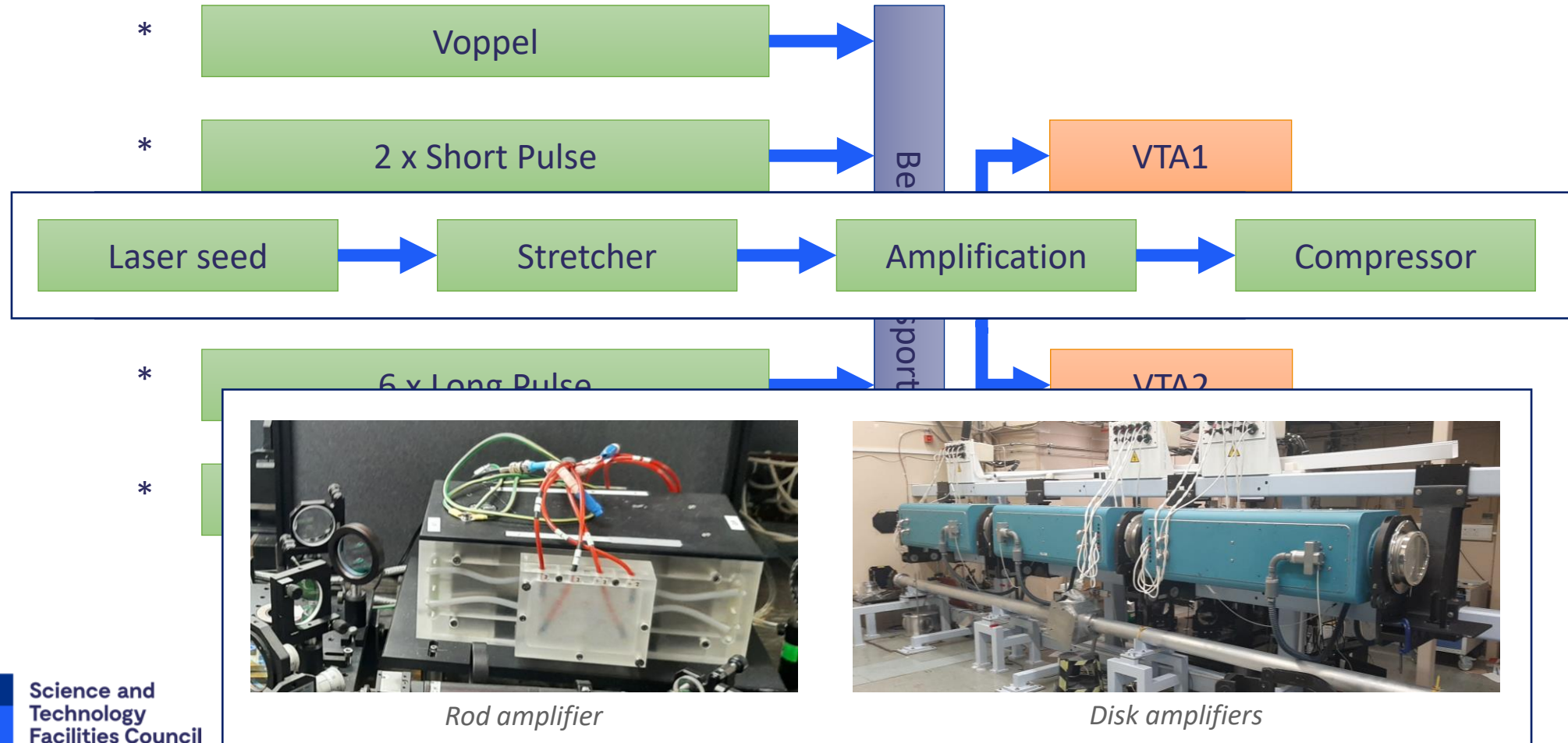
- Exciting new £82M upgrade of Vulcan
- Deliver 20PW, 400J in 20fs (20x peak power)
- OPCPA technology
- Improve shot rate from 20 to 5 min
- Set to be the most powerful laser in the world again
- Science:
  - Replicate interstellar conditions
  - Research fusion energy
  - Plasma physics
  - ...and more



*Vulcan 20-20 proposed layout*

<https://www.clf.stfc.ac.uk/Pages/Vulcan-2020.aspx>

# Vulcan 20-20



Rod amplifier



Disk amplifiers

# Architecture Overview

- EPICS-based control system
- PV Access over Channel Access where possible
- PVA Gateway
- EPICS IOCs Functionality:
  - Device status/control
  - Soft IOCs
  - PLC Interface using OPC UA (status and control)
  - Motion Control
  - Area Detector (cameras)
  - DAQ Modules (data capture)



# Architecture Overview

- User interfaces will be a combination of Phoebus and Blazor
- Automated control/data capture whenever possible
- Data Management
  - Adopt tools & architecture (where suitable) from EPAC

The screenshot displays a Blazor control interface for a synchrotron facility, titled "PM-201-FE-1-Summary". The interface is organized into several panels:

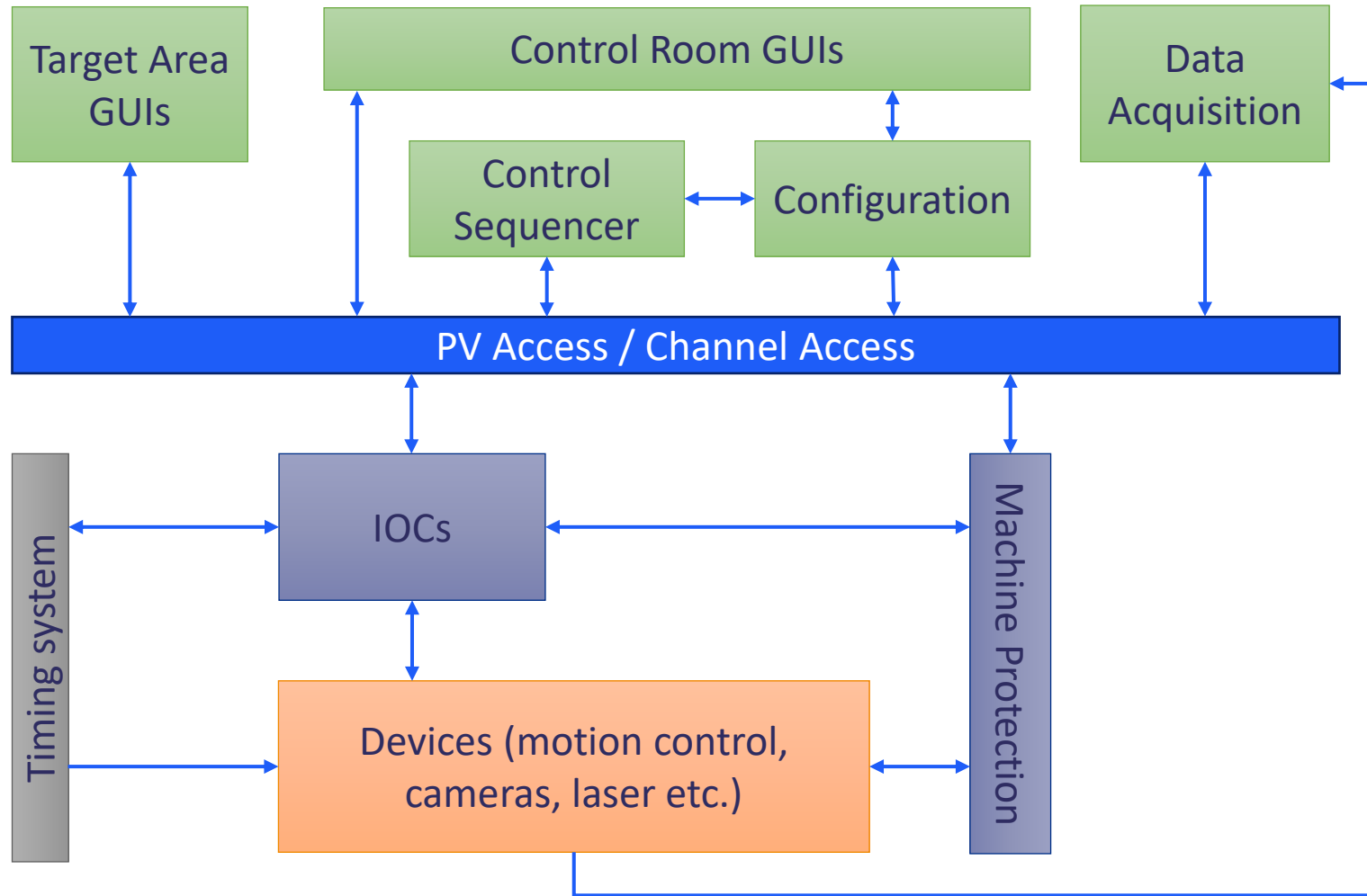
- PM-201-FE-1-Summary:** Includes a "Load Profile" section with "Default", "Custom", and "Save Profile" buttons. Below are tabs for different camera units: "PM-201-FE-1-D-CAM-1", "PM-201-FE-1-D-CAM-2", "PM-201-FE-1-D-CAM-3", "PM-201-FE-1-D-CAM-4", and "PM-201-FE-1-D-CAM-CR-PA-2". A note indicates: "Press and hold CTRL + Left-click to drag and drop dashboard panes."
- PM-201-CO-PLC:** A table showing the status of various components:

Component	IN	OUT	Status	Action
PM-201-FE-WP-2	Green	Grey	Shutter Status	Connected
PM-201-FE-WP-4	Green	Grey	Shutter Status	Connected
PM-201-FE-1-SHUT-2	Green	Grey	Shutter Status	Connected
PM-201-FE-CW-SHUT-3	Green	Grey	Shutter Status	Connected
PM-201-FE-1-SHUT-4	Green	Grey	Shutter Status	Connected
- FLIPPERS:** A table showing the status of flipper units:

Component	IN	OUT	Status	Action
PM-201-FE-1-SA	Green	Grey	Flipper Status	Connected
PM-201-TJ-CW-SA	Green	Grey	Flipper Status	Connected
- PRESSURE GAUGES:** Shows a single gauge for "PM-201-FE-1-VAC-GAG-1" with a value of 17123343 mBar and a "VSF Status" of "Error".
- VALVES:** A section for valve control, currently empty.
- Laser Mode:** Includes "Pulsed" and "CW" buttons, and "Energy Meter 1" and "Energy Meter 2" sections with "Energy Value" displays.
- CW 1:** Shows "Interlock" (red X) and "Connection To Device" (green checkmark) status, along with a list of components (FE, TJ-DF, TJ, HJ-DF, BT / HJ-CW) with "View" buttons.
- Fiber Front End:** Includes a "Seed Laser" section with "Key" (ON/OFF), "Wavelength" (1029.7999 nm), "Temperature" (0 C), "Current" (10 mA), and "Power" (0 mW) displays.
- Pre-Amplifier 1:** Shows "RESET" and "Open Interlock" buttons, "Amp LD Current" (43.00 A), "Interlock Error" (red X), "External Interlock Error" (red X), and a "LaserDiode" section with "Off" and "On" buttons.

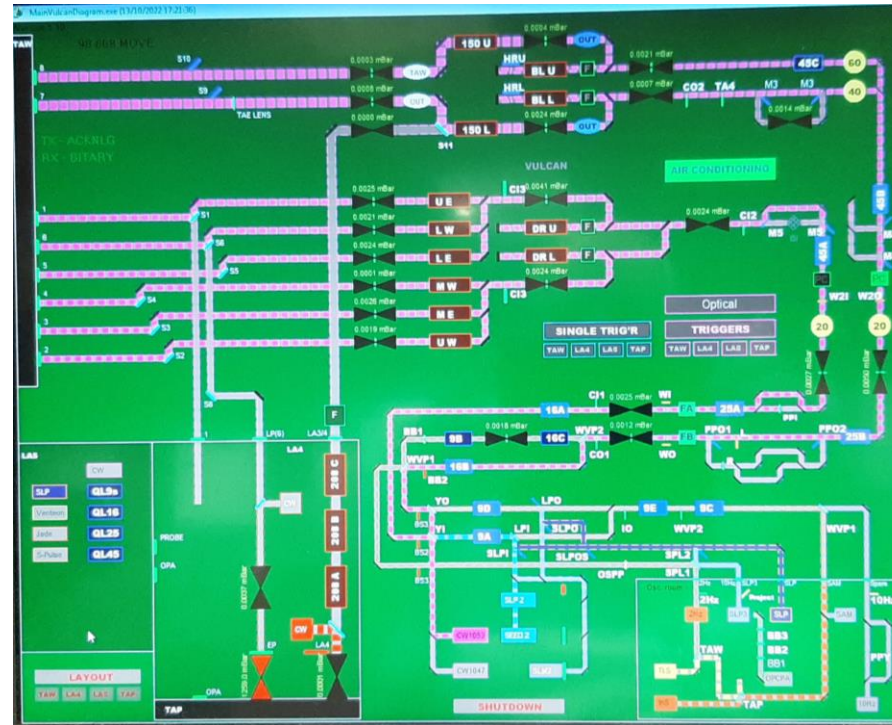
Example Blazor screen

# Architecture Diagram



# Software Controls - Challenges

- Increased repetition – increased automation
- Instrumentation platform
- Highly configurable system – more machine safety tasks
- Network and security
- Deployment



Control screen



# Software Controls - Strategy

- Consider new technologies
- Reuse IOCs, drivers etc. where possible
- Learn lessons from CLF EPAC project
- Learn lessons and experience from the community



*EPAC (Extreme Photonics Application Centre)*



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# Thank you

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