UNIVERSITY VISVESVARAYA COLLEGE OF ENGINEERING

Department of Electrical and Electronics Engineering K R Circle,

Bangalore – 560001

An internship report on

DISTRIBUTION AUTOMATION SYSTEM

Submitted in fulfillment of the requirements for the award of

Bachelor of Technology in

Electrical and Electronics Engineering

Submitted by

AKSHAY D S (20GAEED001)

Internship carried out at

BESCOM Integrated Control Center-2,

DAS Section, Corporate Office, BESCOM

Internal guide	External guide
DR H.R RAMESH	**SMT. PRIYA JAKKANNAVAR K**
Professor & Chairman	Deputy General Manager (Ele.),
Dept. of EEE, UVCE	DAS Section, Corporate office, BESCOM

Verified

25/4/2023

27/4/2023

UNIVERSITY VISVESVARAYA COLLEGE OF ENGINEERING
K R Circle, Bangalore – 560001

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

INTERNAL GUIDE CERTIFICATE

Certified that the Internship Report on **"DISTRIBUTION AUTOMATION SYSTEM"** carried out by Mr. **AKSHAY D S, Reg. no: 20GAEED001**, a bonafide student of **UNIVERSITY VISVESVARAYA COLLEGE OF ENGINEERING, BENGALURU**, in partial fulfilment for the award of B.Tech in **ELECTRICAL AND ELECTRONICS ENGINEERING** at UNIVERSITY VISVESVARAYA COLLEGE OF ENGINEERING during the year 2022-23. It is certified that all corrections/suggestions indicated during Internal Assessment have been incorporated in the report deposited in the department. The **INTERNSHIP** report has been approved as it satisfies the academic requirements prescribed for the said Degree.

Signature of guide 25/04/23
Dr. H. R. RAMESH
Professor & Chairman
Dept. of Electrical and
Electronics Engineering
UVCE

CHAIRMAN
D.O.S. in ELECTRICAL ENGINEERING
U.V.C.E., K.R. Circle,
BANGALORE - 560 001.

CERTIFICATE TO THE STUDENT

I hereby declare that **AKSHAY D S (20GAEED001)** student of VIII semester B. Tech, Electrical and Electronics Engineering of **UNIVERSITY VISVESVARAYA COLLEGE OF ENGINEERING, BANGALORE,** working presented in the Internship entitled **"DISTRIBUTION AUTOMATION SYSTEM"**, which is being submitted as partial fulfillment for the award of B.Tech in Electrical & Electronics Engineering from UVCE, BANGALORE, is an authentic record of Internship work that has been carried out by him during the academic year 2022-2023, from 17/03/2023 to 17/04/2024 at DAS section, corporate office, BESCOM.

Date: 25/04/23
Place: Bangalore

Dr. H. R. RAMESH 25/04/23
Professor & Chairman
Dept. of ELECTRICAL ENGINEERING,
UVCE,
Bangalore

CHAIRMAN
B.O.S. in ELECTRICAL ENGINEERING
U.V.C.E., K.R. Circle,
BANGALORE - 560 001.

DECLARATION BY THE STUDENT

I, **AKSHAY D S**, hereby declare that the Internship report entitled **"DISTRIBUTION AUTOMATION SYSTEM"** submitted as partial fulfillment for the award of B.Tech in Electrical & Electronics Engineering from **University Visvesvaraya College of Engineering,** BANGALORE.

I also declare that the Internship has not been submitted any time to any other university or institution for the award of any degree.

Date: 25/04/2023
Place: Bangalore

AKSHAY D S
20GAEED001

EXTERNAL GUIDE CERTIFICATE

This is to certify that this Internship report entitled **"DISTRIBUTION AUTOMATION SYSTEM"** submitted as partial fulfillment for the award of B.Tech in Electrical & Electronics Engineering from University Visvesvaraya College of Engineering, BANGALORE. It was carried out by Mr. **AKSHAY D S (Reg. no:20GAEED001)** under the guidance of **SMT. PRIYA JAKKANNAVAR K,** from 17/03/2023 to 17/04/2023.

This has not been submitted any time to any other university or institution for the award of any degree or certificate.

Signature of Guide DGM (DAS)

SMT. PRIYA JAKKANNAVAR K

Deputy General Manager (Ele.),

DAS section, Corporate office,

BESCOM

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Date: 25/04/2023
Place: Bangalore

AKSHAY D S
20GAEED00

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Chapter-1 INTRODUCTION

Electricity, once Upon a time 'luxury' has today transformed into one of the basic essential commodities to us from 'DC generation and transmission system' to the latest concept of Smart Grids, the technology associated with electricity has also seen a great transformation. This report will help one understand the concept behind Automation of a power distribution network specifically the technology which is implemented in Bangalore urban area of Karnataka state in India the operational concept, expected (or grunted) functions advantages limitations of the project are all touched upon with more focus on the electrical section of the project.

1.1 Power system in India

- Electricity in India is generated majorly from Thermal Plants (69.6%), supported by Hydro (14.1%), Renewables (14.4%) and Nuclear (1.9%) at voltage levels ranging from 11 KV to 25 KV.
- The location of thermal plants is geographically, in proximity with the coal mines distancing from the large consumer pool the hydro plants being close to water source and others in remote places due to environmental and other reasons.
- Huge transmission lines carry the electricity from generation stations across the country high voltages (HV) such at 66KV, 220KV,400KV, 750KV, 800KV depending upon the stepped voltages level at the last stage of generation.
- The higher voltage level helps in decreasing the losses and regulating the voltage at the receiving end. These high voltages are stepped down to medium voltage (MV) level 33KV or 11KV at the substation before being distributed to the consumers.
- Again, except for Industrial loads, voltage as low (LV) as 400V is the standard 3 phase voltage used by commercial and residential consumers. The 11KV is stepped down at the distribution transformers located close to the load across various points in the distribution network.
- As the economy of the country and hence the per capita consumption of electricity is continuously increasing apart from building up generation capacity via setting up of new plants curtailing the various losses of electricity is also emphasized across the electricity supply chain.

1.2 Power system in Karnataka

KPTCL (Karnataka power transmission corporation limited), company owned by State Government of Karnataka is responsible for transmission of power across the entire Karnataka state. Hence, construction of transmission lines, substation and their maintenance falls under the purview of KPTCL as per data on 31.03.2016 on the KPTCL website, it owns 4 numbers of 400 KV substations 97 numbers of 200KV substations,385 KV substations of 110 KV substations and 602 numbers of 66KV substations.

Distribution of power has been vested with five distribution companies, also called ESCOMS they are:

- BESCOM (Bangalore electricity supply company)
- MESCOM (Mangalore electricity supply company)
- HESCOM (Hubli electricity supply company)
- GESCOM (Gulbarga electricity supply company)
- CESCOM (Chamundeshwari electricity supply corporation limited)
- PCKL (power company of Karnataka limited)

Takes care of capacity addition and also plays a lead role in procuring power on behalf of ESCOM s from various sources.

1.3 Single line diagram of 66KV/11 KV substation.

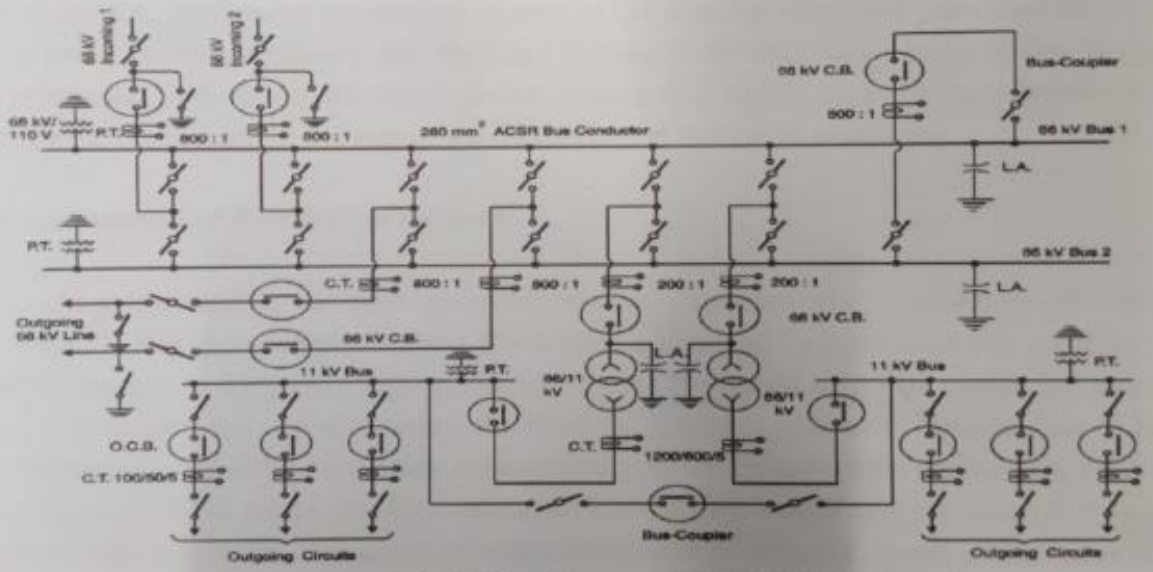


Fig 1.1 conceptual single line diagram of 66KV/11KV substation

1.4 Concept of Feeders

An 'Electrical Feeder' is a line originating from the substation carrying the transformed voltage (here 11KV) and traversing the network area. 'N' number of feeders originate from a single substation, carrying power in different direction as they traverse the network (refer to figure 1.1) further branches tap the power across intermediate area from these main feeder lines. The point of tapings acts as switch sources, thus segmenting the network into smaller sections. Electrical poles which support the lines are accompanied with switches such as 'GOS' which help in connecting or disconnecting the lines more than one feeder can terminated on a pole in which case, the GOS will ensure open conduction of one of the feeders the same can be connected when the other feeder fails to supply power due to fault in the section figure 2.1 represents single line diagram of a feeder.

1.5 Fault detection and isolation (distribution network)-prior to automation

A switch and a fusing element constitute the basic requirement of system protection when LV system is used. Fuse helps in autonomously isolating the particular load/segment which is faulty a similar concept is applied to the MV system as well the circuit breaker-relay combination present at the start end of the feeder originating from substation act as "breaking element indicating and isolating the fault in the entire feeder line / network and the "group operating switches (GOS)' located at various points are used to specifically disconnect the segment in which the fault has occurred there by restoring power supply to other segments. The tripping of the circuit breaker (CB) is the first indication of fault in the network.

Response: The tripping of CB will be alarmed at the substation The CB will be attempted to reset, which would be successful, if the fault was a temporary one. It the CB trips again immediately, it indicates that the fault needs to be rectified and is not a temporary one. A line -man (a technician deputed for repair and maintenance of the area distribution network) will be intimidated about the situation, who would sequentially open the GOS from the start end of the feeder line confirming the reaction (status) of CB from the substation personnel for every GOS being opened and closed thus, the exact location of the fault would be identified, in case of permanent fault also if the feeder circuit breaker fails to trip, then the bank breaker and further the breaker on the LT side of the transformer at substation would trip.

1.6 Automation of distribution network

The effort involved in the fault detection process, explained above is tedious and time consuming. It is quoted approximately 20-45 mins is involved for same. And this accounts to loss of revenue to the power supply company during the period of power outage (no power supply to consumers). By automation, the expected change is primarily, identification of the faulty segment and isolation of same, independently by the system within much lesser amount of time (around 1-2 mins), real time availability of the distribution network data viz voltage current reading switches status, remote controllability of the network, visual indication of the network indicating every connection at the control centers.

Chapter-2 BESCOM - A Brief Introduction of Company

BESCOM – Bangalore Electricity Supply Company Limited is responsible for Power distribution in Eight districts of Karnataka (Bangalore Urban, Bangalore Rural, Chikkaballapura, Kolar, Davanagere, Tumkur, Chitradurga and Ramanagara). BESCOM covers an area of 41,092 Sq. Kms. with a population of over 207 lakhs.

The company has 4 operating Zones

- Bangalore Metropolitan Area Zone (North)
- Bangalore Metropolitan Area Zone (South)
- Bangalore Rural Area Zone
- Chitradurga Zone

BESCOM has 9 Circles, 32 Divisions, 147 Sub-divisions and 534 Section Offices.

Zonal Office

A Zone has 2 to 3 Circles under its jurisdiction. It is also an administrative office which does not deal with consumers directly. It is headed by an Officer of the rank of Chief Engineer and assisted by sub-ordinate officers. A Controller of Accounts is placed in the Circle office to look after the Financial and Accounting functions of the Circle.

Circle Office

A Circle has 3 to 5 Divisions under its jurisdiction. It is also an administrative office which does not deal with consumers directly. It is headed by an Officer of the rank of Superintending Engineer and assisted by sub-ordinate officers. A Deputy Controller of Accounts is placed in the Circle office to look after the Financial and Accounting functions of the Circle.

Division Office

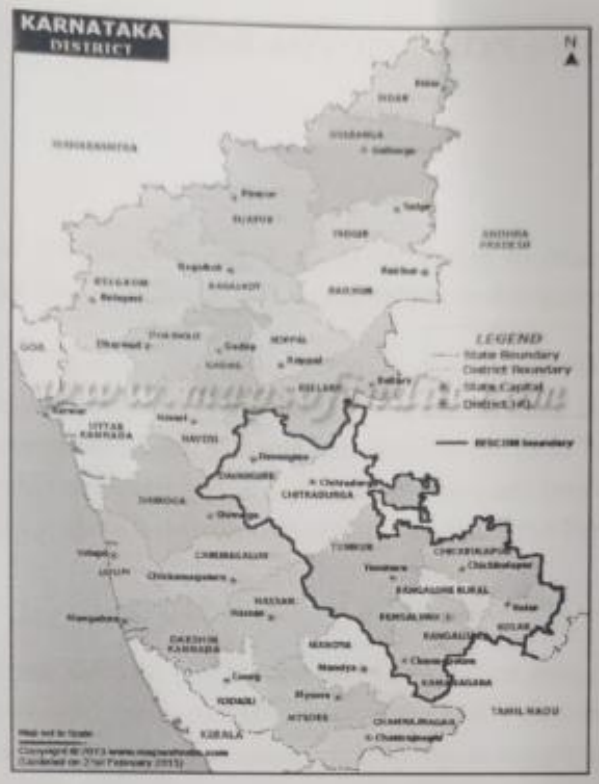
A Division has 3 to 5 sub-divisions under its jurisdiction. It is purely an administrative office and does not deal with consumers directly. It is headed by an Officer of the rank of Executive Engineer and assisted by sub-ordinate officers. An Accounts Officer is also placed in the Division office to look after the Financial and Accounting functions of the Division.

Sub-divisional Office

A Sub-division consists of 3 to 5 O&M Units and headed by an officer of the rank of Assistant Executive Engineer. He oversees the functioning of O&M Units, so as to ensure reliable distribution of power in the jurisdictional area. An Assistant Accounts Officer/Senior Assistant is placed in the Sub-division to look after the Accounting and Finance related functions.

Unit Office

Operational & Maintenance Unit is the primary link between the consumer and the company. It is the lowest office in the hierarchy, where consumer relationship is established. It is headed by an officer of the rank of an Assistant Engineer or a Junior Engineer.



Responsibilities of BESCOM

- Distribution of power to consumers at the rates approved by KERC Tariff regulations.
- Supply at specified voltage and frequency
- Maintenance of 11 KV lines, distribution of transformers and equipment's to ensure reliable and quality power supply.
- Augmentation of infrastructure to meet the demand.
- Ensuring safety of human and animal life by taking suitable action to minimize risk of accidents
- Perspective planning of activities in relation to demand and supply of power.

Vision & Mission of BESCOM

Vision

The Vision of BESCOM is to become Number One in Customer Satisfaction in South Asia in Power Distribution

Mission

The Mission of Bangalore Electricity Supply Company Limited is to ensure absolute consumer satisfaction and continuous profit in business

- By ensuring total employee satisfaction
- By developing infrastructure, commensurate with growth, thus ensuring reliable and quality power supply
- By using best technology in communication and best practices in power sector

Chapter-3 DISTRIBUTION AUTOMATION SYSTEM (DAS) OVERVIEW

3.1 Definition

Distribution automation system abbreviated as 'DAS' refers to renewing of the manually controlled electrical distribution network into a remotely operable automatic system.

Referring to few other definitions which are found appropriate as "Distribution automation system provides a means to interact with the distribution system from a central location requiring less dependence on operation and line personnel in the field" and "DAS are SCADA system extended from traditional generation and transmission parts into the distribution section to monitor co-ordinate and operate distribution network in real time from control centers".

3.2 Objective

BESCOM is implementing DAS project for the Bangalore urban area distribution network in order to improve the reliability, safety and efficiency of the 11KV distribution network through real time monitoring and supervisory control enabled by automation where in intelligent devices inserted at specific nodes operate autonomously along with remote controllability option.

3.3 Benefits

- Real time monitoring and control of the distribution network
- Increased reliability by quicker response to fault detection
- Remote isolation of faulty segment and restoration of the power by alternate sources
- Increase in revenue through reduction in unscheduled power outage hours
- Improve efficiency with reduction in losses
- Enables online energy audit through real time data acquisition

3.4 Scope of the DAS project

The project is currently implemented in the Bangalore metropolitan area zone of the BESCOM, covering more than 2.9 million consumers over a geographical area of 1600 km^2, majorly including the urban area of Bangalore.

Since the substation are monitored and controlled by KPTCL, the scope of DAS starts from the feeder line originating at the substation i.e., after the circuit breaker till it reaches the distribution transformers. The LT side of the distribution transformers supplying 3 phase, 400V to consumers is not included in the scope of this project, currently. the primary focus is to establish the DAS system with automatic reclosers, load break switches and ring main units inserted in the network through which the network data and control signals, & reliable communication network for enabling movement of data.

3.5 Automatic switches

In order to implement DAS, the following changes are brought in the manually controlled network:

- Installation of automatic recloser switches (LRCS-line recloser unit & LBS-load break switch) at various points in the 11 KV network
- Installation of DAS compatible RMU s-ring main unit & RTUs-remote terminal unit
- Establishment of control center facilities & communication systems The LRCs & LBS have inbuilt FTU, RMUs do not such facility hence an external RTU (remote terminal unit) is installed next to every RMU which interfaces the RMU with the communication network

3.7 Operation

Two control centers, one at HSR Layout and other at Rajajinagar comprises of the hardware and software facilities necessary for SCADA /DMS application i.e., servers, workstation, video projection system LCD panels firewalls, routers etc. through this and the established communication network, the DAS will not only be able to monitor the LRC, LBS, RMUs in the network, but also can control the opening/closing of these switches, turning on/off of the devices change the devices setting etc.

3.8 DMS (Distribution management system)

1) Distribution management system refers to the set of software applications/functions that aid in efficient management of the electrical power distribution network, some of the functions available in DMS are
2) Fault detection isolation, and restoration (FDIR) of the power to healthy section of the feeder
3) Switching management system inspecting if the created switching order would introduce feeder overload and /or voltage problems
4) Optimum feeder reconfiguration to avoid feeder overloading and voltage limitation violation
5) Load shed/restore during emergency electricity supply shortages
6) Calculation of quality service indices (such as SAIDI, SAIFI, CAIDI and MAIFI)
7) Volt/VAR control by controlling the substations transformers, voltage regulators, capacitor banks (currently not under the scope of BESCOM DAS project)
8) Distribution state estimation using the SCADA data and historical load profile data

Chapter-4 LINE RECLOSER(LRC)

4.1 Introduction

Automatic line recloser (LRC) is an overcurrent protection device that automatically trips on detection of fault current; and recloses itself. The tripping and reclosing continue for a preset number of times; after which the LRC retains its open position if the fault persists. The automatic reclosing mechanism is built into it avoid unnecessary power outages due to temporary (lighting momentary touching of lines due to wind birds etc.). A line recloser can hence be interpreted as a combination of circuit breaker an over current relay & a reclosing relay.

The recloser used in the DAS project is a SF6 gas insulated automatic vacuum recloser type. The controlling unit is, microprocessor based and is also integrated with a remote terminal unit (RTU) for remote controllability.

Fig 4.1: A picture of P & C tech line recloser used in DAS project

4.2 LRC Structure

It has two main parts as shown in fig 3.1

- A circuit breaker chamber with connecting terminals integrated CTs (3); PTs (6)
- Control cabinet with reclosing relay, microprocessor-based controller battery bank, FTU (feeder terminal unit)

4.3 Control module:

The control module houses the relay capacitor, control logic, microcontroller DSP memory counter ADC battery, battery chargers, radio, communication ports and is responsible for

- Measurements of voltage current, power energy power factor, frequency, THD
- Normal & faulty events recording
- Providing control signals for enabling &/or disabling reclosing interlocking mechanism (gas low handle lock live load), battery test manual opening/closing of recloser etc.
- The controller used in DAS for LRC is FTU-200 (feeder terminal unit)
- 24V DC power supply is necessary for controller operation. An auxiliary transformer 11KV/240V, mounted on the pole provides the 240v supply to the control module.
- Where in, again it is reduced to 24v through another transformer before being supplied to the battery charger.
- The PTs & CTS necessary for measurements are integrated in the circuit breaker chamber.