Distributed Control Systems, DCS

- Individual Controllers communicating to a central computers acting as workstations.
- Communication accomplished by digital data highways, multidrop system, several devices connected to the same network, daisy chain.
Distributed Control Systems (DCS)

• The Database is the key, a well-defined coordinated articulate database, seamless between devices.
• Failure of a single component will not cause system failure, shutdown; sometimes called *graceful degradation*
• A hardware or software failure will not go undetected. Usually done with status bits, or logic.
• I/O – Input Output, electrical signals connected to the system
• Some systems use redundant I/O to increase reliability
DCS Hardware

- Analog inputs provides 12 bits 1 in 4096
- Analog Output 10 bits 1 in 1024
- The I/O are wired in card files and racked in electrical cabinets, most often located in a shelter remote from the operator control room.
- Industrial grade can handle harsh environments, electrical noise transients, radio interference, etc.
- IEEE C37.90.1-1989 was called 472; defines an electrical test that standardizes these conditions.
- Electrical Grounding - usually "isolated" from the plant ground system, however it is connected at one point.
DCS Reliability

- Reliability – very high, usually defined example 2 hardware failures or less per year.
- MTBF mean time before failure 100 years
- MTTR mean time to repair 1 hour or less.
- Online diagnostics; provides a report of the network traffic, communication errors, retries.
- Redundancy – will allow some or all components in the system to be redundant. Provides status and alarming for failures.
The DCS contains some to all of the following:

- A Control Network; linking the components on the network. Can have separate network for field devices and centralized processor as well as a network for the workstations, PCs.

- Workstations, usually a PC used for real time optimization programs executed there. Route data, configure system.

- Real Time Clock; all devices within the system have coordinated and synchronized with a Global Position Sensor.

- Operator Stations, usually a PC for operator interface, can print, log alarms, and generate reports.
DCS Operator Stations

- Consoles or HMI, Human Machine Interface—Computer consoles or workstations are used for operator entry. Special work surfaces are architecturally designed to accommodate telephone, paging in addition to the keyboard and mouse, usually a track ball design.

- Consoles frequently incorporate dual monitors, printers for plots and reports.
The DCS contains some to all of the following, cont:

- Engineering Workstation PC used to develop control strategy design or configure the system.
- Remote Control Units (RCU) Used to communicate with remote units, multiplexers, data concentrators, wireless.
- Application Stations PC run databases, spreadsheet interface, simulations. Uses OPC as a data link to the DCS database.
- Mass Storage Device, Archiving data; Data compression algorithms allow archiving large data sets.
DCS Historian

- Historian, short term, 90 day, and long term historian. Long term historian is on a separate computer, OPC connection used to communicate the values. A DVD archiving device.

- Because of the volume of data stored, many systems incorporate a data compression algorithm. Reduces the number of data points in the historical database by not repeatedly storing the point if it doesn't change by some small value. All points are usually reported at some interval even if they don't change.
DCS Alarm Management

- Alarms – DCS have sophisticated alarming conventions
- Alarm Hi HiHi, Lo, LoLo, etc, as well as rate of change.
- Alarms should have dead band to prevent chatter, on and off at the same point due to noise.
- Configured in a priority manor with different sounds colored schemes
- Can be suppressed, example during a startup, shutdown sequence.
- Acknowledge in the console display where the variable is configured, forces the operator to pay attention to the variable's operation
- Alarm history file can be analyzed by an off line software program to sort by various attributes.
DCS Report Generation

• Trend display
• Report generation, such as Shift, Daily, reports etc.
• Generates an event file that shows all the operations made to the system in a log form.
• Engineering console is usually separate from the operator's workstation.
DCS, Business System Integration

- DCS can be integrated with a Process Management Manufacturing Execution Systems
- Integrates business or enterprise resource planning systems, (or computer program) with real-time production data, plant can schedule production, manage raw materials, and optimize equipment use, etc.
DCS, MES

- Manufacturing Execution Systems (MES), for production automation systems.
- Provide open information exchange across manufacturing production and business planning systems.
- Provide integrated real-time manufacturing applications.
- Also called Computer Integrated Manufacturing or CIM.
- Model the business enterprise in "Levels"
Level 1 Process measurement and control loop
Level 2 Plant Systems
Level 3 Business Systems
Sometimes add a 4th for corporate communications
The system is based upon Microsoft Technologies
COM (Component Object Model)
OPC (OLE for Process Control) for real-time information
XML (eXtensible Markup Language) for transactional information. Communication standards that permit the free flow of information across functional areas without an additional software applications or multiple custom programmed interfaces.
The DCS contains some to all of the following, cont:

- Inter nodal Communications DCS system architecture allows data transfer to manufacturing databases

- Summary – a DCS is more than just a collection of controllers and a way to operate them, it is a system designed to interface with the overall manufacturing environment.