

Familiarize with automation simulation software & DCS/SCADA/HMI

Week-6, Session 4

Distributed Control System(DCS)

6.4.0 What is DCS?

A distributed control system (DCS) is a specially designed automated control system that consists of geographically distributed control elements over the plant or control area.

Concept of DCS

It differs from the centralized control system wherein a single controller at central location handles the control function, but in DCS each process element or machine or group of machines is controlled by a dedicated controller. DCS consists of a large number of local controllers in various sections of plant control area and are connected via a high speed communication network.

DCS is most suited for large-scale processing or manufacturing plants wherein a large number of continuous control loops are to be monitored and controlled. The main advantage of dividing control tasks for distributed controllers is that if any part of DCS fails, the plant can continue to operate irrespective of failed section.

Distributed control system is also widely used in many other industrial fields like chemical plants, metallurgical process plants, food processing units, water management systems, nuclear power plants, automobile industries, petrochemical plants, etc.

6.4.1 Data acquisition and data control in DCS

In DCS control system, data acquisition and control functions are carried through a number of DCS controllers which are microprocessor based units distributed functionally and geographically over the plant and are situated near area where control or data gathering functions being performed as shown in the figure above. These controllers are able to communicate among themselves and also with other controllers like supervisory terminals, operator terminals etc.

Distributed individual automatic controllers are connected to field devices such as sensors and actuators. These controllers ensure the sharing of gathered data to other hierarchical controllers via different field buses. Different field buses or standard communication protocols are used for establishing the communication between the controllers. Some of these include Profibus, HART, arc net, Modbus, etc.

6.4.2 Typical DCS Architecture

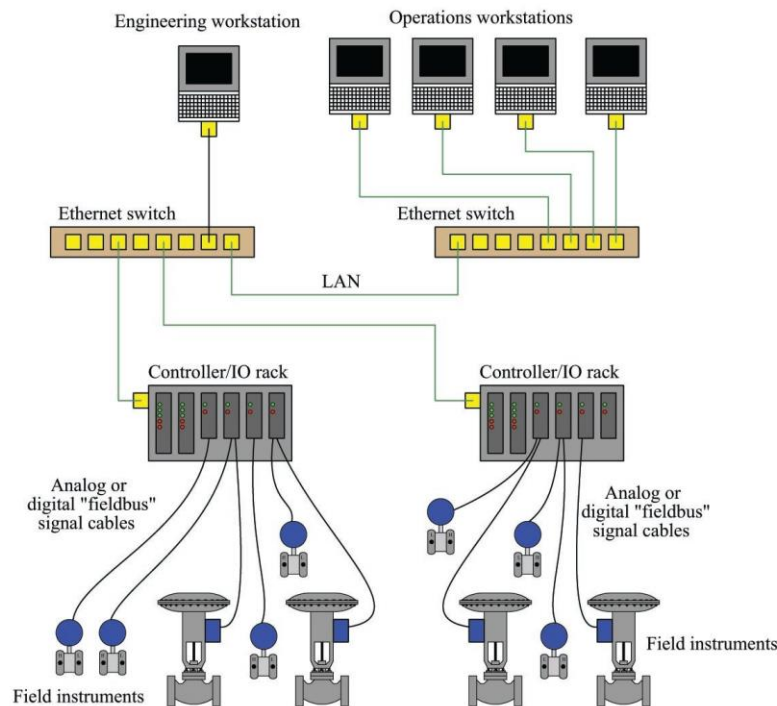


Fig 6.1

The basic elements comprised in a DCS include engineering workstation, operating station or HMI, process control unit or local control unit, smart devices, and communication system.

1) Engineering Workstation:

It is the supervisory controller over the entire distributed control system. It can be a PC or any other computer that has dedicated engineering software

2) Operating Station or HMI:

This is used to operate, monitor and control plant parameters. It can be a PC or any other monitoring device that has a separate software tool on which operator can view process parameter values and accordingly to take control action.

3) Process Control Unit of DCS:

It is also called as a local control unit, distribution controller, or process station. These controllers consist of a powerful CPU module, field bus or communication module. The field devices like sensors and actuators are connected to I/O modules of this unit

These units acquire the information from various sensors via input module, analyze and process it based on the control logic implemented and sends the output signals via output modules to have control on actuators and relays.

4) Communication System

The communication medium plays a major role in the entire distributed control system. It interconnects the engineering station, operating station, process station and smart devices with one another. It carries the information from one station to another. The common communication protocols used in DCS include Ethernet, Profibus, Foundation Field Bus, DeviceNet, Modbus, etc.

6.4.3 Application of DCS/SCADA/HMI in automation industry

1. Food/Pharma production: This is a major SCADA/DCS application. SCADA/DCS is used to

- monitor and control all phases of production,
- control the exact mix of ingredients,
- monitor the time and temperature required to process/manufacture food & beverages or pharmaceutical products.
- document data that proves the production process meets industry standards and governmental regulations.

2.Oil & Gas systems: SCADA/DCS systems are used

- to monitor wells and pumping sites, pumping pressure,
- to monitor pipeline flow and compressor stations.

- to detect anomalies and prevent catastrophic events from occurring – thus enhancing safety.

3. Manufacturing plants: In manufacturing industries, SCADA/DCS precisely controls all plant operations, ensuring all systems run smoothly. It is used to

- keep tracks of how many units are produced,
- measures values like temperature, pressure, humidity, etc. at different production stages,
- control assembly-line robots,
- monitor parts usage for in-time inventory control is implemented.

Reference:

- [1]<https://www.electricaltechnology.org/2016/08/distributed-control-system-dcs.html>
- [2]<https://instrumentationtools.com/distributedcontrolsysteamsdcs/>
- [3]<https://instrumentationtools.com/concept-of-dcs-in-industrial-automation/>
- [4] <https://www.messungautomation.co.in/knowledge-bank/scada-applications/>
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