Electro-hydraulic Actuators and Network Communication: the forefront of Asset Management

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The importance of Safety

Flixborough, 1974 – 28 fatalities out of 72 people on site

Piper Alpha, 1988 – 167 fatalities out of 228 people on site the worst offshore oil disaster in terms of lives lost and industry impact

Bophal,1984 – 3,787 immediate fatalities, > 8,000 fatalities due to gas release diseases

Buncefield, 2005 – 0 fatalities, largest detonation after WWII (2,4 Richter scale)

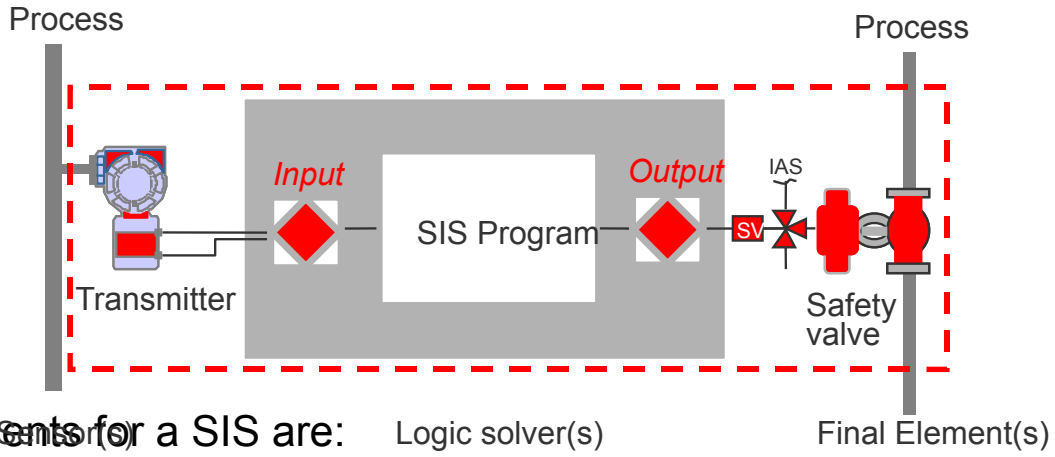
Safety Instrumented Systems (SIS)

As the result of various accidents around the World, Government sponsored organisations/agencies and major oil companies have produced new standards:

- The processes have to comply with standards such as IEC 61511
- Equipments, including the actuated valves, need to comply with IEC 61508
- The system and products need to comply with the determined Safety Integrity Level (SIL) of the plant

Safety Instrumented Systems (SIS)

Safety Instrumented Systems (SIS) by definition is the instrumentation installed in a facility for taking the process or specific piece of equipment in the process to a safe state.



Typical requirements for a SIS are:

- Spring Return ESD actuators
- SIL 1 to SIL 3 is specified (SIL 2 is the general norm)
- Partial stroking capability – to test and confirm the actuated valve is available to shutdown if or when required.
- Datalogger for diagnostics and to record the data for auditing by approved agencies

Actuator type options

- Electric actuators
- Pneumatic actuators
- Hydraulic actuators
- Electro-hydraulic actuators

Electric actuators

- Lower installation and maintenance cost
- Ideal for remote application where pneumatic actuators are not a practical solution
- Proven in use for operating multi turn valves such as gate valve
- Diagnostics data is available and communications and control signals directly connect to the control system
- Max torque and operating speeds can be an issue
- Fail-safe action requires battery back-up – but suitable only for non-hazardous areas
- Fail-safe action can be performed with a spring – but for limited torque range

Pneumatic actuators

- A spring return actuator is the simplest and most reliable device to provide failsafe action
- Max torque and operating speed are not an issue
- Compressor available on site
- Smart positioner/controller are necessary for each actuator to cover the diagnostic request
- Not ideal for remote area installations, where the presence of a compressor could be an issue

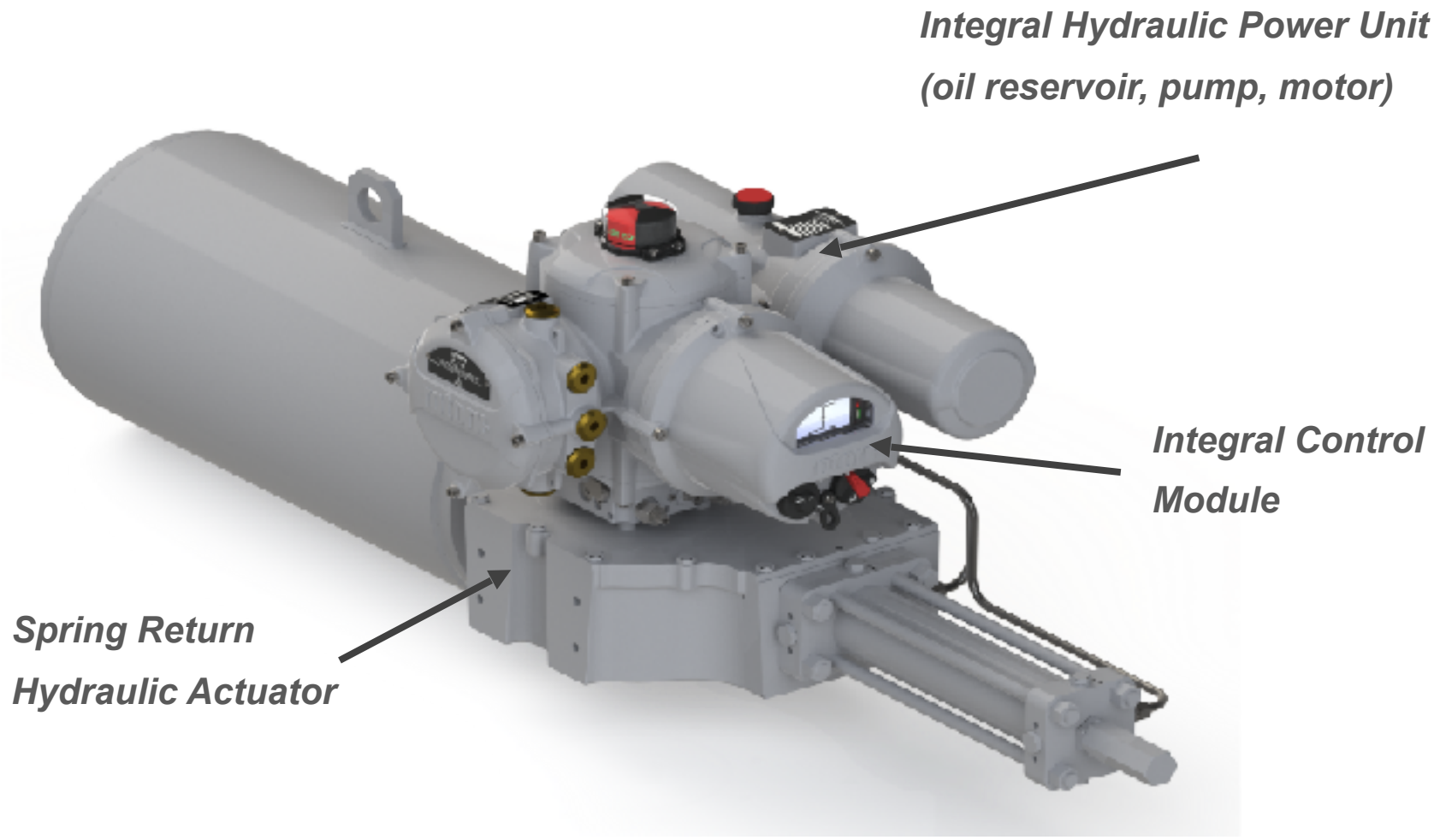
Hydraulic actuators

- A spring return actuator is the simplest and most reliable device to provide failsafe action
- Max torque and operating speed are not an issue
- High torque with compact cylinders when compared to the equivalent pneumatic one
- They need an integral or centralized hydraulic power unit that requires period maintenance
- Accumulators require annual testing and re-charging.
- High installation cost

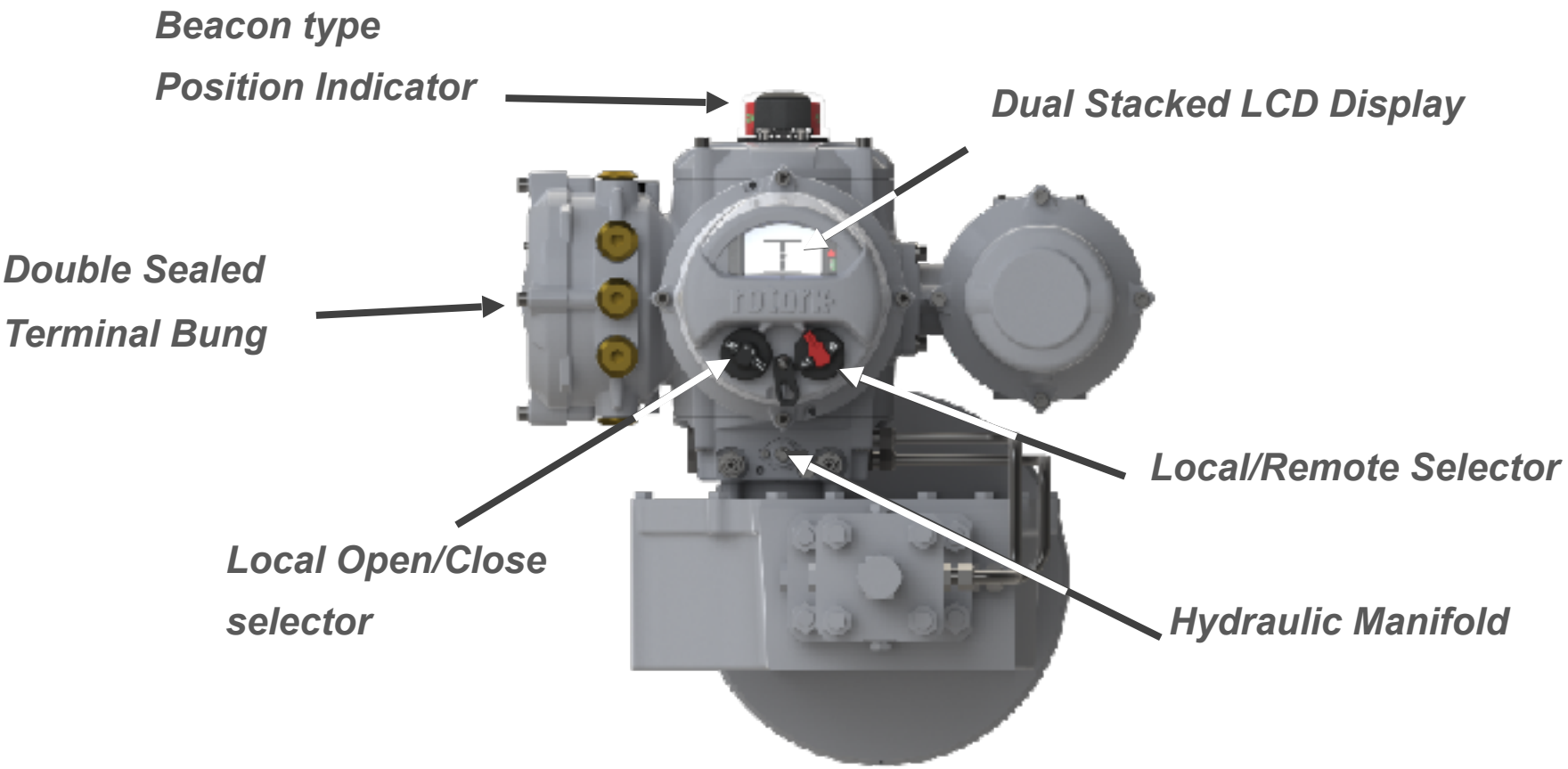
Electro-hydraulic actuators

- Combines the simplicity of electrical operation, precision of hydraulic control and the reliability spring return
- Self contained - Ideal for remote locations
- Built-in diagnostics, partial stroke testing and field-bus communications
- Designed for safety critical applications
- Reduced installation & maintenance costs
- Lower power consumption

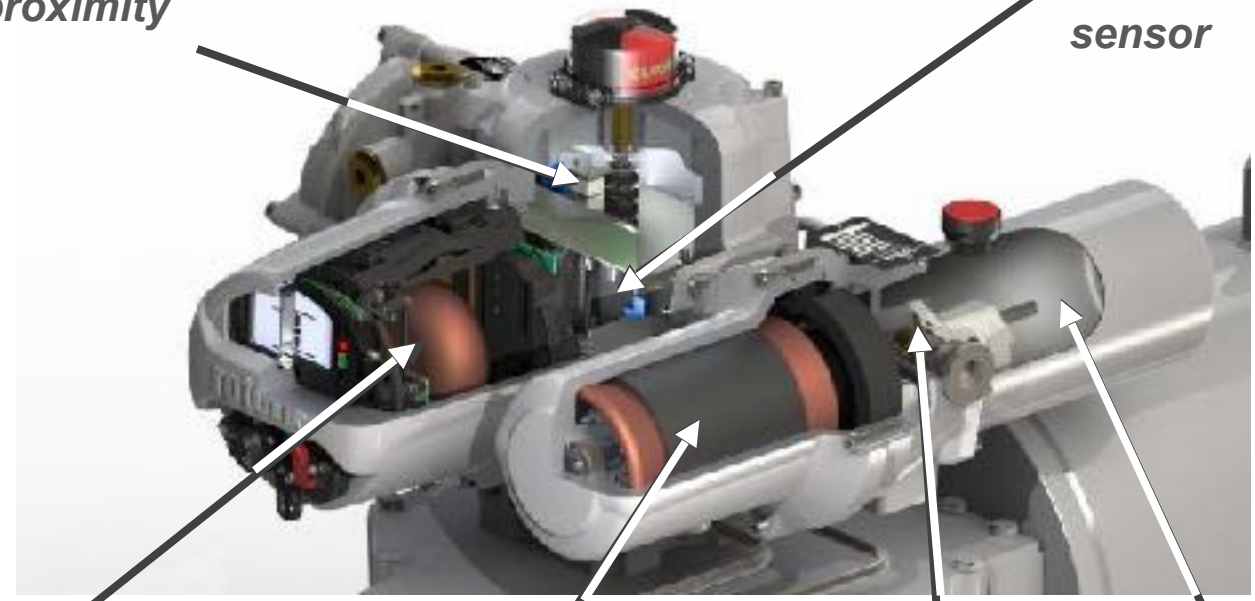
Electro-hydraulic actuators



Electro-hydraulic actuators

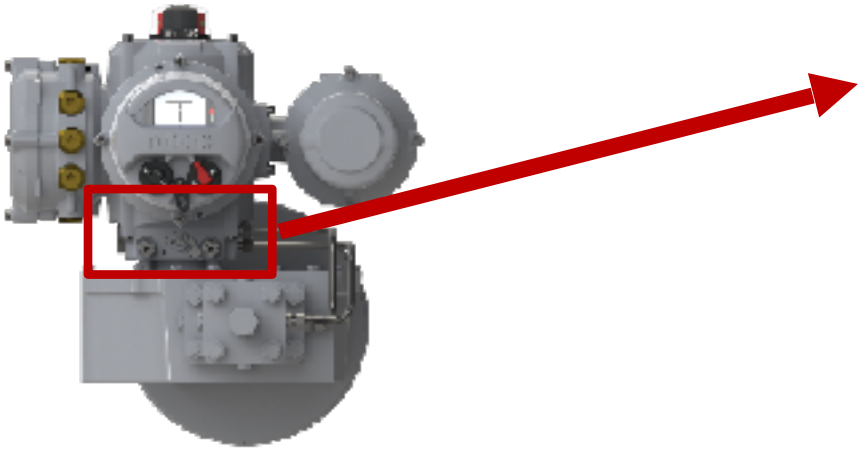


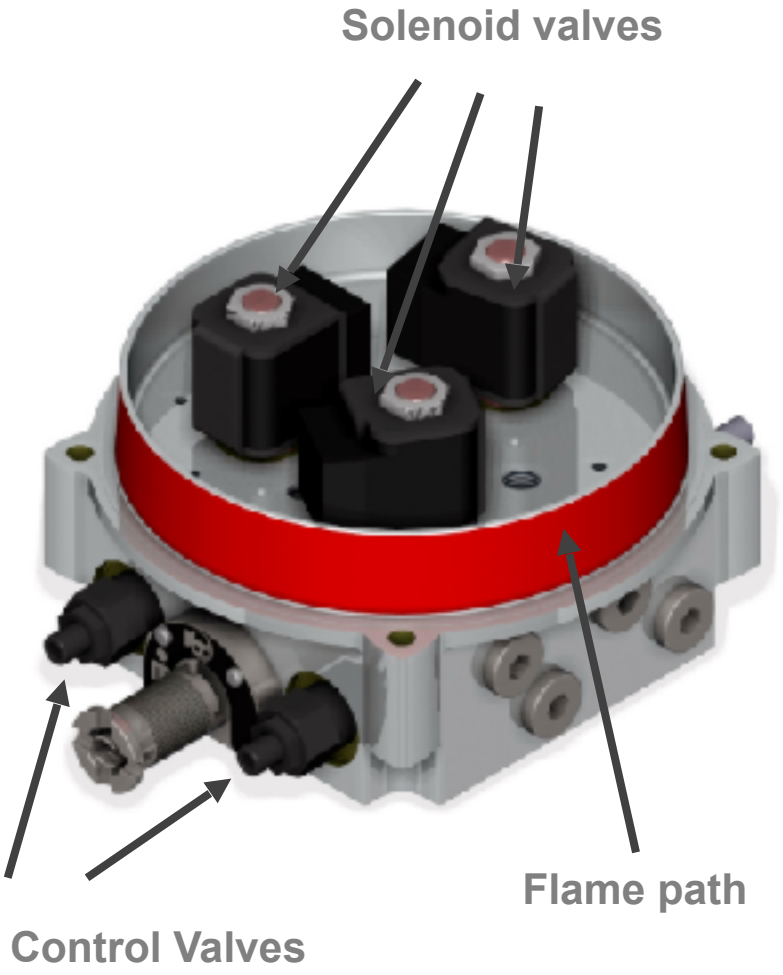
Electro-hydraulic actuators



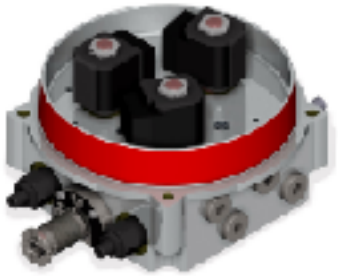
Electro-hydraulic actuators

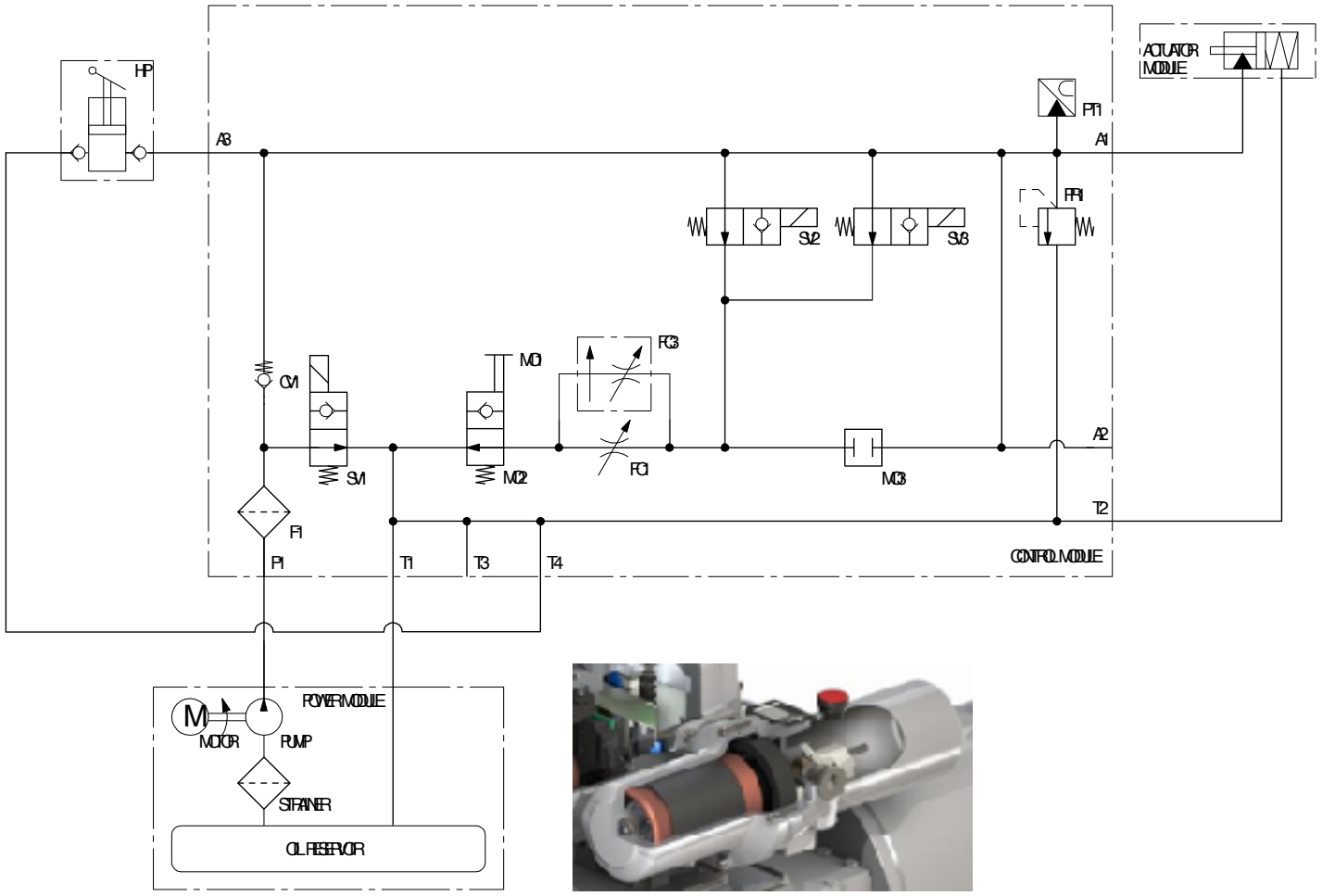
Solenoids are built into the hydraulic manifold with the coil housed in the control module.





Electro-hydraulic actuators





Electro-hydraulic actuators

- The **Control Module** is responsible for driving the logic function of the actuator
- **LCD display** - Hydraulic pressure settings, position limits, controls, indication functions, alarms and data logger are easily available to the operator
- Access fully non-intrusive by means of a Bluetooth® or infra-red **Setting Tool**
- Open and close stroke can be initiated locally through the dedicated inbuilt selector or remotely from the control room

Electro-hydraulic actuators

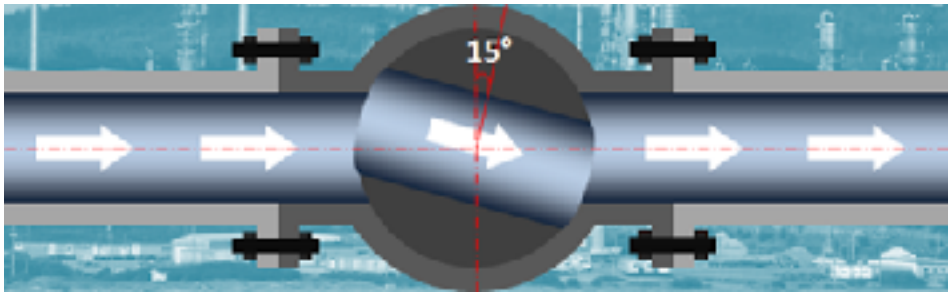
Monitoring Status & Alarms -

- General Alarm
- **Process alarm**
- Over pressure (end of travel)
- Over pressure (mid-travel)
- Over pressure (any position)
- Stall (any position)
- Stall (mid-travel)
- Stall (end of travel)
- Motor thermostat
- Accumulator pressure (SI-4 only)
- **Control Alarm**
- Phase loss(three phase only)
- ESD Active
- Motor Running
- Moving (either direction)
- Moving Closed
- Moving Open
- Partial stroke pass
- Partial stroke failed
- Partial stroke active
- Full stroke pass
- Full stroke failed
- Full stroke in active
- % Position trip
- Manual operation
- Manual reset
- Actuator alarm
- Open Limit
- Closed Limit
- Stop Selected
- Local Selected
- Remote Selected
- Temperature % Trip
- Loss of HMI
- Loss of Bluetooth
- Loss of customer 24Vdc output.

Electro-hydraulic actuators

Partial Stroke Test (PST)

- The PST will be achieved by moving the valve from its fully open position to a pre-determined position and back to open position
- This allows the user to identify any potential fault that could prevent the actuated valve from performing its safety function
- Allows testing of Isolating Valve without effecting the process.
- Tests critical components, actuator and valve to confirm availability to operate in an emergency.
- Reduces number of shutdowns required for maintenance

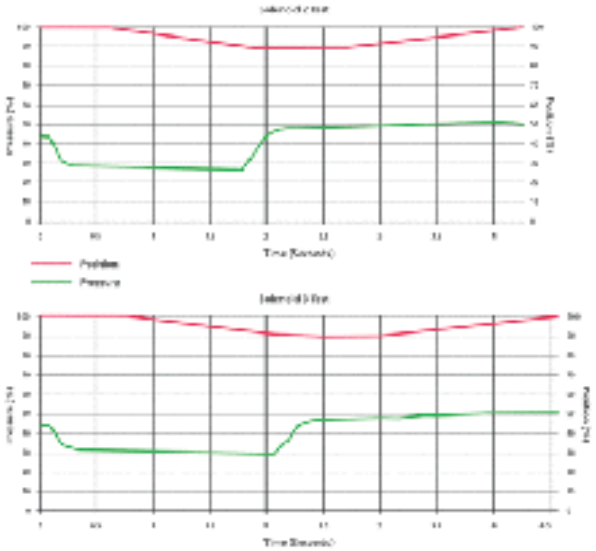


Electro-hydraulic actuators

Partial Stroke Test (PST)

- The Control Module handles the PST by de-energizing each bleed solenoid valve in sequence, to allow the valve to move to the required position and then return the valve to the original position.
- The percentage of valve movement can be configured by the end user
- PST can be initiated locally via Setting Tool or remotely from control room or via network card
- Result displayed - pass/ fail on the LCD display
- Trend overlay - comparing test to initial commissioned
- Date & time stamp

- Last 25 PST results are logged and can be viewed on the display
- The PST logs can be downloaded from the actuator and viewed on a PC through software

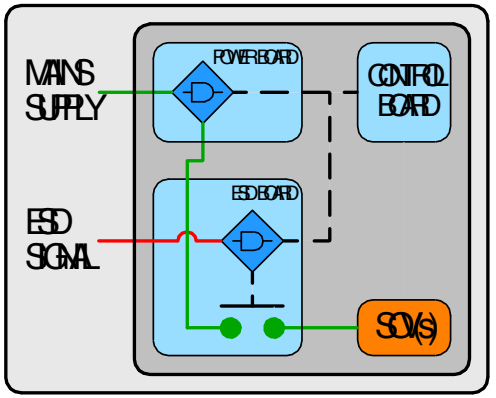


Electro-hydraulic actuators

Specifically designed for fail-safe application, this actuator can accept and ESD signal as part of a SIS.
All ESD circuits are configured and controlled through hardware components, software is used for monitoring the status:

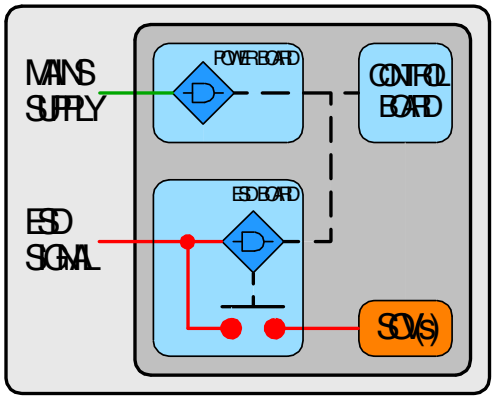
- **Standard ESD**

  - **Failsafe** on loss of ESD signal
  - **Failsafe** on loss of mains supply
  - Bleed solenoid valve(s) are powered from the **mains supply**

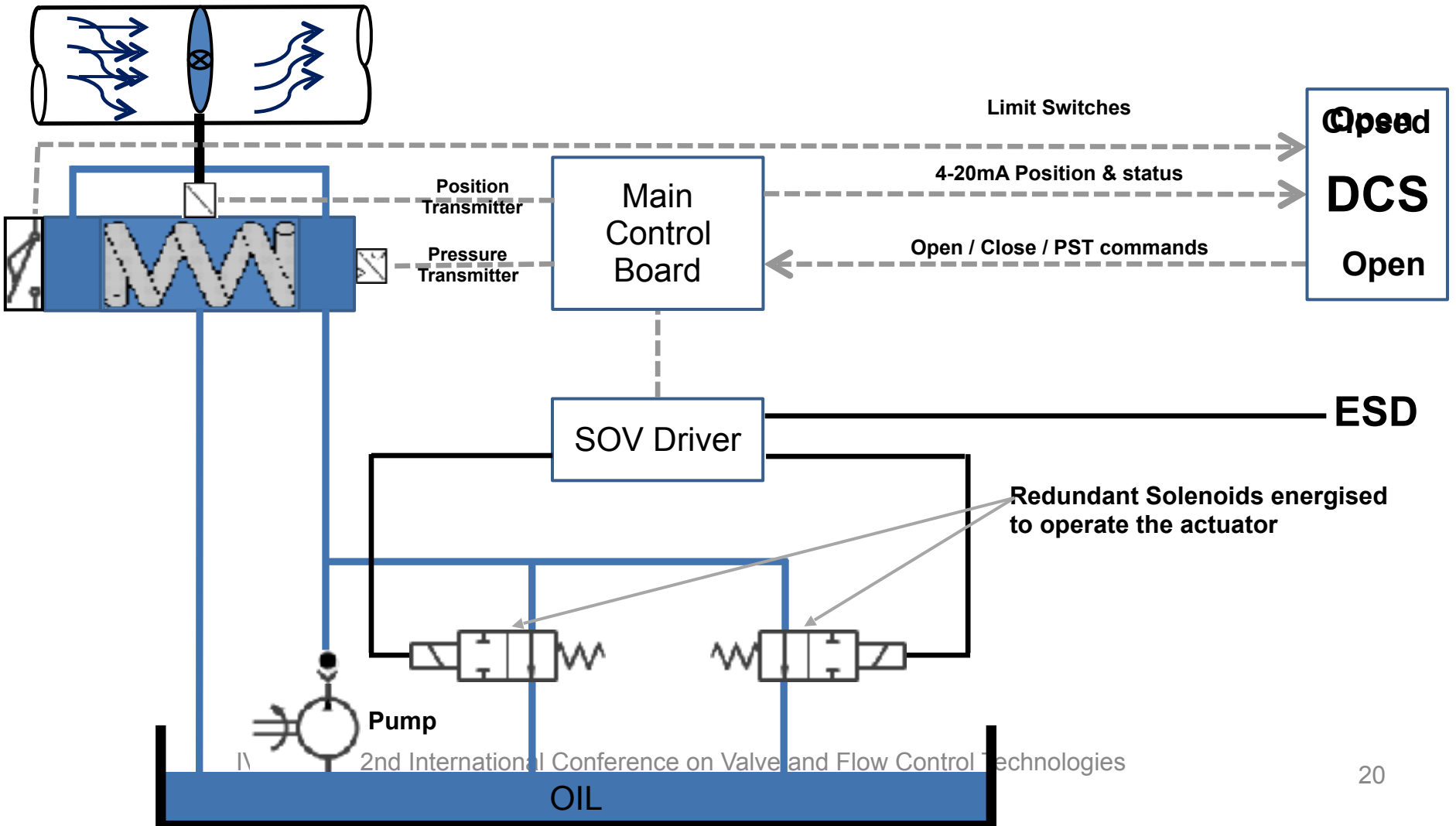


- **Hardwired ESD**

  - **Failsafe** on loss of ESD signal
  - **Fail in position** on loss of mains supply
  - Bleed solenoid valve(s) are powered from the **ESD signal**



Electro-hydraulic actuators



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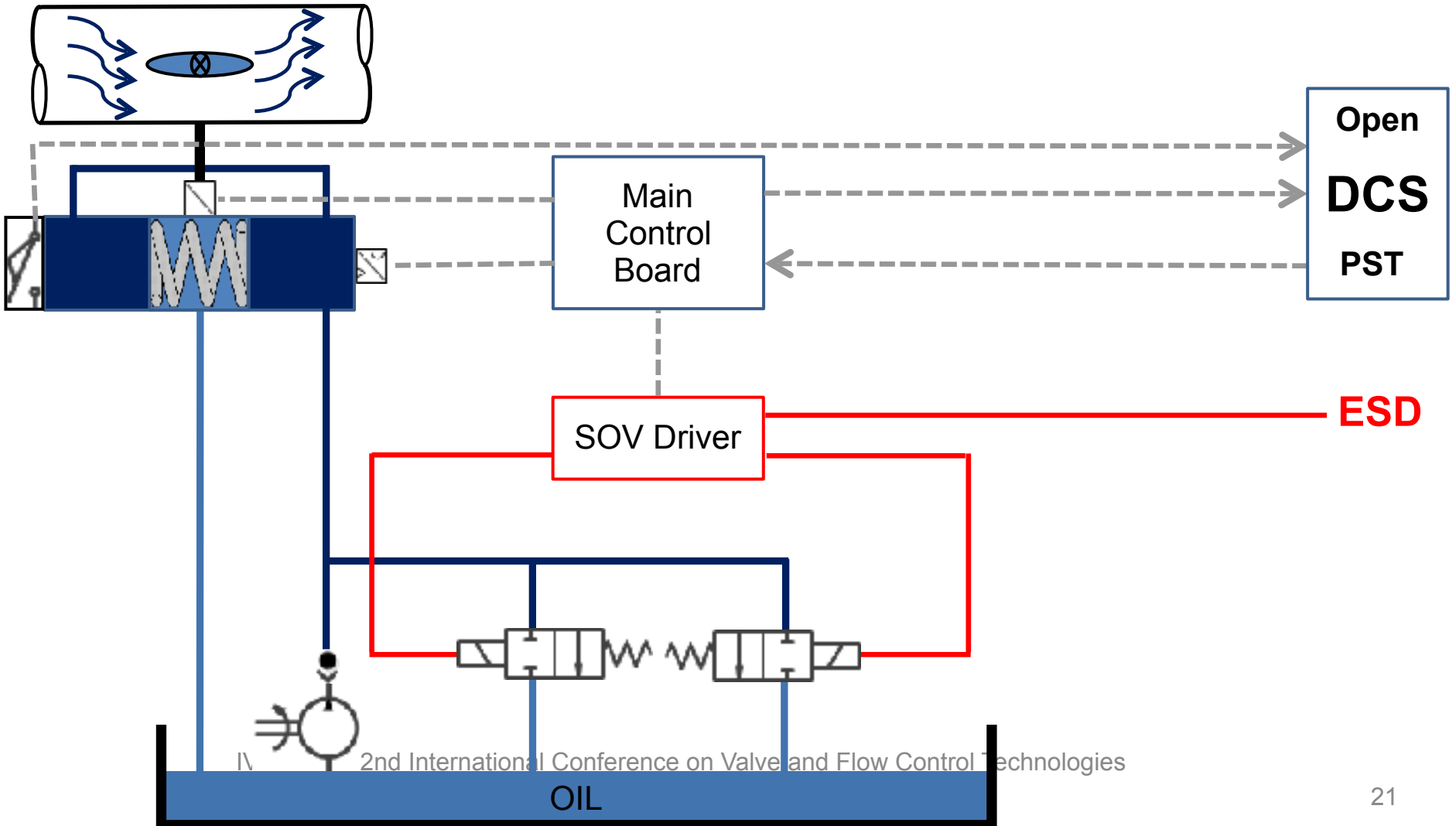
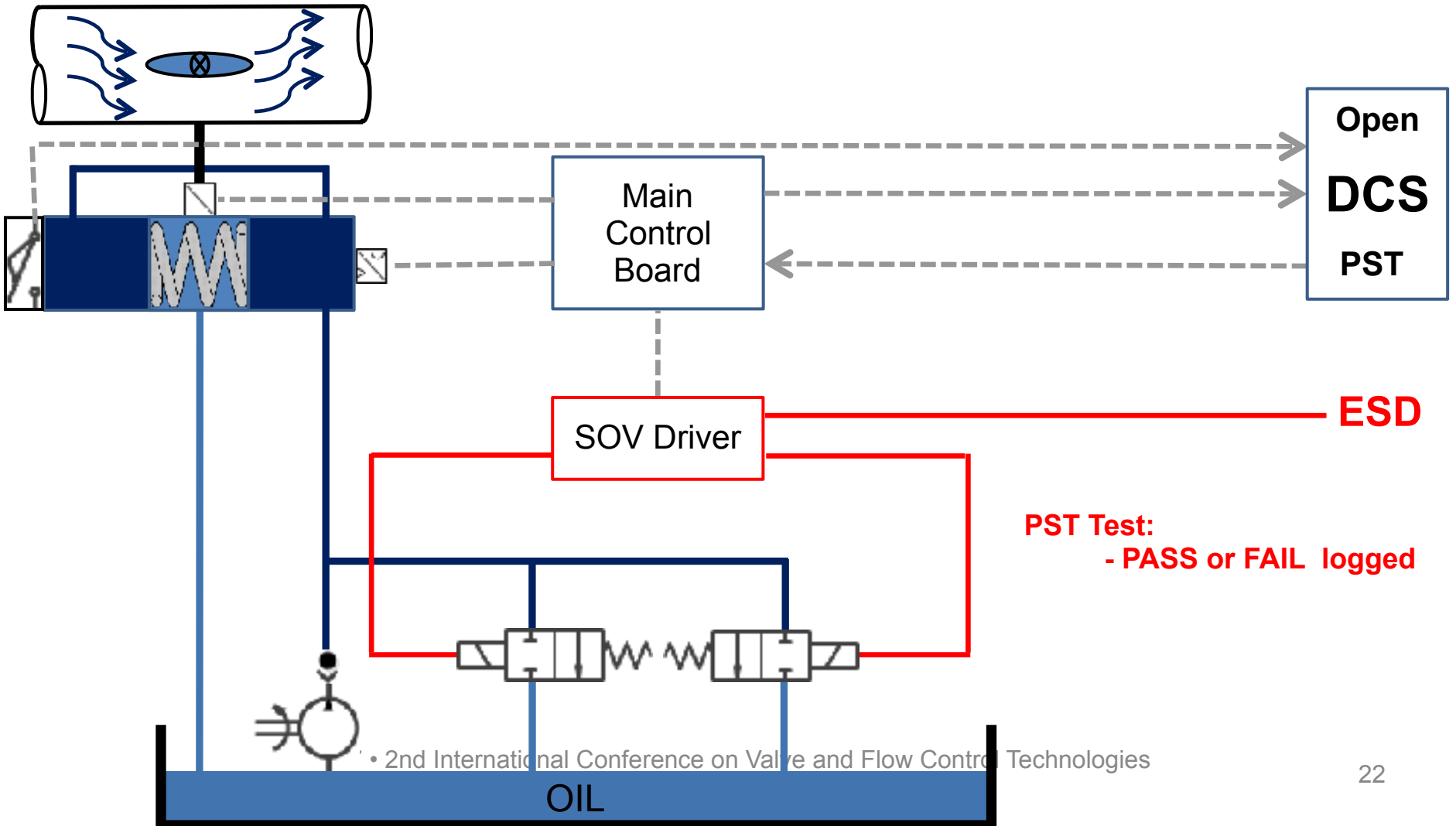


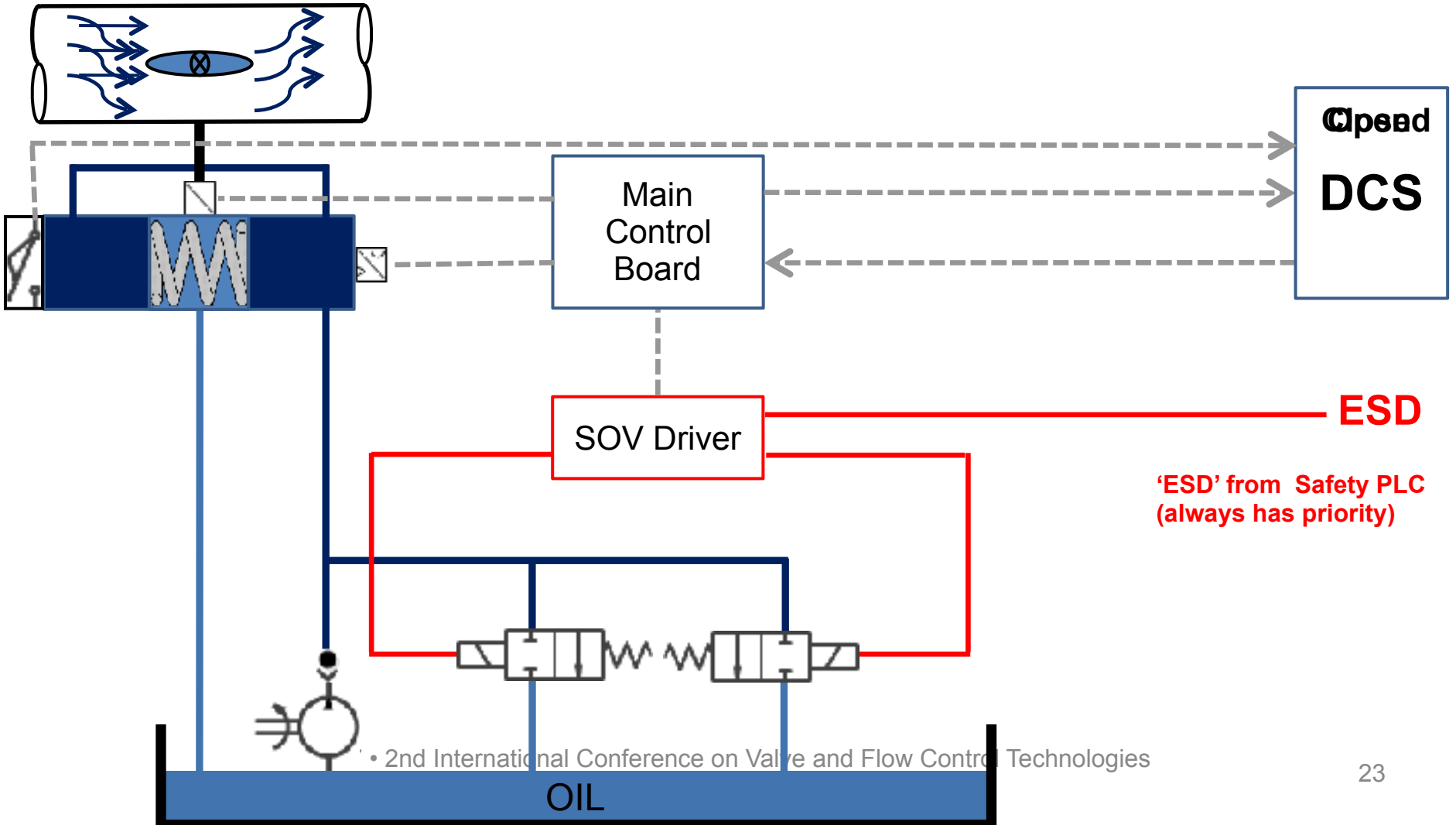
Electro-hydraulic actuators



Electro-hydraulic actuators

Key

- Low pressure hydraulic
- High pressure hydraulic
- Energised electrical
- De-energised electrical
- Control Signal



Electro-hydraulic actuators

The **data logger** stores up to 3,000 events, providing the operator with a historic records for asset management:

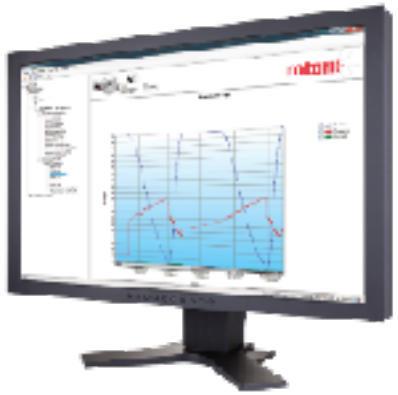
- Actuator configuration file
- Events
- Trends
- Alarms

- Data can be viewed on the display or downloaded through the setting tool to a PC and viewed through a proprietary software
- Actuator configuration files can be uploaded & downloaded through the setting tool
- All configurations and data logger files are secured in a non-volatile EEPROM memory, which means total safety even when power is removed
- Should the power be disconnected, an internal super capacitor will keep the real time clock alive for 2 weeks.

Electro-hydraulic actuators

Asset Management data regarding the actuator and the valve can be stored within the actuator, including tag numbers, built data along with service information.

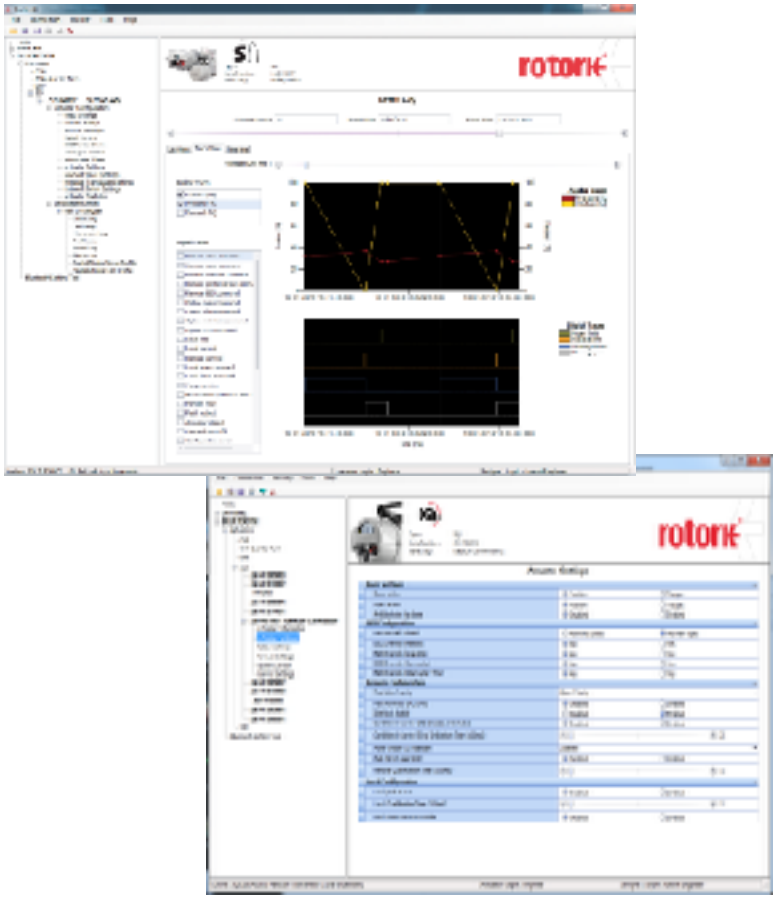
- Allows possibility of improved preventative maintenance
- Improved feedback for the maintenance team
- Improved record keeping of commissioning information
- Record of all events and alarms
  - Time based
  - Pressure (torque) data
  - Position data
  - Can be backed up and supported by Site Services



Electro-hydraulic actuators

PC based software

- Connect via Bluetooth to the actuator or Bluetooth Setting Tool
- Allows configuration setup data to be displayed and updated
- Allows each actuator datalogger file to be reviewed



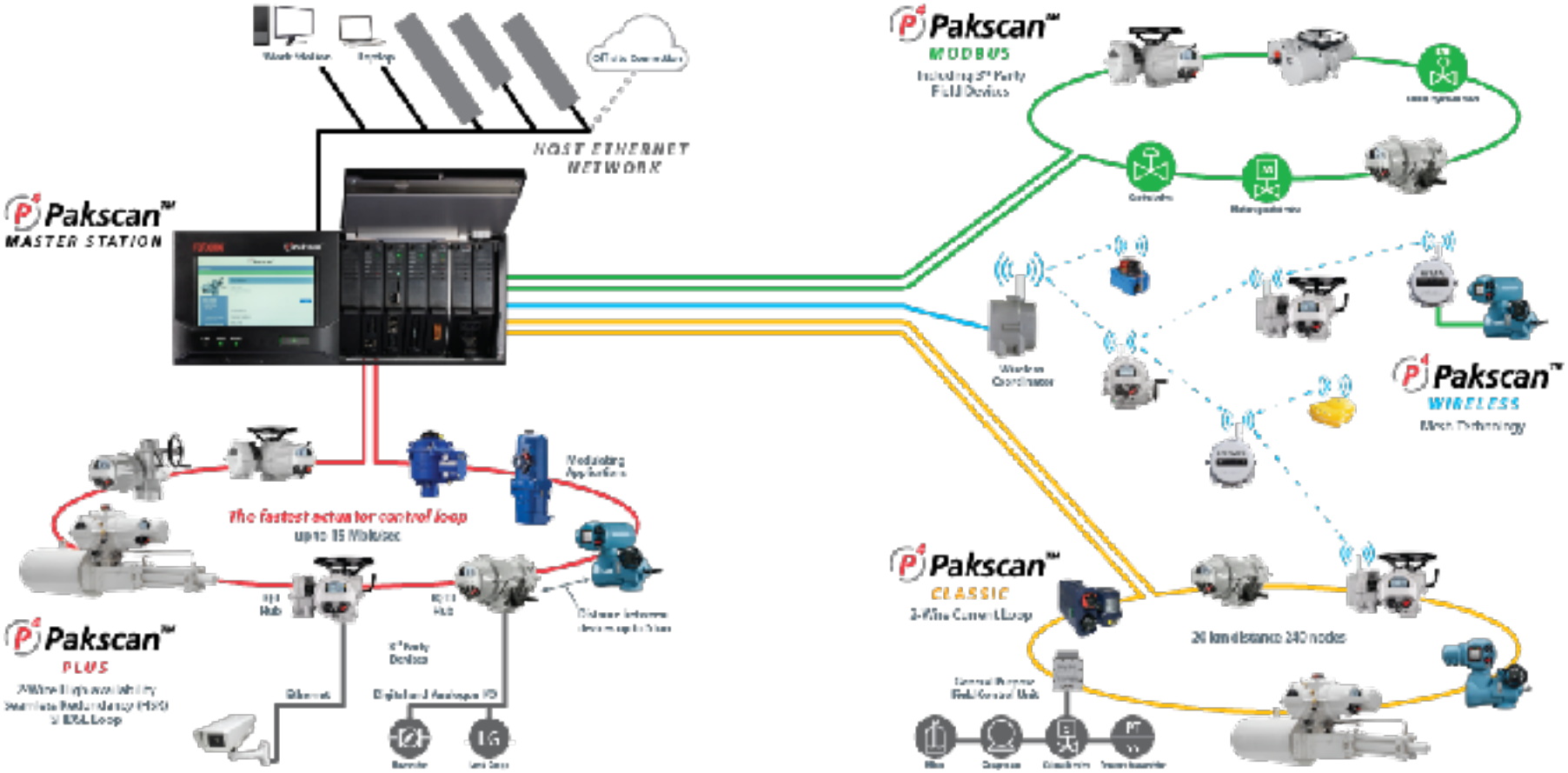
Electro-hydraulic actuators

Network System connectivity

With the addition of the appropriate option card, the actuator can be incorporated into a number of fieldbus control systems.

- All control functions, position and status indication would be communicated through the applied network
- With all option cards the ESD input can be hardwired for SIS, maintaining functional safety requirements

Electro-hydraulic actuators



Electro-hydraulic actuators

The use of the network enables the management of the assets connected to it:

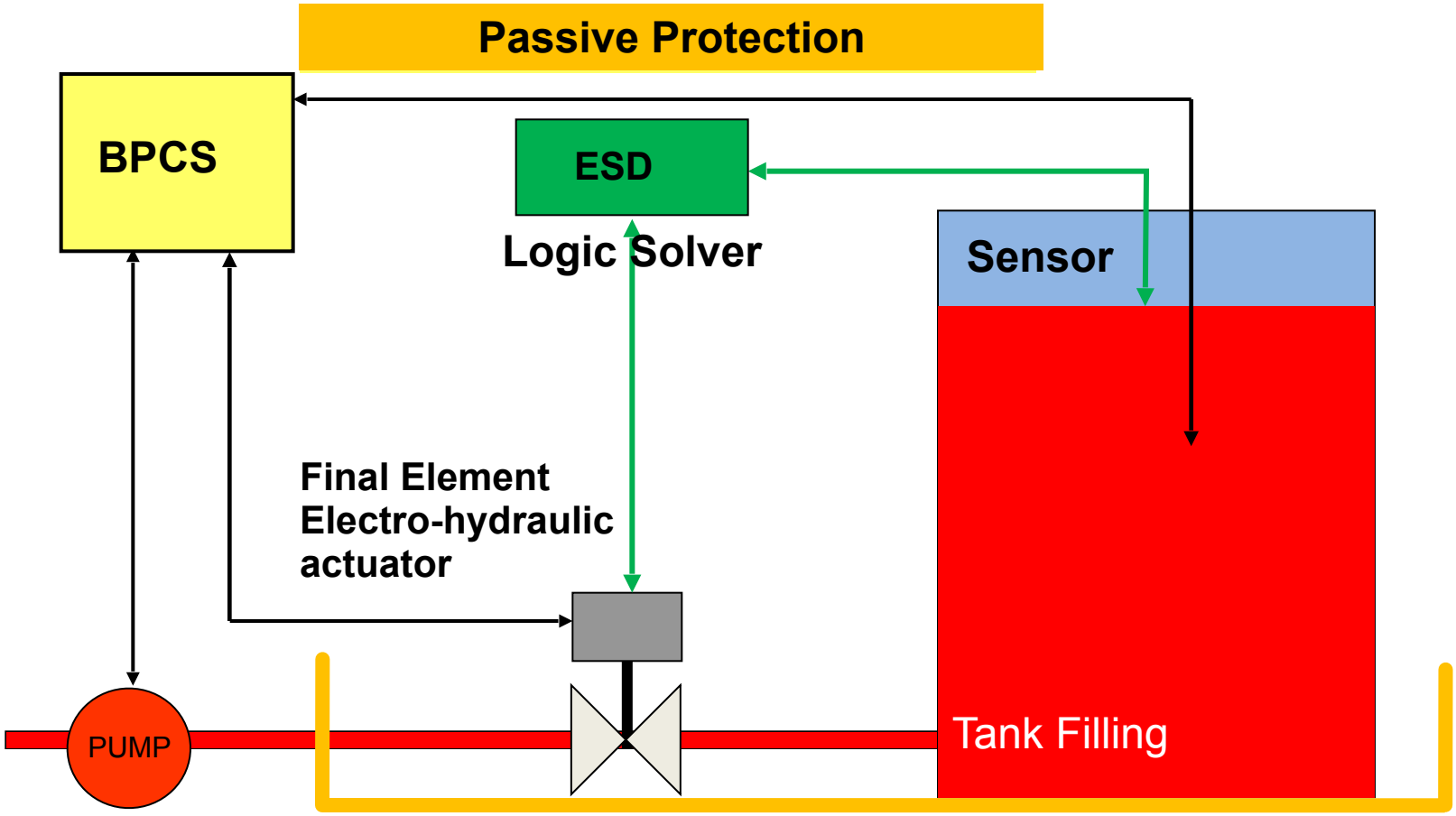
- Easy access to real time diagnostic data directly at the master station to aid troubleshooting.
- Easy access to historical logged data in the master station and from the actuator to help with Planned and Predictive Maintenance regimes.

Ultra-fast network speed allows dedicated fast response to command signals and reporting of device status and alarms. The devices configuration and datalogger download does not affect the speed of actuator and plant process control.

Electro-hydraulic actuators

- Precision instrument capable of 2-way communications with the control room
- Allows users to manage their flow control assets, maximising efficiency and reducing cost of ownership

Electro-hydraulic actuators



THANK YOU!!