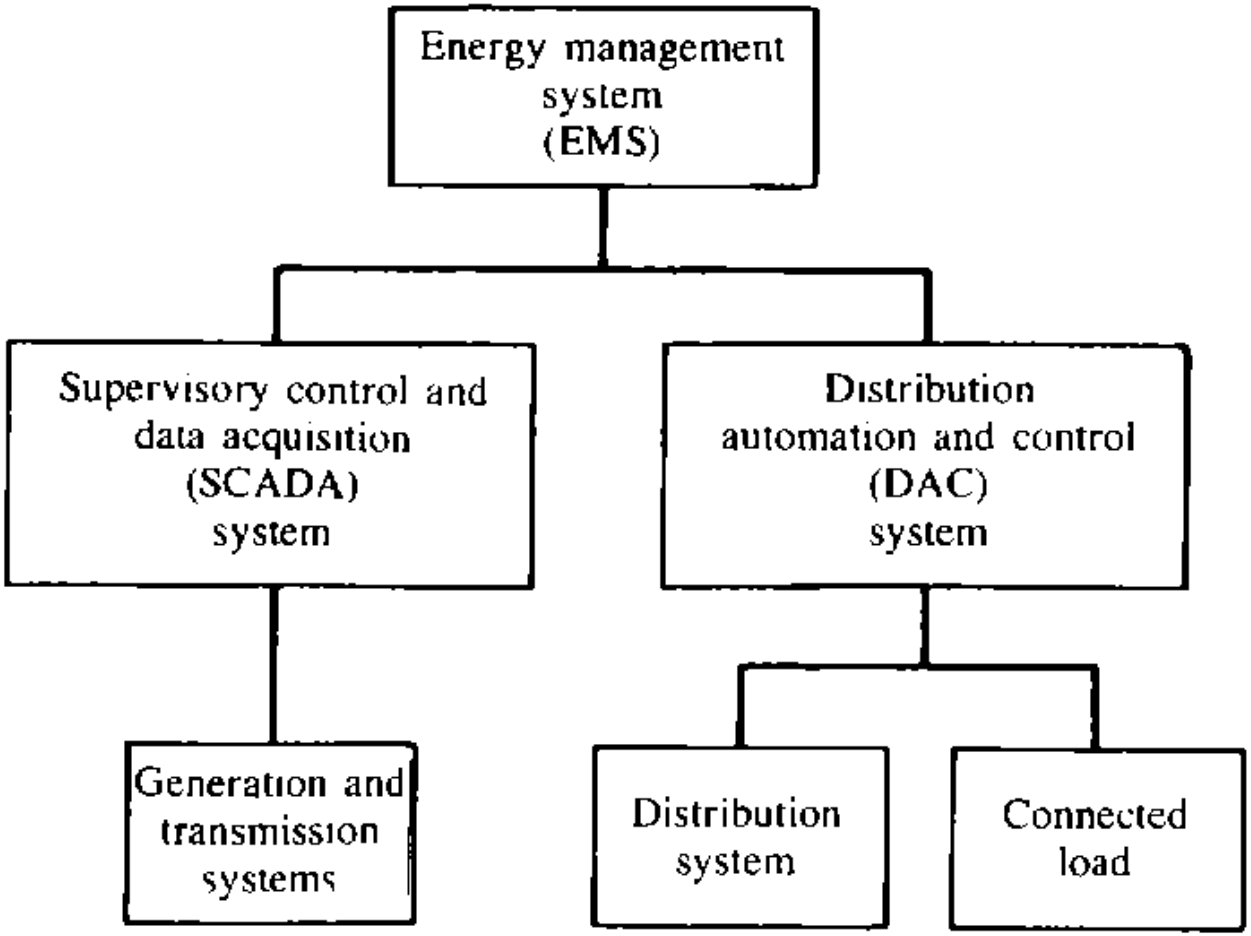
DISTRIBUTION AUTOMATION

Energy Management

- Power Energy Management System (EMS) is a family of unique solutions that ensure reliable and stable energy supply for customers
- It should be efficiently
  - generate electric energy
  - transmit electric energy
  - distribute electric energy
- It's main function is to
  - Supervise
  - control
  - manage power networks in an integrated manner.

Energy Management System Scheme



- SCADA involves generation and transmission system.
- DAC supervises the distribution system to

❖ improve overall system efficiency .

❖ increase reliability of service to essential loads.

Distribution Automation and Control(DAC)

- Objectives:

- Effective control and management of distribution system with reduced staff.
- Reduce outages, service restoration time and line losses.
- Low voltage(voltage sag) problems and reactive power management, better voltage management and quality of power.
- Improved revenue collection.

ISSUES IN DISTRIBUTION SYSTEM

1. **Reliability**
   - Continuity of power supply
   - Fault detection, isolation, service restoration after fault
2. **Quality**
   - Voltage, power factor, Harmonics, Frequency variations
3. **Efficiency**
   - Technical losses, commercial loss
4. **Unplanned Growth of Electric Power Network**
   - In Distribution; cause of difficulty in Management of the network
5. **Complexity**
   - Of network, Of technology
6. **Cost**
   - Implementation cost, maintenance cost
7. **Time**
   - To meet the requirement of customer within shortest time

Function of Distribution Automation System

Remotely monitors the distribution system, facilitates supervisory control of devices and provides decision support tools to improve the system performance

IEEE Definition: [1988 tutorial]
‘‘A system that enables an electric utility to remotely monitor, coordinate, and operate distribution components in a real-time mode from remote locations.’’

- Distribution Automation Data consists of continues analog data from feeders, transformers, etc., such as

- Electrical parameter data
- Voltage,current,pf,frequency, power
- Non-electrical parameters like oil temp, winding temp, CB gas or oil pressure in the tank.

Main function of DAC

- Load Management
- Operational Management

✓ Recently computers and powerful microprocessors are inexpensive.

✓ Hence the concept of distribution automation is easy.

Load Management

- Load Switching

➢ Involves direct control of loads at individual consumer premises from a remote central station.

➢ In this way

- The load is reduced in a particular substation.
- Overall system peak load is reduced.

- Peak Load Tariff:

➢ Implementation of peak load tariff programs by remote switching of meter registers automatically for the purpose of time-of-day metering.

- Load Shedding

➢ It permits the rapid dropping of large blocks of load according a selected priority or staggering of rural/urban feeders supplies as per pre-programme.

Load Shedding:

- When there is not enough electricity available to meet the demand from all customers, it could be necessary to interrupt supply to certain areas. This is called load shedding.
- It is different from a power outage that could occur for several other reasons.
- It is a last resort to balance electricity supply and demand.
- It is an effective way to avoid total collapse of the electricity supply grid.
- If unbalances on the power is not managed this could lead to the risk of collapse of the entire power network. If this occurs, it could take more than a week to restore power to the entire country.
- By rotating and shedding the load in a planned and controlled manner, the system remains stable.

Operational Management

- Voltage regulation

➢ It allows the remote control of selected voltage regulators, network capacitor switching to effect coordinated system wise voltage control.

- Transformer Load Management(TLM)

➢ It enable the monitoring and continuous reporting of transformer loading data to prevent overloads and damage by timely improvement and replacements respectively.

- Feeder Load Management(FLM):

➢ Loads are monitored and measured on feeders and feeder segments.

- Capacitor Control:

➢ It permits selective and remote controlled switching of power capacitors for reactive power planning and loss minimization.

- Fault Detection location and isolation:

➢ Relays located in the system detect abnormal conditions.

- This information is used
  - to automatically locate faults
  - to isolate the faulted segment
- Load Studies:
- It involves the automatic on-line collection of load data for analysis at the substation and further transmission to dispatch centre for day to day planning and operation of power system

- State Monitoring:

➢ It involves real time data gathering and status reporting to sub station from which minute-to-minute status of the power system can be determined.

- Automatic Consumer meter reading:

➢ It allows the remote reading of consumer meters for total consumption, peak demand, time-of-day metering.

- The computer programs relevant to DAC or SCADA are available in various companies such as

- ❑ Electronics Corporation of India Ltd.(ECIL)
- ❑ Alstom
- ❑ Bharat Heavy Electrical Ltd.(BHEL)
- ❑ CMC

Necessity of Distribution Automation

- To measure, protection control and monitor the components which are remotely located outside the substation
- To integrate all substations within a circle and all such components which are remotely located outside the substation for performance analysis
- To make the fault detection and automatic isolation
- To integrate automatic meter reading to avoid manipulation and loss of revenue by integrating DA with Automatic Billing and Collection Centre
- To maintain load shedding schedule automatically
- To monitor network topology and network components (assets) using GIS (Geographical Information System).
- To increase overall efficiency, reliability.
- To make operation and maintenance easy
- To save the time gap between a trouble call by a customer and actual service by integrating DA and Trouble Call Management

Distribution Automation Technology

- **Components of Distribution Network**:-
  1) Transformers
  2) Ring Main Units
  3) Substations
- **Basic Components of Automation**:-
  1. Master Distribution Automation Software
  2. Engineering analysis software
  3. Data Acquisition and Control Hardware like RTU, Relays, Digital Multifunction Meters, Remote Tap Changer
  4. Communication Hardware
- **Basic Features**:-
  1. Monitoring
  2. Control
  3. Protection

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- **Necessary Functions:-**
  - System Level
    - Monitoring
    - Control
    - Substation Automation
    - Feeder Automation
  - Customer Level
    - Remote Meter Reading and Billing
    - Load management
    - Customer Automation

continue

- **Monitoring and Control Functions**:-
  - Data Monitoring
  - Data logging
  - Analog Data freeze
  - Remote Meter Reading and Billing
  - Automatic Bus/ Feeder Sectionalizing
    - Fault location, Isolation and Service Restoration
    - Feeder Reconfiguration and Substation Transformer Load Balancing
    - Substation Transformer overload
  - Integrated Volt/ VAR Control
    - Capacitor Control
    - Voltage Control
  - Emergency Load Shedding
  - Load Control

- BENEFITS OF AUTOMATION

- Reduced losses
- Increased service reliability
- Life extension of equipment
- Effective utilization of assets
- Facility for better voltage, reactive power and quality of power and their management
- Improved revenue collection
- Faster decision making
- Effective and efficient monitoring of system

- FAULT LOCATION

- Information from protective devices
- Information from customersTelephone calls
- AMR(Automatic meter reading) devices at customer-end
- Other devices located in the system
- Deduction based on incomplete and imprecise information
- Communication bottlenecks in the event of widespread outages due to storms

- SERVICE RESTORATION

➢ Isolate faulted part of the system

  – Find alternate paths to supply power to healthy parts of the systemKeep loading within limits
  – Keep voltage within limits
  – Do this as quickly as possible

  – Account for cold load pickup for long outagesStep-by-step restoration may be required

- RECENT TRENDS

- Emergence of new technologies
- New measuring devices and sensors
- Powerful and refined communications equipment
- Highly advanced computing equipment
- Advanced power electronics
- Advanced protection equipment

THANK YOU