Skill India
कौशल भारत-कुशल भारत

सत्यमेव जयते
GOVERNMENT OF INDIA
MINISTRY OF SKILL DEVELOPMENT
& ENTREPRENEURSHIP

N·S·D·C
National
Skill Development
Corporation
Transforming the skill landscape

Telecom
Sector
Skill
Council

Participant Handbook

Sector
Telecom-Tower Technician

Sub-Sector
Passive Infrastucture

Occupation
Operation & Maintenance - Passive Infrastructure

Reference ID: **TEL/Q4100, Version 4.0**
NSQF Level 4

Click/Scan this QR code to access the e-Book

Telecom - Tower Technician

This book is sponsored by

Telecom Sector Skill Council of India

Estel House, 3rd Floor, Plot No:- 126, Sector 44 Gurugram,

Haryana 122003

Phone: 0124-2222222

Email: tssc@tsscindia.com Web:

www.tsscindia.com

First Edition, July 2022

Printed in India

Disclaimer

The information contained herein has been obtained from sources reliable to Telecom Sector Skill Council of India. Telecom Sector Skill Council of India disclaims all warranties to the accuracy, completeness or adequacy of such information. Telecom Sector Skill Council of India shall have no liability for errors, omissions, or inadequacies, in the information contained herein, or for interpretations thereof. Every effort has been made to trace the owners of the copyright material included in the book. The publishers would be grateful for any omissions brought to their notice for acknowledgements in future editions of the book. No entity in Telecom Sector Skill Council of India shall be responsible for any loss whatsoever, sustained by any person who relies on this material.

> Skilling is building a better India. If we have to move India towards development then Skill Development should be our mission.

Shri Narendra Modi
Prime Minister of India

Certificate

COMPLIANCE TO QUALIFICATION PACK – NATIONAL OCCUPATIONAL STANDARDS

is hereby issued by the

TELECOM SECTOR SKILL COUNCIL

for

SKILLING CONTENT : PARTICIPANT HANDBOOK

Complying to National Occupational Standards of
Job Role/ Qualification Pack: 'Tower Technician'
QP No. '**TEL/Q4100 NSQF Level 4**'

Date of Issuance: **Dec 30th, 2021**

Valid up to*: **Dec 30th , 2025**

**Valid up to the next review date of the Qualification Pack or the 'Valid up to' date mentioned above (whichever is earlier)*

Authorised Signatory
(Telecom Sector Skill Council)

Acknowledgement

Telecom Sector Skill Council would like to express its gratitude to all the individuals and institutions who contributed in different ways towards the preparation of this “Participant Handbook”. Without their contribution it could not have been completed. Special thanks are extended to those who collaborated in the preparation of its different modules. Sincere appreciation is also extended to all who provided peer review for these modules.

The preparation of this Participant Handbook would not have been possible without the Telecom Industry's support. Industry feedback has been extremely encouraging from inception to conclusion and it is with their input that we have tried to bridge the skill gaps existing today in the Industry.

This Participant Handbook is dedicated to the aspiring youth who desire to achieve special skills which will be a lifelong asset for their future endeavors.

About this book

India is currently the world's second-largest telecommunications market with a subscriber base of 1.20 billion and has registered strong growth in the last decade and a half. The Industry has grown over twenty times in just ten years. Telecommunication has supported the socioeconomic development of India and has played a significant role in narrowing down the rural-urban digital divide to some extent. The exponential growth witnessed by the telecom sector in the past decade has led to the development of telecom equipment manufacturing and other supporting industries.

Over the years, the telecom industry has created millions of jobs in India. The sector contributes around 6.5% to the country's GDP and has given employment to more than four million jobs, of which approximately 2.2 million direct and 1.8 million are indirect employees. The overall employment opportunities in the telecom sector are expected to grow by 20% in the country, implying additional jobs in the upcoming years.

This Participant Handbook is designed to impart theoretical and practical skill training to students for becoming a Tower Technician. Tower Technician in the Telecom industry is also known as Site Engineer/Tower Engineer/Site Technician.

Individuals at this job needs maintain site live 24x7, maintain and repair level-1 faults/issues at telecom tower site, level-1 preventive and corrective maintenance and report faults to the supervisor in time. Individual also needs to travel inter-state and work during odd hours, when required.

This Participant Handbook is based on Tower Technician Qualification Pack (TEL/Q4100) & includes the following National Occupational Standards (NOSs)

1. Maintain the tower site and report periodically-TEL/N4138
2. Manage Site operations safely and hygienically-TEL/N4139
3. Organize Work and Resources as Per Health and Safety Standard-TEL/N9101
4. Interact Effectively with Team Members and Customers-TEL/N9102

The Key Learning Outcomes and the skills gained by the participant are defined in their respective units. Post this training, the participant will be able to keep sites live 24x7 through site maintenance.

We hope that this Participant Handbook will provide a sound learning support to our young friends to build an attractive career in the telecom industry.

Symbols Used


Key Learning Outcomes


Steps


Practical


Notes


Unit Objectives


Exercise

Table of Contents

Table of Contents

Skill India
कौशल भारत-कुशल भारत

सत्यमेव जयते
GOVERNMENT OF INDIA
MINISTRY OF SKILL DEVELOPMENT
& ENTREPRENEURSHIP

N·S·D·C
National
Skill Development
Corporation
Transforming the skill landscape

1. Role and Responsibilities of a Tower Technician

Telecom Sector Skill Council

Key Learning Outcomes

At the end of this module, you will be able to:

1. Discuss about the telecom sector.
2. Understand about different types of Cellular networks.
3. Identify various companies in Tower Infra industry and develop understanding about them.
4. Know about various organization in telecom industry.
5. Get knowledge of Companies in Tower Infra Industry.

UNIT 1.1: Introduction to Telecom Industry

Unit Objectives

At the end of this unit, you will be able to:

1. Get an overview of the Telecom Industry.
2. Identify various telecom operators in India and internationally.
3. Develop an understanding about Telecom product companies and Telecom solution providers.

1.1.1 Size and scope of the Telecom Industry – Passive Infrastructure Sector

The telecommunications industry is made up of businesses that enable global communication, whether it be via the phone or the Internet, over airwaves or cables, via wires or wireless. These businesses built the network that enables the transmission of data in the form of text, voice, audio, or video throughout the globe.
Internet service providers, satellite companies, cable companies, and telephone operators are the biggest businesses in the industry.

Infrastructure, Equipment, Mobile Virtual Network Operators (MNVO), White Space Spectrum, 5G, Telephone service providers, and Broadband are the sub-sectors that make up the telecommunications sector.

1.1.1 Tower Technician

The Indian telecom tower market has expanded dramatically by 65% during the last seven years. In 2021, there will be 660,000 mobile towers, up from 400,000 in 2014. Similar to this, there will be 2.3 million mobile base transceiver stations in use by 2021, up quickly by 187 percent from 800,000 in 2014.

Additionally, it is predicted that 5G technology will boost the Indian economy by $450 billion between 2023 and 2040. The IMT/5G spectrum auction is now underway.

According to the GSMA, India will have almost 1 billion installed smartphones by 2025 and 920 million unique mobile customers, including 88 million 5G connections. This will make India the second-largest smartphone market in the world.

Nearly the past ten years, India has added over 500 million additional smartphone users. By 2026, there will be 850 million smartphone users worldwide, or around 55% of the population.

By December 2022, the DoT wants to have 30 lakh km of fiber-optic cable installed, average internet speeds of 25 mbps, and 100 percent broadband access in all of the country's villages. By December 2024, it is looking at 70% fiberisation of towers, average broadband speeds of 50 Mbps and 50 lakh kms of optic fibre rollouts at a pan-India level

The transition to digital learning and remote working:

Due to the COVID-19 pandemic's impacts, digital learning and remote working have grown in popularity in recent months. Telcos have played and will continue to play a part in the acceleration of the shift from learning and working in physical places to online due to the pandemic. Reliable and secure connectivity as well as data management are required for online learning and remote working to function properly. Numerous Telcos have had to negotiate this and will continue to do so.

The provision of the same level of accessibility and connectivity to those in remote places is another factor that must be taken into account when examining this trend and potential development chances.

1.1.1 a Remote Learning

- Radio Network Controller (RNC) sharing entails keeping logical control over each operator's RNC in isolation.
- Sharing switches (MSC) and routers (SGSN) on the operator's fixed network is referred to as backbone sharing.
- Network sharing, in which a network infrastructure is specifically built with resource sharing in mind. For instance, a joint venture between Telenor Sweden (formerly Vodafone Sweden) and HI3G created a shared network that covers 70% of Sweden (Hutcheson Investor). When a user is inside one of the major cities, his calls are routed through Telenor's or HI3native G's network infrastructure, while when he is outside of the cities, his calls wander into 3GIS's common network.
- Geographical splitting: A FTTH network's design is heavily influenced by geography, particularly in how it affects subscriber density. Population-dense areas need less cable and typically more fibre splitters, while suburban areas with lower densities frequently use cascaded splitters to serve fewer subscribers per splitter. In rural areas, long cable runs are frequently necessary, and the choice of whether to connect the subscriber using fibre or wireless must be made. Rural networks feature a variety of alternatives, including remote OLTs and splitter taps.

Who should take this course?

This Course should be taken by

a. New entrants who are interested in making a career in Telecom Industry.

b. Existing members of telecom industry who want to get enhanced training for career growth.

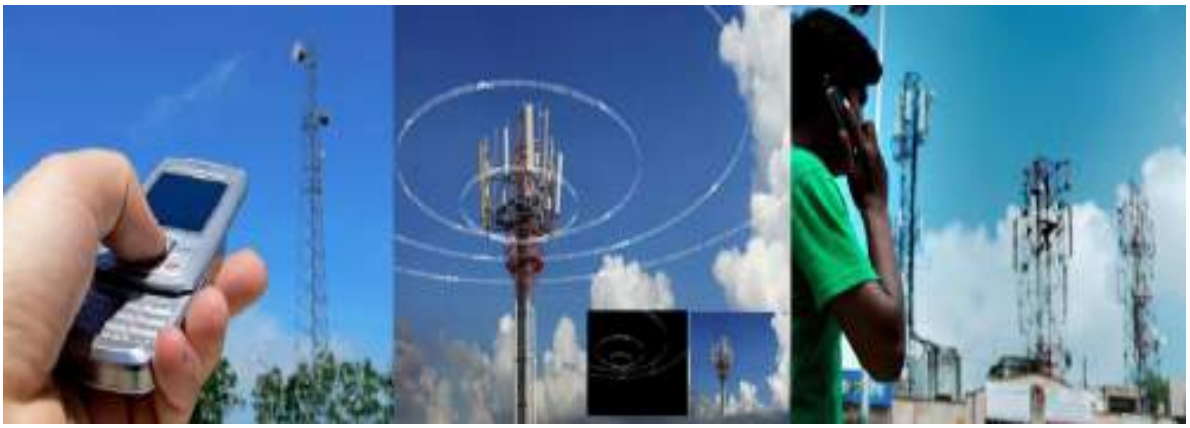


Fig. 1.1.1 Telecom Services in Operation

1.1.2 Indian Telecom Operators

Telecom Operators are the companies who have taken licence from the govt. to provide telecommunication services to users. They own all the elements necessary (Radio spectrum, wireless network infrastructure, back haul network, a billing solution, customer care, marketing and repair organization) to sell and deliver communications services to end users. They are also called mobile network operator, wireless service provider, wireless carrier, cellular company or mobile network carrier. There are usually multiple Telecom operators in a country to ensure competition and better quality of service to users. Examples of some Indian telecom operators and International telecom operators are provided for your reference(Refer to Fig. 1.1.2).

Fig. 1.1.2 Major Telecom operators of India

1.1.3 International Telecom Operators

Telecom operators which are present in the countries out of India are known as International telecom operators. Many of these have operation in multiple countries. Few of these International operators are given below (Refer to Fig. 1.1.3).

Fig. 1.1.3 Key International Telecom Operators

1.1.4 Telecom Product Companies

Telecom product Companies and Telecom solution Providers are organizations who work towards building technologies, products and solutions needed for deploying the wireless/wireline networks, back haul networks and other connectivity/IT solutions used for a proper operation of a Telecom service provider. There are many companies world wide who specialize in a particular field of technology needed by these telecom operators. These are called Telecom Products companies and they sell their products directly to telecom operators as product companies or through bigger companies These bigger companies are called Telecom solution providers and they put together multiple products as an overall solution for Telecom operators put together multiple products as an overall solution and are called Telecom solution Providers. Some major Indian and Global telecom product companies and solution providers are referred below (Refer to Fig. 1.1.4).

Fig. 1.1.4 Telecom product Companies and Telecom solution Providers

UNIT 1.2: Types of Communication

Unit Objectives

At the end of this unit, you will be able to:

1. Clearly understand the definition of Tele communication.
2. Differentiate between wireless and wire line communications.

What is Telecommunication?

Tele communication is exchange of information between individuals at a distance, using electronic products over a medium which could be wired (landline communication) or wireless (Cellular or Mobile communication). A complete telecommunication arrangement is made up of two or more stations equipped with transmitter and receiver devices communicating over a medium.

Below shows communications between various individuals. Both users have a handset which is a receiving and transmitting device. This handset can be of a land line network or of a Mobile Network. Communicating medium could be wires or open air depending on the telecom operator user 1 and user 2 have selected (Refer to Fig. 1.2.1 & 1.2.2) .

Fig 1.2.1 Caller making a Tele call

Fig 1.2.2 Receiver receiving a Tele call

1.2.1 Wired/Landline Communication

In Wired/ Landline communication the information is shared between individuals using a physical cable which could be a copper cable or a Fibre optic Cable. The communication between users passes through a telephone exchange which routes the call to the destination user. As per a recent survey there are 1.3 billion land line users world wide, but many user are shifting to wireless/Mobile communication. Picture below shows a land line caller calling through a wire line network to the receiver he wants to talk to.

In the Fig. 1.2.3 a land line user picks up her handset dials the number of her friend. Call goes through the wire line network (Refer to Fig. 1.2.4) and reaches her friend (Refer to Fig. 1.2.5). Her friend picks up phone and they start talking.

Fig 1.2.3 Caller with Handset

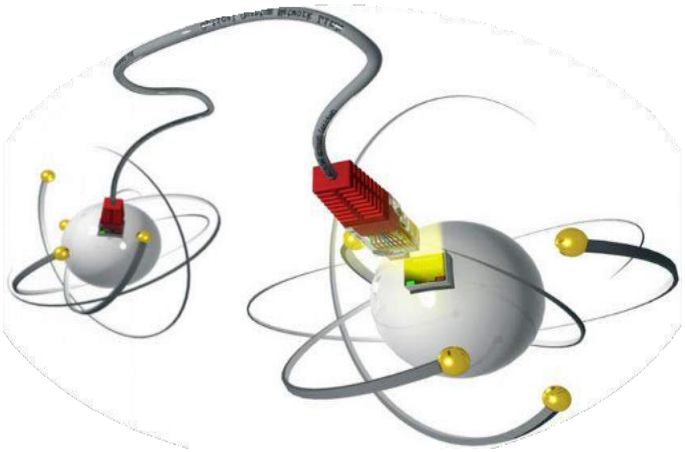


Fig 1.2.4 Wire-line Telecom Network

Fig 1.2.5 Receiver with Handset

1.2.2 Wireless/ Cellular/ Mobile Communication

In Wireless/ Cellular/ Mobile Communication information is shared between individuals using airwaves as shown in the picture below. While there are many wireless technologies like Radio, free space optics, Wi-fi, blue-tooth etc. but for mobile communication between individuals there are predominantly two technologies being used, which are GSM and CDMA. In both GSM & CDMA signals goes to a mobile tower and from mobile tower they reaches the mobile switching center to be directed to the cell tower where the recipient user is stationed. As per estimates there are around 5 billion mobile users in the world. The picture below shows the call flow between two users. User 1 (Refer to Fig 1.2.6) is calling mobile User 2 (Refer to Fig 1.2.10) through her mobile Handset. Her call is taken by airwaves which are using CDMA/GSM technology to a nearest cellular tower (Refer to Fig 1.2.7) . From the cellular tower a back haul network of mobile operator carry this call to mobile switching center (Refer to Fig 1.2.8) . Mobile Switching Center will find the location of user 2 based on her mobile number. After finding the location of User 2, mobile Switching Center will forward the call to a cell tower nearest to the location (Refer to Fig 1.2.9) of mobile User 2 on the back haul network of the telecom operator. From the Cell tower the communication is passed on to Mobile User 2 over air waves. Mobile User 2 gets a ringing tone on her handset.

Fig.1.2.6 Mobile user 1 with Handset

Fig. 1.2.7 Cell Tower

Fig. 1.2.8 Mobile Switching Centre

Fig. 1.2.9 Cell Tower

Fig. 1.2.10 Mobile User 2 with Handset

UNIT 1.3: Types of Cellular Networks

Unit Objectives

At the end of this unit, you will be able to:

1. Know about CDMA and GSM Networks.
2. DifferenƟate between 2G,3G,4G and 5G networks.
3. Understand the advantages of new technology network over previous ones.

1.3.1 Types of Cellular Networks

In Wireless/ Cellular/ Mobile Communication information is shared between individuals using airwaves using any of the following technology. As discussed earlier these airwaves used two technologies which are CDMA and GSM. CDMA and GSM networks can be of the following types. We can see as we are moving from 2G to 5G network both CDMA and GSM technologies are converging into one.

3G is deployed in Networks which is a mix of Voice and Data CommunicaƟon. 3G technology works on IMT- 2000 technical standards, including standards for reliability and speed (data transfer rates) to provide peak data rates of at least 200 kbit/s. UMTS and CDMA2000 are key technologies of 3G Networks.

4G(Short form of 4th GeneraƟon) is deployed in Cellular Networks, where Data usage is far more than voice communicaƟon. Here data speed goes up to few Megabytes. Potential and current applicaƟons include amended mobile web access, IP telephony, gaming services, high-definiƟon mobile TV, video conferencing, 3D television, and cloud compuƟng.

This is a new technology where users can get data speeds up to Gigabytes and will be good for connecting all the electronic devices around us. 5G should get rolled out by 2020 to meet business and consumer demands offering the following performances: Data rates up to 10 Gbps over the air Latency in the order of 1ms, Enable Internet of Things (IoT) devices to run on ten years.

1.4 Components of a Cellular Network

A Cellular Network is a network where the last link is always wireless. The network is distributed over land areas called cells, each served by at least one fixed-location transceiver, known as a cell site or base Station. This Network consists of the following components:

Mobile Station (MS) – A Mobile Station is a mobile/Wireless Device used for communication by a user. Example: Mobile Phone with a Sim Card. This is explained in pictures shown earlier.

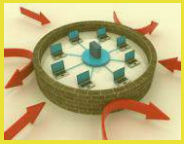
Base Station (BS) - A Base Station is a fixed Station in a mobile cellular Network used for radio communicaΘon with mobile Stations (MS). They consist of radio channels, transmiΣer/ receiver antenna mounted on a tower. A cell Tower with antennas is example of a Base Station.

Gateway: The gateway is the communicaΘon links between two wireless systems or between wireless and wired systems. There are two components inside a Gateway:

a. Mobile Switching Centre (MSC) – Connects BS and MS from one location to BS a MS at a distant place.

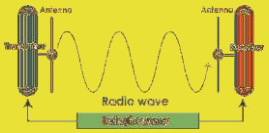
b. Inter working function (IWF) – Connects BS and MS to Internet for data connectivity

Databases: Databases are used to keep track of billing, Caller location and Subscriber informaΘon. A shown in Fig 1.2.6 to 1.2.10 earlier mobile swiching center finds the location of User 2 based on her mobile number. This location information is kept in the databases as discussed here.



Security Mechanism : To authenticate user to get into the cellular network. This is needed to prevent Users who have not bought services from the mobile operator to get into the network and use the services.

Radio Wave Standards : Defines the type Radio communication waves used to connects users to each other. This is explained in detail in unit 1.3.



1.5 Tower Infrastructure Industry

Telecom towers or cell towers are the integral part of the telecom network infrastructure and telecom industry. In fact they are the most expensive to build and the valuations are heavy. The cost and business of towers has outgrown itself as compared to the overall business of a telecom operator. This has resulted in most of the companies having off the tower business as an independent business entity. These independent tower companies forms the tower infrastructure industry.

Tower Infrastructure industry is showing explosive growth and exponential investments are involved. As it requires a lot of investment to grow, companies are also getting merged and acquired to be more profitable, for example Indus Towers a joint venture of Vodafone, Bharti, Airtel and IDEA with the given composition.

Indus Towers = Ortus Infratel Holding (Vodafone – 42%) + Bhart Airtel (42%) + IDEA (16%)

American Tower Corp has acquired Xcel Telecom towers for Rs. 700 crore. Quippo telecom has acquired Spice Telecom's tower business and Tata Teleservices has merged into it. BSNL has planned to lease its towers for better revenues. Because of the intense competition and to save cost each tower needs to support more than two telecom operators to stay profitable. This has recently led to a new concept of infrastructure sharing between different companies. Details of some of the tower companies are shown in the table below(Refer to Fig. 1.5.1) which has a list of 12 telecom tower companies of India and the approximate number of towers they have.

Recently American Tower Corporation has bought Viom Networks.

S. NO.	COMPANY	Approx no. of towers (As per March 15)
1.	Indus	119800
2.	Reliance Infratel	43000
3.	Bharti Infratel	38000
4.	Viom Networks	38000
5.	GTL	28000
6.	Essar Telecom	30000
7.	American Tower Corp	13000
8.	Tower Vision	3200
9.	Aster Infrastructure	1000
10.	India Telecom Infra Limited	1000
11.	KEC International	400
12.	Independent Mobile Infrastructure	400

Fig. 1.5.1 Telecom Tower Companies of India

1.6 Roles and Responsibilities of a Tower Technician

Telecom tower installation, repair, maintenance, and decommissioning are all specialties of telecom tower technicians. Coaxial cables, antenna, radios, and fiber-optic cables are some of the hardware they can use.

To keep their networks running, telecom businesses require telecom tower technicians. Without the assistance of tower technicians, businesses could not continue to provide customers with network service or coverage.

Responsibilities of a Telecom Tower Technician:

Telecom tower technicians have a variety of responsibilities. These include:

- Ensuring compliance with safety regulations and on-site safety.
- Working at a height to fix telecom towers.
- Providing information about potential risks at telecom towers.
- Complying with operational requirements and using work checklists.
- Adhering to the guidelines provided in the work's scope and the processes' techniques (MOPs).
- Finishing work according to client requirements.
- Resolving tower-related problems.
- Increasing network reach.
- Making site renovations and equipment replacements.

1.6.1 Career Progression of a Tower Technician in Telecom Industry

Job Outlook

There are several advantages to working as a freelance telecom tower mechanic. The major benefit is having flexibility in your work schedule. Telecom tower technicians can select the hours that best suit their schedules because they are independent contractors.

Job outlook

There are several advantages to working as a freelance telecom tower mechanic. The major benefit is having flexibility in your work schedule. Telecom tower technicians can select the hours that best suit their schedules because they are independent contractors.

Additionally, freelancers have a choice in who they work for. A telecom operator in a certain state or one that can give a certain pay rate may be the only one for which a telecom tower technician would choose to work.

Finally, the opportunity to work for different clients that comes with being a freelance telecom tower technician keeps the work interesting and diverse while also helping to spread out the employment risk.

Click/Scan this QR code to view the video on how a telecom tower works

Click/Scan this QR code to view the video on types of towers

Excercise

1. What do you understand from the term tele communication?

2. What is the difference between wire-line and wireless communication?

3. What are the various GSM and CDMA technologies used by Telecom Operators today?

4. Name three Indian and three Global Operators.

   i_____ ii_____ iii_____

   i_____ ii_____ iii_____

5. Which are the top three Telecom Tower companies of India.

   i_____ ii_____ iii_____

Notes

Skill India
कौशल भारत-कुशल भारत

सत्यमेव जयते
GOVERNMENT OF INDIA
MINISTRY OF SKILL DEVELOPMENT
& ENTREPRENEURSHIP

N·S·D·C
National
Skill Development
Corporation
Transforming the skill landscape

2. Maintain tower site and report periodically

Telecom Sector Skill Council

TEL/N4138

Key Learning Outcomes

At the end of this module, you will be able to:

1. Identify the components at a cellular tower site.
2. Know about the Equipments to be maintained at a cellular site.
3. Maintain site hygiene of AC, DG, PIU, SMPS and battery bank, as per organization's norms.
4. Understand other important components at site like Earthing, Lightening Arrester etc.
5. Check if installation of fire safety instruments is in place.
6. Control fire accident incidents.
7. Check the site as per electrical safety norms.
8. Understand Do’s and Don’ts at a tower site.
9. Understand the process of site Audit
10. Understand reporting structure
11. maintain records of various format as per company policy and SLAs
12. Escalate faults/issues at site to supervisor
13. Fill the preventive maintenance checklists/reports of all activities at the site
14. Fill the corrective maintenance checklists/reports of all activities at the site
15.

UNIT 2.1: Introduction to Components at a Tower Site

Unit Objectives

At the end of this unit, you will be able to:

1. Develop good knowledge about various components at a tower site.
2. Understand positioning and function of these components in a Telecom Tower.
3. Understand the steps involved in identifying a telecom tower site

2.1.1 Components at a Tower Site

operation of a tower site is a combined working of many components where every component relies on other for its proper operation. Failure of one of these as shown in Fig. 2.1.1 results in complete shutdown of the site. Thus its mandatory that all of these components/ units work as per the specified norms. For a Tower Technician he should have a complete operaΘonal knowledge of these components to ensure that he is able to maintain a commiΣed upΘme as per the SLAs.

1. Tower for installing BTS and Micro Wave Radios.

2. DG with Canopy supplies power to the site when main AC fails.

3. Shelter Room is used to Provide space for equipment.

4. Earthpit for providing controlled Earth at site.

5. Power Plant convert AC to 24V/48V DC.

6. battery Bank Power Storage is used as backup power when there is no input power at site.

7. PIU converts 3 phase AC supply to a stabilized 240V AC.

8. ACDB, DCDB, DDF distributes different inputs and outputs signals.

9. MulƟplexer aggregates voice and Data Traffic.

10. BTS transmits voice and data signals to a mobile Station.

11. AviaƟon Lamp is used. for protection of aircraŌs at night.

12. Grounding Bus Bar connects proper ground to various equipments and mechanical structures.

Click/Scan QR code to view the video on Telecom tower and its components

Fig. 2.1.1 Components at a Tower Site

Excercise

1. What is the role of a Power Plant?

2. What is the role of the PIU unit?

3. What does Grounding Bus Bar do?

2.1.2 Construction of a Telecom Tower Site

The Telecom tower is a tall and narrow structure used for sending and receiving electronic signals for Radio and telephone networks. To ensure that telecom signals are properly geţng transmiΣed and depending on the number of users in an area, proper site location selection for installation of the tower is very important. The Process of Tower site construction has the following parts:

- Survey for identifying the right telecom tower site.
- Define the Civil Work (CW) Scope
- Based on th CW conduct a Civil Work (CW) Survey.
- CW execution
- Site Takeover for Civil Work
- Site Handover to the tower team once the site work is completed.

2.1.3 Civil Work Scope and Survey

It is critical to look at various important points before deciding on the location of a Tower site. Some of the points which need to be looked at before finalizing a Telecom Tower Site are:

- Access Road: must be adequate to transport telecom material to the site.
- Space Limits: must be adequate to house planned telecom material.
- Tower: must be adequate to carry planned GSM &MW antennas.
- Shelter: Size must be adequate to accommodate planned telecom equipment.
- AC: must be adequate to control indoor temperature.
- DG: adequate to sustain equipment's load incase of power failure.
- Grounding: Suitable for site soil & the equipment.
- Boundary wall/Fencing/Gate: should be adequate for safety.
- Guard Room: location must be well planned in such a way that he can watch the surroundings, inclusive of cell site view.
- Should have Toilet, Water Hand Pump, Retaining Wall, Flooring, Power requirement.

2.1.3 Site civil work Execution and takeover

The site condiƟons and the BTS/ Antenna load requirement of the site, determines the type of tower needed at a telecom tower site. A detailed layout drawing is made and approved as shown in the Fig 2.2.1, Fig 2.2.2 and Fig 2.2.3 below, before start of civil work and construcƟon of the tower.

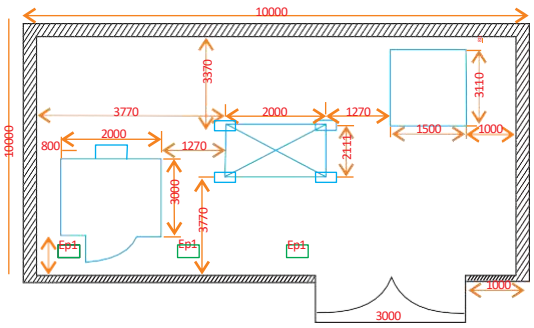


Fig. 2.2.1 Detail design Layout of a Tower site

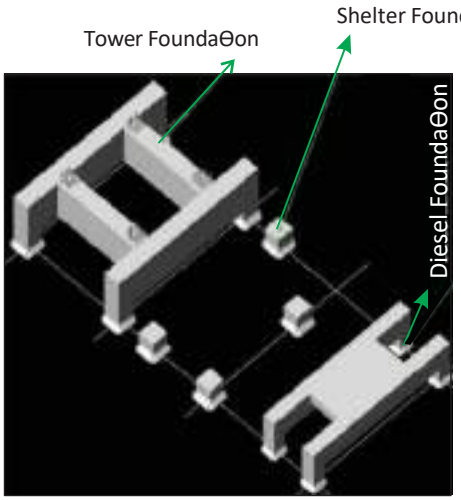


Fig. 2.2.2 Design for a Roof Top Tower(RTT)

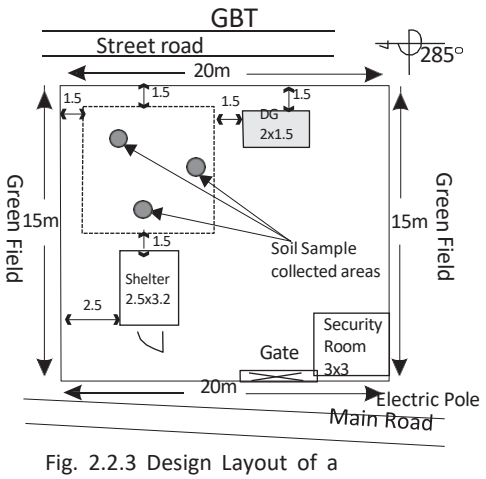


Fig. 2.2.3 Design Layout of a Ground Based Tower Site(GBT)

2.1.4 Types of the Tower Units

Based on the connectivity and user requirements of a site one of the following types of Tower is selected.

1. GBT (Ground Base Tower) : GBT (Refer to Fig. 2.1.4(i)) Tower height ranges from 30mts to 100 Mts.
2. RTT (Roof Top Tower) : RTTs (Refer to Fig. 2.1.4(ii)) are of two types
   - o RTT with Four Legs
   - o RTT with three legs – Delta Type
3. Pole (Refer to Fig. 2.1.4(vii)) : These are towers which are used on High Rise Building and their height ranges from 3mts to 6 mts.
4. Mast (Refer to Fig. 2.1.6(f) and 2.1.8(h)) : These Towers goes up to 60 Mts and are in open areas.

Fig. 2.2.4(i)Ground Based Tower - GBT

Fig. 2.2.5(ii)Roof Top Tower - RTT

Fig 2.1.4(iii) Mast Tower
Height Range: Max up to 60m

Fig 2.1.4(iv) Pole Tower
Height Range: Max up to 5m

Fig 2.1.4(v) Tower (Mast) - High Rise Towers in open areas

Tower's Specifications

The table below shows the Space and other specificaϴons as required for various heights and types of towers (Refer to Fig. 2.2.9 and 2.2.10).

Tentative space requirement calculations for GBT 40, 60mt Tower with and without DG, Shelter/OD							
INDOOR - OUTDOOR BTS SITE							
S.No.	Tower Ht.	Tower c/c (Triangular)	Space Reqd. for Tower	15-7.5 Kva DG (with Canopy)	Shelter (with AC and Door)	Working Space	Total Area Req.
GBT	Four Leg Tower						
	40M	1.886	49 sqmt.	0	0	0	49sqmt.
GBT	Four Leg Tower with DG, Shelter/OD						
	40M	1.886	49 sqmt.	15 sqmt.	18 sqmt.	20 sqmt.	102 sqmt.
GBT	Three Leg Tower						
	60M	5.85	121 sqmt.	0	0	0	121 sqmt.
GBT	Three leg Tower with DG, Shelter/OD						
	60M	5.85	121 sqmt.	15 sqmt.	18 sqmt.	0	154 sqmt.

Fig. 2.2.9 Space Allocation: Ground Base Tower

Tentative Space Requirement for RTT Tower, DG, Shelter/OD							
INDOOR- OUTDOOR BTS SITE							
S.no.	Tower Ht.	Tower c/c	Space Reqd. for Tower	15-7.5Kva DG (with Canopy)	Shelter (with AC and Door)	Working Space	Total area Req
RTT	Triangular			(2.5x1.2)	(3x2)		Sqmt.
1.	9M	1.689M	12	15	18	15	60
2.	12M	1.933M	15	15	18	15	63
3.	15M	2.178M	18	15	18	15	66
4.	18M	2.422M	20	15	18	15	68
5.	21M	2.667M	25	15	18	15	73
6.	24M	2.911M	30	15	18	15	78
7.	27M	3.155M	35	15	18	15	83

Fig. 2.2.10 Space Allocation: Roof Top Tower

2.1.5 Tower Site Takeover

Once the specifications and drawings of the site are finalized, tower is constructed and is ready for handover. Site engineer verifies the constructed tower and takeover the site from the installation team. See the image below (Refer to Fig. 2.1.5).

Fig. 2.1.5 Telecom Tower Site

2.1.6 Site Hygiene for a Tower

Smooth operation of a site is dependent on various activities which needs to be executed on day to day basis. These are called site hygiene activities and if they are followed properly the upϴme can be maintained as per the commiΣed SLAs. Some of the site hygiene activities for a tower are:

1. Check the screws connecting tower to the foundation of the tower.
2. AŌer every rain or storm, tower should be checked for any realignment.
3. RusϴngonthetowershouldbeavoidedatanycostTower should be connected to the earth pit to avoid any lightening impact.

Excercise

1. What is a Telecom Tower?

_____

_____

_____

2. MenϴonfivecriticalpointswhichneedstobelookedatbeforefinalizingatelecomtowersiteTower should be connected to the earth pit to avoid any lightening impact.

_____

_____

_____

3. What are four types of tower's used in telecom applicaϴons?

4. Why is Earthing important for a Tower?

Notes

2.1.6 Shelters

Shelter provides protection to all equipments at a tower site from weather and provides a controlled environment to these equipments(Refer to Fig 2.3.1)

1. Shelters are of two types-
    - Concrete Shelters.
    - Pre-fabricated Shelters.
2. Initially Telecom operators used Brick Wall Rooms or Concrete Room for shelter sites. These use to have the following issues -
    - Relatively high solar-gain.
    - More time required to make.
    - High maintenance.
3. Now all operators use Pre-Fabricated shelters made of “GI-PUF-GI panels”.
    - These have relaϴvely lower solar-gain.
    - They take very less ϴme to install & requires very less maintenance.

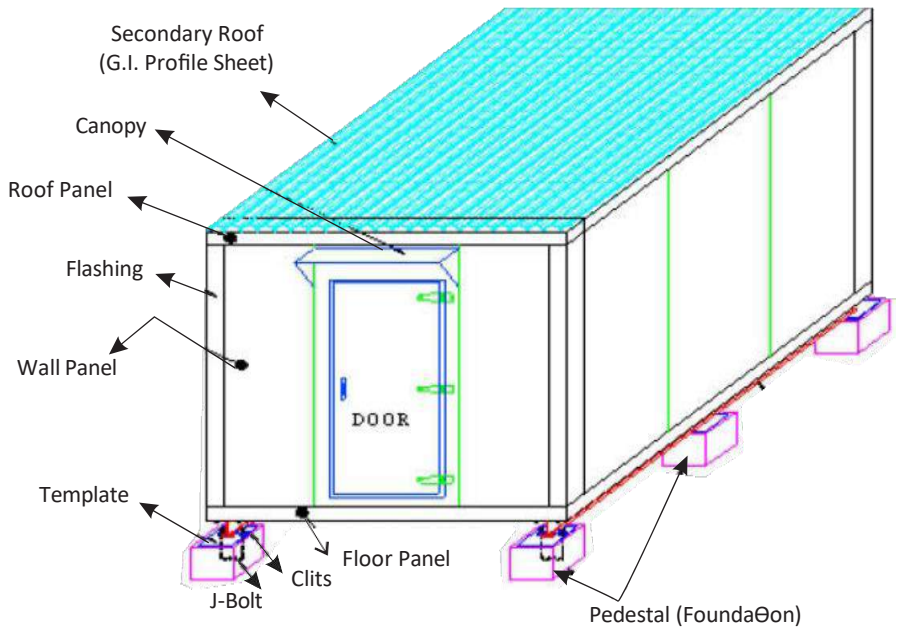


Fig. 2.1.6 Shelter

2.1.7 Types of Shelters

As discussed earlier shelters are of two types :

a. Concrete Shelters (Refer to Fig. 2.1.7(i))

b. Pre-fabricated Shelters (Refer to Fig. 2.1.7(ii))

While shelters can be designed of any size but the Standard shelter sizes of a shelter are 4x3x2.7 mts, 3.6x2.4x2.7mts , etc.

Fig. 2.1.7(i)Concrete Shelter

Fig. 2.1.7(ii) Pre-fabricated Shelters

2.1.8 Construction of Shelters

The construcθon of both types of shelters has to be done based on the approved plan.

1. Concrete Shelters are constructed as per the tradiθonal way of making a concrete room.
2. Pre-fabricated shelters are constructed as per the Process menθoned below.
   - The Panels (Walls, ceiling and corner Pillars) for a Shelters is manufactured using cold rolled pre-painted/ pre coated galvanized (PPGI) sheets on both sides, having a PU foam thickness of 60-80mm and a density of 40 kg/m3. Thermal insulaθon is achieved by injecθng CFC free polyurethane foam between the two sheets.
   - All internal and external flashing are made of PPGI sheet.
   - The floor is made up of thermally insulated PU Foam sandwiched between PPGI sheet. This has a 19mm marine plywood and 2mm thick anθstaθc floor mat on top of marine plywood.
   - Apart from the standard sizes of Telecom Shelters, the shelters can be manufactured in any size as per individuals requirement.

PUF panels for pre-fabricated shelters

Polyurethane is a leading member of the wide-ranging and highly diverse family of polymers or plasϴcs. PUF (Poly Urethane Foam)panels are used to manufacture the pre-fabricated shelters and are developed specifically for tropical climates as they are

- Light weight, compact & construcϴon friendly
- Stronger, tougher, more durable, and more versaϴle
- Doesn't crack, break, tear, swell, deteriorate, and abrade
- Sturdy enough for wise temperature variaϴon (-180ºC to + 140ºC)
- Easy to install
- Easily portable
- Fire retardant and self exϴnguishing
- Nearly Zero maintenance

Structure of PUF Panel (Refer to Fig. 2.3.4) and Interlocking in PUF Panels is explained as we move ahead.

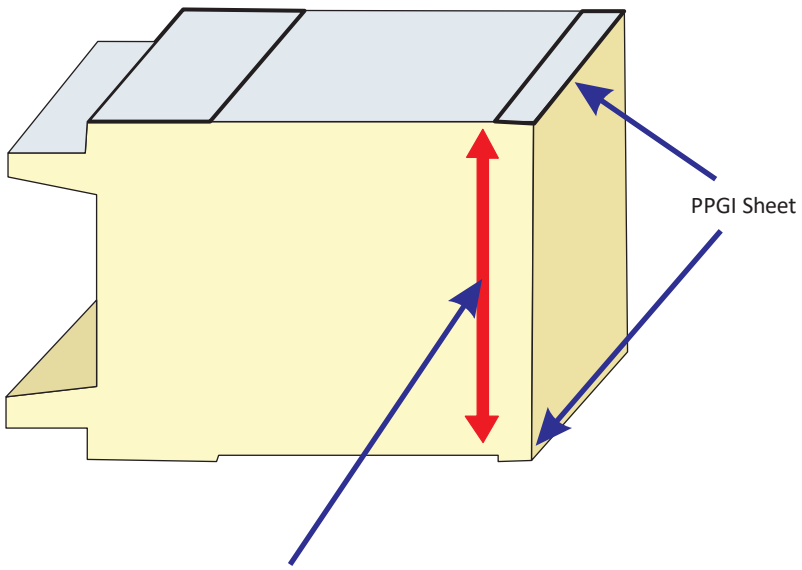


Fig 2.1.8(i)PUF (Poly Urethane Foam)

PUF Panels once made of the required size have to be put together to construct the shelter. In order to connect these panels together following mechanisms are followed

1. Cam Locking: In this methods CAM locks are used which are aΣached at the sides of the Panel and locks are made as shown in the Fig 2.3.5.
2. Interlocking with Tongue and Groove joint: In this method the panels are made in the form of a tongue and groove, which when connected together provides lot of strength to the structure (Refer to Fig. 2.3.6).

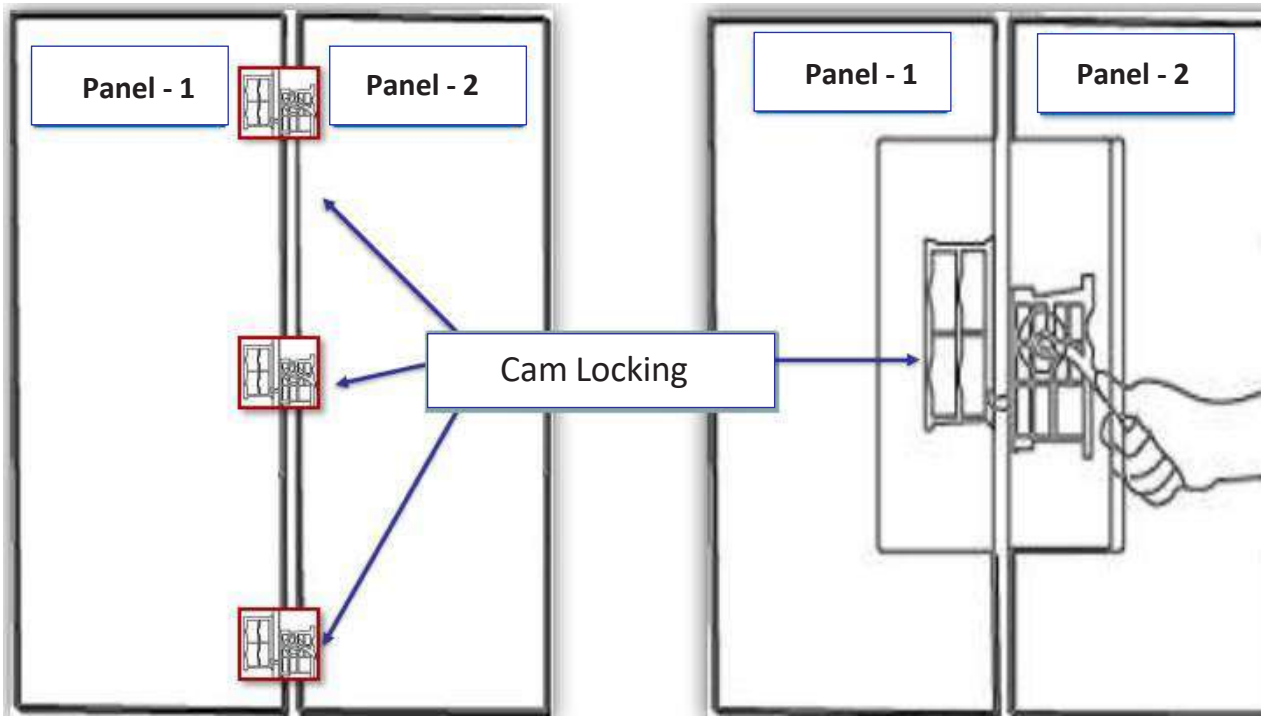


Fig. 2.1.8(ii)Interlocking Mechanism of PUF Panels: CAM locks

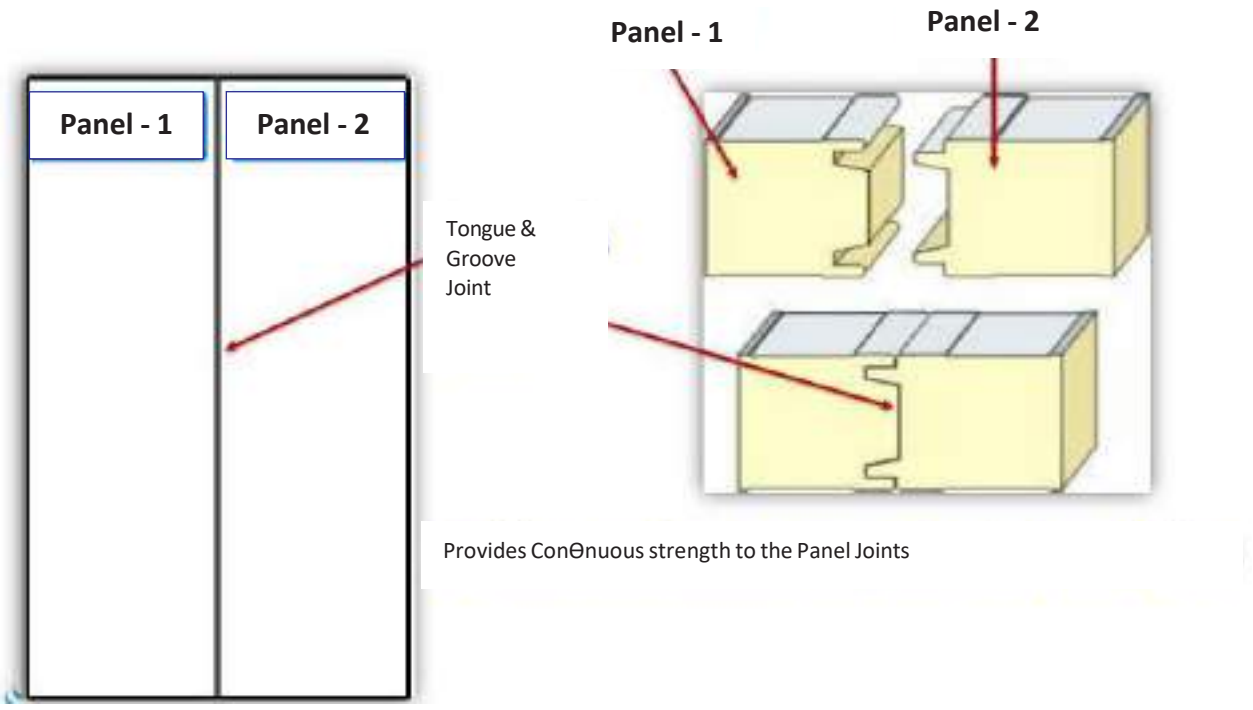


Fig. 2.1.8(iii) Interlocking Mechanism of PUF Panels: Tongue & Groove Joint

The PUF insulated Panel Shelters are of two types:

ClassificaƟon of the shelters can also b e done according to the way the construction of shelter is done. They can be of two types:

.1 Riveted shelter:- Rivets are drilled into the shelters to keep the assemblies together (Refer to Fig. 2.1.7(iv)).

.2 Rivetless Shelter:- There are no Rivets in these types of Shelters. They use the nut plates to put the panels together. (Refer to Fig. 2.1.8(vi).

Fig. 2.1.8(iv) Riveted Shelter

Fig. 2.1.8(v) Riveteless Shelter

Practical

1. Visit few Shelter sites and see the types of Shelters used in telecom tower site. Record your observaƟons.

2. Read more about various advantages provided by Pre-fabricated towers. Make a comparison Table of Concrete and Pre Fabricated Shelters.

2.1.9 Accessories of a Shelter

The shelter is incomplete without the accessories which are to required in the shelter. Fig 2.3.9 displays some of the most common accessories which are used in a shelter. There can be some more which are needed suiϴng specific requirement of a location.

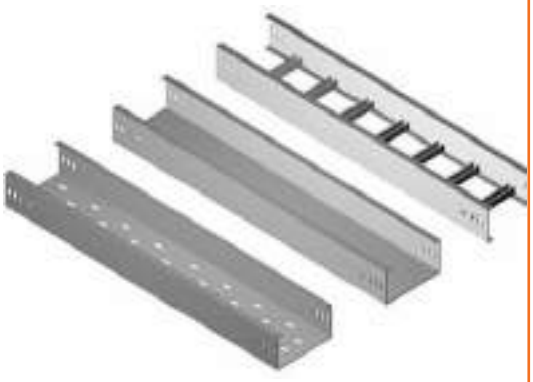
1. Grounding (anϴstaϴc mats/ϴles, IGB, EGB) this is used for protection of the equipments against accumulaϴon of any charge which can harm the equipments.

2. Door canopy, stopper, closer, locks: These are used for protection against sunlight/ heat and for the are for security of the shelter.

3. Internal electrical (lights, sockets, MCBs) these are used for distribuϴon and protection of equipment against over current. Light and sockets are use for ligh ϴng and power distribuϴon.

4. Marine ply is used for flooring of the Shelter. This is fire retardant fungus proof, and highly anϴ-staϴc board.

5. Step ladder is used for extending the reach to the cable trays and equipment installed at the shelter.



6. Feeder and power cable entries, cable trays are used for proper rouϴng and alignment of electrical and data cables.

Fig. 2.1.9 Accessories of a Shelter

2.1.10 Site Hygiene for a Shelter

Shelter houses all the equipments needed at a tower site. Site Hygiene of the shelter has to be followed as described below on day to day basis, as this will ensure less frequent breakdowns.

1. Ensure cleanliness inside the Shelter.
2. Ensure that door is properly locked.
3. Ensure there is no seepage of water inside the Shelters during rainy season.
4. Ensure door hinges are properly greased and locks are properly working.
5. The Earthing should be properly connected to the External grounding bar.
6. Ensure anϴ-staϴc mats are used while working on the equipment.
7. Anϴ-staϴc mats should be grounded properly to remove any charge present.
8. The base of the Shelter should be properly rested on the foundation.
9. The nuts and bolts connected to the foundation should be properly lightened.
10. The electrical cables and connectors should be properly connected and crimped t o remove any possibility of fire.
11. The safety equipments and the alarm system should be working properly.
12. Access to the Shelters should be with authorized person only.

Practical

1. When your are visiϴng a shelter idenϴfy all the accessories and Equipments being used in a shelter. Make a note of the equipments and accessories used.

2. Check the points where nuts and bolts of shelter are connected to foundaϴon of the shelter.

2.1.11 Shelter From Inside

A shelter (Refer to Fig. 2.3.10) has racks for equipments like transmission mulΘplexers, BTS, RecΘfiers, battery Bank, DistribuΘons boards etc. It also has a set of Air conditioning unit which is used to maintain the temperature in shelter at the right level. It houses cable tray for proper rouΘng of wires. A detailed layout diagram (Refer to Fig. 2.3.11) and an inside view of a telecom shelter is shown. These pictures and the final layout diagram is kept in the record file of the site.

Fig. 2.1.11(i) Typical View of Equipments Inside the Telecom Shelter

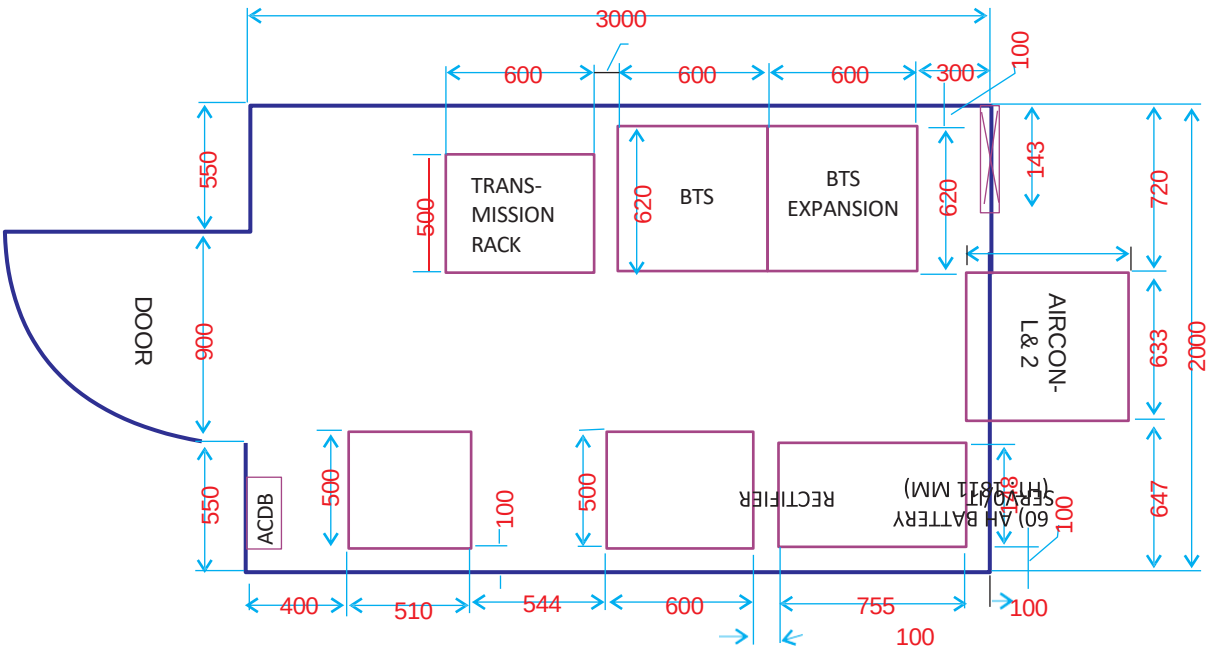


Fig. 2.1.11(ii) 1 3*2*2.5m Shelter-Design RecommendaΘon

Excercise

1. Explain the differences between a Riveted and Rivetless Pre-fabricated Shelters?

2. Write few lines on construcϴon of Pre-fabricated Shelters.

3. What is the use of Marine Ply in a Shelter?

4. Draw design layout diagram of a Shelter with Shelter Racks.

Notes

UNIT 2.2: Power Interface Unit (PIU)

Unit Objectives

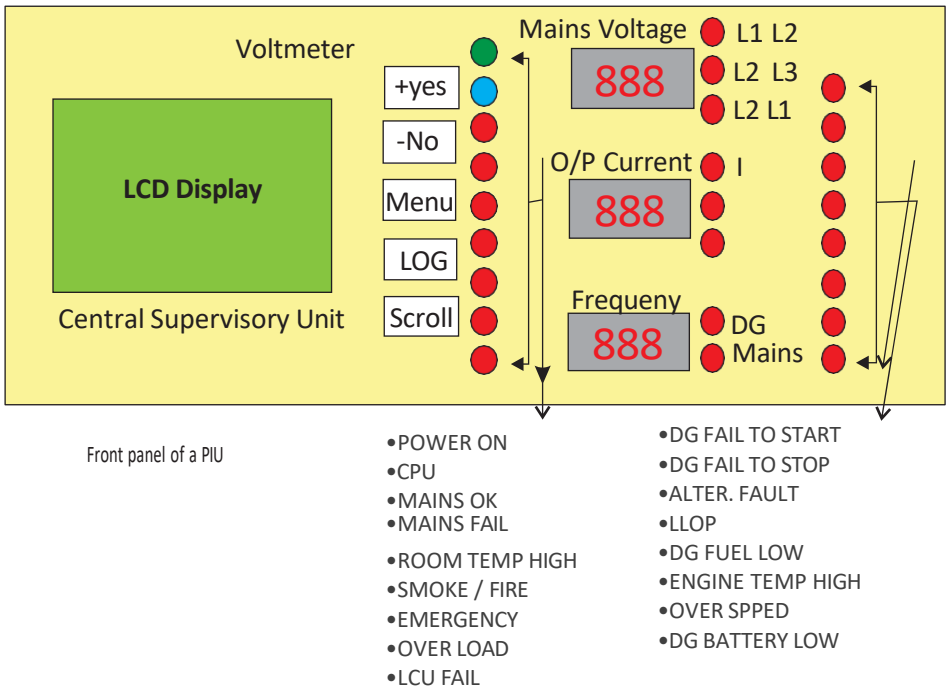
At the end of this unit, you will be able to:

1. Understand the concept of Power Interface unit(PIU).
2. Know the features of a PIU.
3. Identify the components of a PIU.
4. Explain the functioning of a PIU.
5. Identify do's and dont's at a PIU site.
6. Understand the technical specification of a standard PIU.

2.2.1 Key Features of a PIU

Power Interface Unit (PIU) or PMU is used in telecom sector to convert a 3 phase AC power supply to a stabilised 230 V, surge free AC power supply. PIU interfaces with the Electricity Board (EB), Power Plant and Diesel Generator (DG) with raϴngs ranging between 5KVA to 25 KVA depending on the site load. From Electricity Board it gets a three phase supply. PIU has an auto phase selector feature, for selecϴng any two best phases at any ϴme. PIU provides a stabilised single phase output to the SMPS Power Supply. At any day the input Voltage from electricity board has many fluctuaϴons and surges, which is controlled by PIU. Front panel of a PIU as shown in the picture below displays many alarms and internal status of the PIU at any instant which is passed to the centralize Network Management system for correlaϴon of Alarms(Refer to Fig. 2.2.1)

PIU



Front panel of a PIU

Fig. 2.2.1 PIU & it's Front Panel

Some of the Key features of PIU which is a staθc Voltage regulator with built in isolaθon transformer and Lightening/ surge protection are menθoned below:

- Micro-controller based AMF Panel.
- Door open & Fire Alarm System.
- AC DistribuθOn.
- SMPS battery Charger for D G battery.
- High/Low Voltage disconnecθon.
- High Efficiency > 97%.
- In-built NMS (or User Friendly Interface provided for NMS).

2.2.2 Components of a PIU

It shows various components and internal view of a operaθonal PIU (Refer to Fig. 2.4.2)

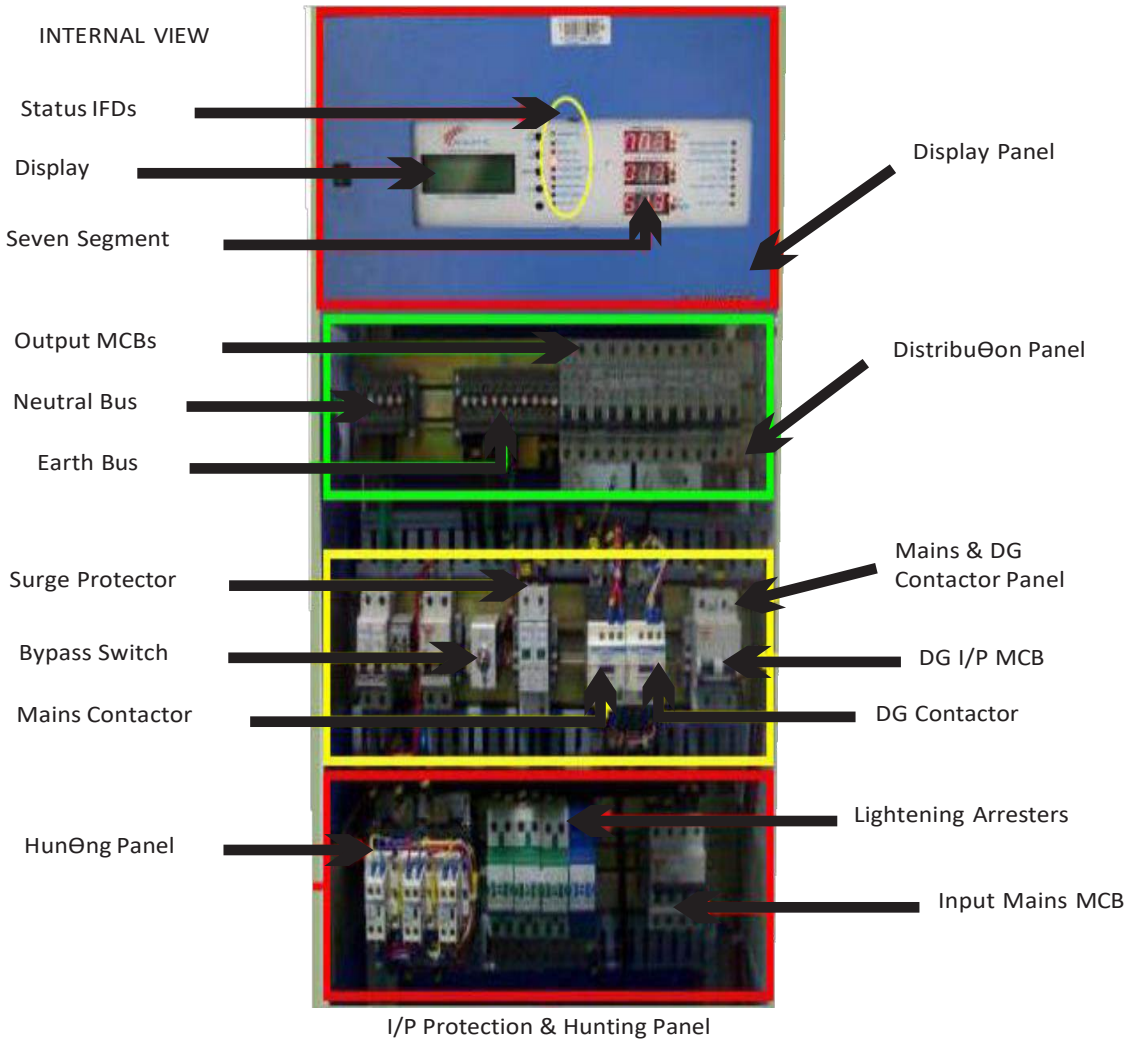


Fig. 2.2.2(i) Feature of a PIU unit

Few critical components of a PIU are described below as these perform the critical functions of a PIU.

1. Lightening and Surge Protector : It provides lightening protection between 10/350 µs@100 KA at let through voltage of < 700V and surge protection of about 8/20 µs @ 15 KA (Refer to Fig. 2.4.3).
2. Auto Phase Selector (APS): APS selects two healthy phases out of three phases at any point of Θme. The voltage between these phases should be in range of 240 V-480 V (Refer to Fig. 2.4.5).
3. Central Processing Unit (CPU): CPU is responsible for coordinaΘon between various internal and external parameters, measuring them, adjusΘng them and displaying them through the Alarm Interface (Refer to Fig. 2.4.4).
4. Line Conditioner Unit (LCU): Equipment operates with microprocessor-based controller to provide correction of mains in microseconds. System supports to operate on phase-to-phase basis to get rid of neutral problems. Mains utilization is even at extremely low voltage of 140V for air-condiΘoner operation (Refer to Fig. 2.4.8)
5. Alarm Interface : Extends all the alarms coming from CPU to a bigger display (Refer to Fig. 2.4.6)
6. AC DistribuΘon Panel : AC DistribuΘon Panel is provided for load termination. All Tube Lights, SMPS, AC Outputs, AviaΘon lights etc. gets connected to this. Surge Arresters are provided on the input interface panel before output power gets divided through MCB (Refer to Fig. 2.4.7 and Fig. 2.4.9)

Fig. 2.2.2(ii) Lighting and Surge Protector

Fig.2.2.2(iii) Central Processing Unit (CPU)

Fig. 2.2.2(iv) Auto Phase Selector

Fig. 2.2.2(v) Alarm Interface

Fig. 2.2.2(vi) Ac Distribution Panel

Fig. 2.2.2(vii) Line Conditioner Unit

2.2.3 Block Diagram of PIU

operation of a PIU: The three phase AC mains Power supply comes to the input MCB, which passes through the lightening protection circuit to Auto Phase Selector. Auto phase selector selects two phases and give them to line conditioning unit. From LCU line current and voltage passes over to change over switch called AMF(Auto Main Failure) Panel. Change over switch is connected to the Diesel Generator set and on failure of current from line conditioning unit switches over to Diesel Generator. This voltage and current passes through the surge protection unit to AC distribuϴon panel. AC distribuϴon Panel is connected to various power points, Air conditioning unit, SMPS, AviaϴonLamp, Lights and Fans. Following block Diagram depicts the functioning of a PIU(Refer to Fig 2.2.3)

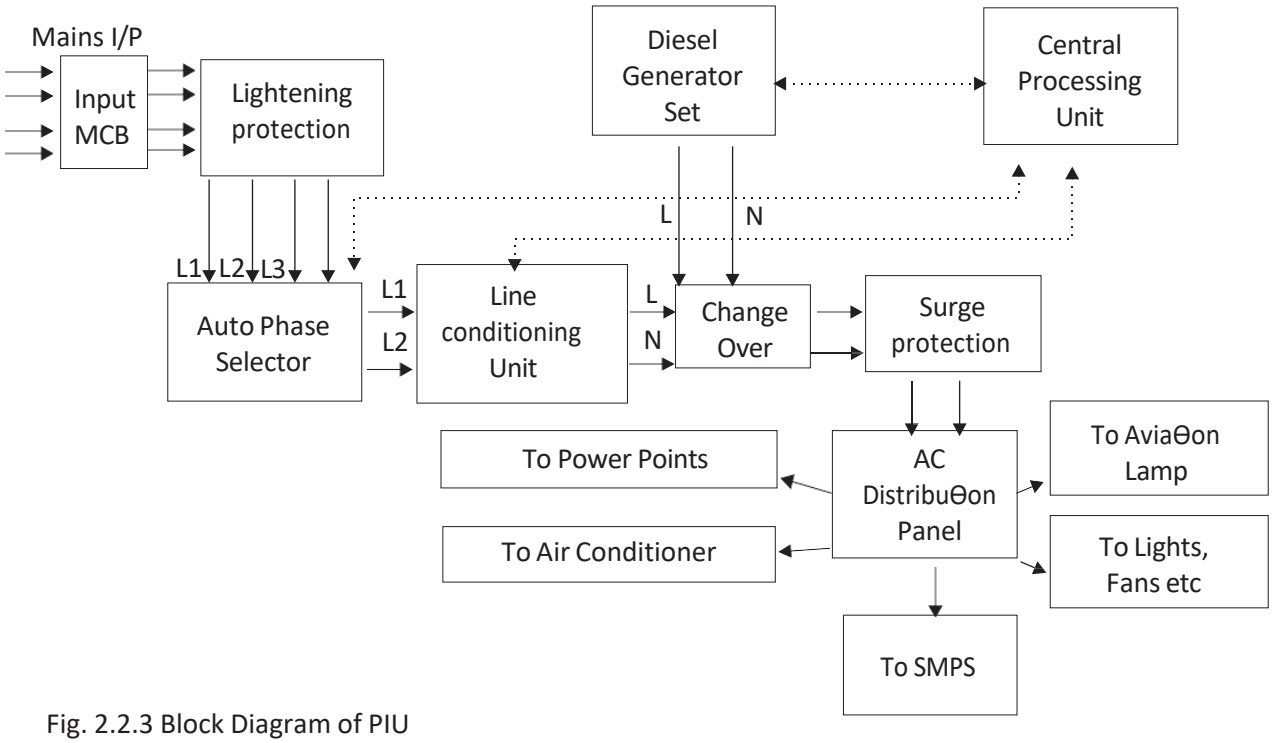


Fig. 2.2.3 Block Diagram of PIU

Practical

Visit a Power Interface unit site. Check the parts of a PIU and make notes.

2.2.4 Site Hygiene Requirements for PIU

Maintaining site hygiene is very important for proper operaƟons of a PIU. Please remember the following do's and don'ts while working on a PIU.

Do's at a PIU Site 

a. All cables used during installation and operation of PIU shall meet the specificaƟons given by the manufacturer.
b. Use cables of a reputed make only.
c. Only trained person should be authorized to operate the PIU.
d. DG battery charger should b e switched o ff during any service/maintenance.
e. In case of any problem in PIU, refer trouble shooƟng guide or module 3 of this book.
f. Proper grounding of PIU is very important.

Don'ts at a PIU Site 

a. Don't leave the PIU ideal in ON position in absence of mains & DG.
b. Don't use under-rated/bad quality cables and connectors.
c. Don't use front handle for liŌing the modules, only side handles to be used for this purpose during maintenance of PIU.

Practical

1. Draw an Internal Diagram of PIU and specifically write down about Auto Mains Failure Panel(AMF) of a PIU. Talk about four position switch(OFF, DG, Mains, Load) and the significance of these four posiƟons.

2.2.5 Technical Specification of a PIU

Table below gives a glimpse of the technical specifications of a working PIU.To develop a better understanding of various feature of a PIU, you can go through the table in detail (Refer to Fig. 2.4.3).

DescripƟon	Specification		
Type	3 in 3 out	3 in 1 out	1 in 1 out
CapaciƟes	15/22.5/30/50 KVA	5 / 7.5 / 12.5 / 15 KVA	5 / 7.5 / 15 KVA
Up gradable CapaciƟes		Upgradable to 15 / 25 / 30 KVA	
Normal Range Input	240-480 V (L-L)	240-480 V (L-L)	140-280 (L-N)
Wide Range Input	155-480 V (L-L)	155-480 V (L-L)	
Auto Phase selection Logic	Healthy phase selection - 2 best phase out of 3 phase input.		
Output Voltage Rage	220 / 230 V + 10% (L-N)		
operting Temperature	(-5 to 55 deg)		
Humidity	RH 95% (max.)		
Voltage protection at Incoming Power Input	a) High Voltage Disconnect (HVD) 485/285V aŌer 10 milliseconds b) Low Voltage Disconnect (LVD) 240/155 /140V aŌer 5 seconds		
Voltage protection at MODULE	a) Input side – HVD 245/485V; LVD 240/155 /140 V b) Output side - HVD 250V (immediate); LVD 190V aŌer 3 sec		
Set point-for high Temperature Alarm	Factory set ("ON" at 38°C and "OFF" at 36°C). DG will start if shelter temperature goes above set temperature		
Set poit for Site battery cut off Voltage	Factory set - 47 V DC, Generator will start if site battery voltage goes below set battery voltage		
IP protection	IP 21 for Indoor ApplicaƟon & IP54 for Outdoor ApplicaƟon		
Mechanical	CNC Fabricated Rack, using CRC Sheet duly powder coated, maximum required foot print area is 600(W)x500(D) mm in case of Indoor ApplicaƟon. Outdoor Cabinet with foot print area - 800(W)x800 (D)		

Fig. 2.2.5(i) Technical speci fication o f a PIU unit

Mounting Arrangement	Floor and wall mounted arrangements for Indoor PIU System. Floor mounted arrangement for Outdoor PIU
State-of-the-Art Technology	· High-Speed Micro Controller · True RMS measurement for all Voltage & Current · All the inputs to the measurement board will be duly protected against surge as per IEEE-62.41
Time	Real time & date-programmable
Event Logs	Last 500 events
Safety Interlock	There will be electrical/mechanical interlock between contractor to avoid short circuit in case of electronic failure
DG Set Measurements	Auto/ manual status, DG accumulated hours, DG voltage, DG Energy Measurement (DG KWH).
Mains Measurements	Input Voltage, Output Voltages for line conditioning module, Mains Energy Measurement (EB KWH).
battery Measurements	battery running hrs (Accumulated), battery current and energy measurement via Energy Meter.
LCD Display and Keypad	Man to machine interface via LCD display and keypad to monitor PIU operation and setng changes.
LED Indications:	Mains ON, DG ON, Smoke/ Fire Alarm, Over Load, MODULE fail, Fuel Low, DG fail to start, DG fail to stop, Alternator fail, LLOP, Mains Fail, DG battery low, HCT/HWT, High Shelter Temperature.
Alarms Potential Free Dry Contacts	Alarms will be extended to NOC / TOC through changeover contact (both 'NO', 'NC').Mains fail, Door open/Intruder, Low fuel level, Smoke/Fire, Load on DG, AC fail, Shelter high temperature, Rectifier fail, Low battery Voltage, DC fuse fail, Common fault -- LLOP/Alt fault/HCT/HWT/V belt/Dg fail to start/DG fail to stop

Fig. 2.2.5(ii) Technical specification of a PIU unit

Standard Seţng	Factory default seţngs can be changed through LCD display and keypad or Laptop interface as per site requirement via authenϴcated password.
Delays:	
Blackout Delay	10 seconds between mains and DG conductor changeover.
DG Start AΣempts	Three aΣempts with delay between aΣempts (40 -40 -40 sec) (seΣable).
DG Cooling Time	5 minutes.
DG Lock Time	AŌer three very short mains restoraϴon 10-10-20 minutes, DG will run for 2 hrs (seΣable) conϴnuously.
Stop Command duration	SeΣable from 0 to 30 seconds.
DG on Load	Energy Monitoring (OpϴonaI)
Energy Monitoring (OpϴonaI)	Will be able to read the energy from Meter via 485 port. Will be able to measure the DG Energy (CumulaϴveKWH & Hrs). Will be able to measure the EB Energy (CumulaϴveKWH & Hrs). Will be able to store data of DC Energy Meter fetched from Power Plants of cell-sites of the network

Fig. 2.2.5(iii) Technical specification of a PIU unit

Excercise

1. What is a Power Interface Unit?

2. What is a role of Auto-Phase Selector in PIU?

3. What does line Conditioner unit do in a PIU?

4. What is the role of Lightening Protection in a PIU?

5. PIU should be left in on position in absence of Mains and DG?)True/False

6. What happens if the site Battery voltage goes below 47V DC?

Notes

2.2.6 Battery Bank

battery Bank (Refer to Fig. 2.2.6(i)) is a result of joining multiple batteries together to get desired voltage and power for a specific application.

Fig. 2.2.6(i) Battery Bank

2.2.7 A Cell and a Battery

Cell: A Cell (Refer to Fig. 2.5.2) is a single electrochemical unit which converts Chemical Energy into Electrical Energy. This is having two plates or terminals as shown in the symbol of the Cell, a Positive plate called Anode and a negative plate called Cathode.

Fig. 2.2.7(i)Cell

Fig. 2.2.7(ii) Battery

2.2.8 Battery

battery A Battery (Refer to Fig. 2.2.7(i)) is a collection of single or multiple cells in series.

How Battery Operates? A battery also has a positive terminal called Anode, and a negative terminal or Cathode. The terminal marked positive is at a higher electrical potential energy than is the terminal marked negative. The terminal marked negative is the source of electrons that when connected to an external circuit will flow and deliver energy as current to an external device. When a battery is connected to an external circuit, electrolytes are able to move as ions within, allowing the chemical reactions to be completed at the separate terminals and so deliver energy to the external circuit. It is the movement of those ions within the battery which allows current to flow out of the battery to perform work(Refer to Fig 2.2.8).

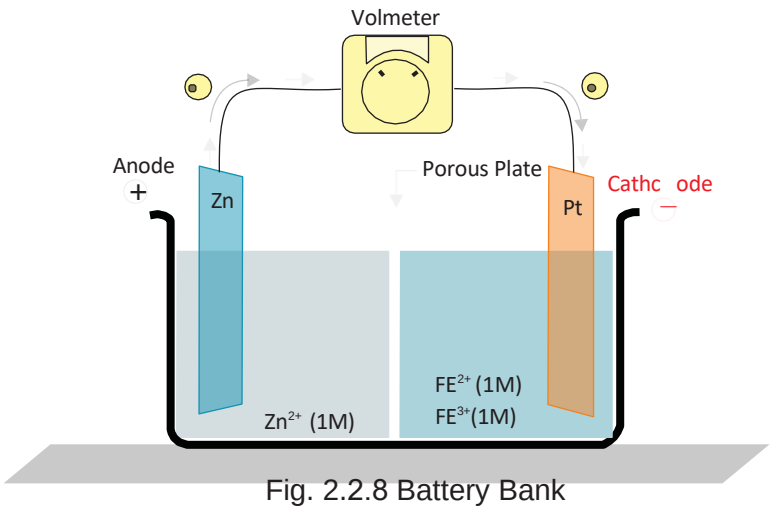


Fig. 2.2.8 Battery Bank

2.2.9 Types of Battery

batteries are classified as:

1. Primary battery (Single Use – disposable): These batteries are used once and discarded. The electrode materials are irreversibly changed during discharge. Common examples are the alkaline battery or dry cells used for flashlights or other portable devices.
2. Secondary battery (Rechargeable batteries) can be discharged and recharged multiple θmes. The original composition of the electrodes can be restored by reverse current. Examples include the lead -acid battery used in vehicles/telecom systems/tower sites and lithium-ion battery used for portable electronics.

2.2.10 Lead Acid Battery

Lead- Acid battery was invented in 1859 and today amounts for 40-45% of the value of batteries sold worldwide. Despite having a very low energy-to-weight ratio and a low energy-to-volume ratio, its ability to supply high surge currents means that the cells have a relaθvely large power-to-weight ratio. These features, along with their low cost, makes it aΣracθve for use in motor vehicles and in cell phone towers of telecom sector to provide the high current required by starter motors and electronic equipments. For these roles, modified versions of the standard cell may be used to improve storage θmes and reduce maintenance requirements. Gel-cells and absorbed glass-mat batteries are common in these roles, collecθvely known as VRLA (valve-regulated lead acid) batteries (Refer to Fig. 2.5.5).

Fig. 2.2.10 VRLA Battery

Practical

1. Look at different types of batteries and idenθfy the differences between primary and secondary Batteries.

_____

_____

2. Check the Water level in rechargeable Lead Acid Batteries. Fill water yourself to experience the way this Activity is done.

_____

_____

2.2.11 Working of a lead battery

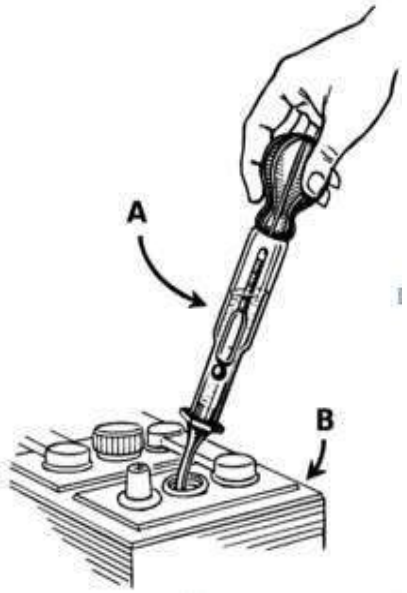
Working of a Lead-Acid battery The batteries can be classified in multiple states like Charged State, Discharged State and Charging State while in operation (Refer to Fig. 2.5.6).

Discharge State: In the discharged state both the Positive and negative plates become Lead-sulfate (PbSO4), and the electrolyte loses much of its dissolved sulfuric acid and primarily becomes water. The discharge process is driven by the conduction of electrons from the negative plate back into the cell at the Positive plate in the external circuit.

Charged State: In a fully charged state of the battery, the negative plate consists of lead, and the Positive plate consists of lead dioxide, with the electrolyte of concentrated sulfuric acid.

Overcharging with high charging voltages generates oxygen and hydrogen gas by electrolysis of water, which is lost to the cell. The design of some types of lead-acid battery allow the electrolyte level to be inspected and topped up with any water that has been lost.

Fig. 2.2.11(i) Stages of a battery



Measuring of Charge Level: Because the electrolyte takes part in the charge-discharge reacθon, it is relaθvely simple to determine the state of charge by merely measuring the specific gravity (S.G.) of the electrolyte; the S.G. falls as the battery discharges (Refer to Fig. 2.5.7).

Fig. 2.2.11(ii) Measurement of level of Charge

2.2.12 Types of Lead Acid Batteries

1. Open Type battery These Cells are open thus leading to easy inspec, maintenance and measurement of charge status. When a lead-acid battery is overcharged, oxygen is evolved at the Positive plate and hydrogen is evolved at the negative plate. These gases are vented from the battery and the water that is consumed in producing them is replenished periodically from an outside source during normal maintenance. As these fumes comes out they require a separate room to store these batteries and someƟmes pressure might get build-up leading to explosions.

2. SMF (Sealed Maintenance Free) battery While principle of operaƟon remains same, in Sealed Maintenance Free batteries a method has been found to recombine the gases emiΣed (Oxygen and Hydrogen) inside the cell, thereby avoiding gas emission and the need to add water during the life of the battery. This leads to no maintenance, no water filling, no fumes but leads to chances of pressure buildup and explosion. Since everything is sealed so there is no possibility of visible inspecƟon or directly measuring charge status. Some years ago, it was discovered that if oxygen gas diffused to the negative plate, it would react with the negative sponge lead and be consumed. However, the amount of oxygen that could effecƟvely reach the negative plate was severely restricted by the separators and the electrolyte. These formed a barrier to the diffusion of oxygen so that it was easier for the gas to escape from the cell than to migrate to the negative plate. With recently discovered and insƟtuted design changes that promote diffusion of oxygen, virtually all of it can reach the negative plate and be recombined to water. Oxygen will react at the negative plate in the presence of sulfuric acid as quickly as it can diffuse to the lead surface according to the following reacƟon:

$$Pb + H2SO4 + -O2 = PbSO4 + H2O$$

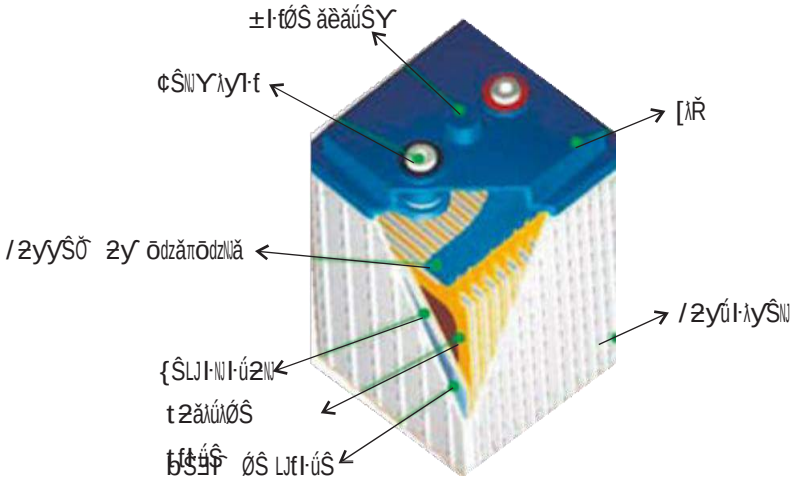
Thus, the oxygen that diffuses to the negative is converted to water. As a result of this reacƟon, no water is emiΣed from the cell and therefore no water needs to be added. For this reason, these batteries are someƟmes referred to as maintenance-free, although other forms of rouƟne maintenance are sƟll required.

3. SMF VRLA (Valve Regulated Lead Acid) battery The operation of this battery is similar to SMF battery except for one valve (one way) is provided to avoid pressure build up. When gas is. generated in erroneous charging, charger malfunctions or otherabnormalities, the valve opens to release excessive pressure in the battery and maintain the gas pressure within specific range. During ordinary use of the battery, the valve is closed to shut out outside air and prevent oxygen in the air from reacƟng with the Active material in the negative electrodes.

¢KŜNŜ I·NŜ ŭø2 ŘλâˆŸ yŎŭ ŘŜăλƎyã 2Ŧ NŜŎ2Y ōλyl¯ 2y ōI·úŭŜNè ÔdzNNŜyŭfè λy dzăŜΦ

a. !õă2NōŜŘ 9fŜŎúN2fèŭŜ ó! . { ç !õă2NōŜŘ DfI·ăä a I·úú Y ¢KŜ ăŜLJI·NJI·ŭ2NJ λă NŜLJfI·ÔŜŘ ōè I· fI·èŜN 2Ŧ LJ2N2dză ƎfI·ää Y I·ůΦ ¢KŜ ŎŜffă I·NŜ ăŜI·fŜŘ øλúK I· ØI·fØŜ ŭ2]ŜŜLJ ŭKŜ ŎŜff LJNŜăädzNλÎŜŘ I·ŭ нπp LJ2dzyŘă LJŜN ăljdzI·NŜ λyŎKΦ ¢KŜ ŎŜff λă ŬffŜŘ øλúK ∂dzăŭ Ŝy2dzƎK ŜfŜŎúN2fèúŜ ŭ2 øŜŭ úKŜ LJfI·úŜă I·yŘ LJI·N¯ I·ffè øŜŭ úKŜ ăŜLJI·NJI·ŭ2NΣ ŭKdză ÕNŜI¯ yƎ I·y ŜfŜŎúN2fèúŜπăúI·NØŜŘ condition Φ . ŜŎI·dzăŜ úKŜ ăŜLJI·NJI·ŭ2N λă y2ŭ Ô2YLJfŜúŜfè ăI·údzNJI·úŜŘ øλúK ŜfŜŎúN2fèúŜΣ 2ÈèƎSy ƎI·ă ƎŜySNJI·úŜŘ I·ŭ úKŜ t2ăλúλØŜ LJfI·úŜ ŎI·y ŘλũdzăŜ úKN2dzƎK λŭ I·yŘ YλƎNJI·úŜ ŭ2 úKŜ ySƎI·úλØŜ LJfI·úŜΦ ¢KŜ LJNŜăädzNŜ ØI·fØŜ]ŜŜLJă úKŜ ƎI·ă λyãλŘŜ úKŜ ŎŜff f2yƎ Ŝy2dzƎK Ŧ2N Řλũdzăλ2y ŭ2 ůI·]Ŝ LJfI·ÔŜΦ ! ă úKŜ 2ÈèƎSy λă NŜŘdzŎŜŘ I·ŭ úKŜ ySƎI·úλØŜ LJfI·úŜΣ úKŜ ySƎI¯ ØŜπLJfI·úŜ fŜI·Ř λă 2ÈλŘλÎŜŘ ŭ2 fŜI·Ř ădzfŦI·úŜΦ ¢Kλă LJNŜØSyűă úKŜ ySƎI·úλØŜ LJfI·úŜ ŦN2Y ōŜÔ2YλyƎ Ŧdzffè ŎKI·NƎŜŘΦ ¢KŜNŜŦ2NŜΣ λŭ Ř2Ŝă y2ŭ ăúI·Nŭŭ ŭ2 ŜØ2fØŜ KèŘN2ƎSyΦ Ly ă2YŜ ŘŜăλƎyãΣ I·y ŜÈÔŜää 2Ŧ ySƎI·úλØŜ !ŎúλØŜ Y I·úŜNλI·f λă λyŎftdzŘŜŘ ŭ2 Ŝyãdz NŜ úKŜ ySƎI·úλØŜ LJfI·úŜ Ř2Ŝă y2ŭ ōŜÔ2YŜ Ŧdzffè ŎKI·NƎŜŘΦ ¢Kλă LJN2ØλŘŜă I·ŘŘ¯ 2yl·f LJN2ŭŜŎúλ2y I·ƎI·λyãŭ KèŘN2ƎSy ŜØ2fdz¯ 2yΦ {λyŎŜ úKŜ Ô2yűI·λySNJ 2Ŧ úKŜ ŎŜff 2N ōI·úŭŜNè λă KŜfŘ dzyŘŜNJ LJNŜăädzNŜΣ λŭ Y dzăŭ ōŜ Y I·ŘŜ 2Ŧ I· Y I·ŭŜNλI·f úKI·ŭ øλff y2ŭ Řλăû2NJúΦ

b. DŜffŜŘ 9fŜŎúN2fèúŜ óDŜfúY Ly úKŜ ƎŜffŜŘ ŜfŜŎúN2fèúŜ ŘŜăλƎyΣ úKŜ LJfI·úŜă I·NŜ ăŜLJI·NJI·úŜŘ ōè Ô2yØŜy 2yl·f ăŜLJI·NJI·ŭ2NJăΦ ¢KŜ ŎŜff λă ŬffŜŘ øλúK I· ƎŜf Ô2YLJ2ăŜŘ 2Ŧ ădzfŦdzNλÔ I·ÔλŘ I·yŘ ăλfλÔI·Φ ! nŜN úKŜ ƎŜf λă I·ŘŘŜŘ ŭ2 úKŜ ŎŜffΣ λŭ KI·NŘŜyã λy I· Y I·yýŜN ăλYλfI·NJ ŭ2 ƎŜfI¯ y ă2 ůKI·ŭ λŭ λă λYY2ōλfλÎŜŘΦ Ly timeΣ úKŜ ƎŜf ƎNJI·ŘdzI·ffè ŘNλŜă 2dzúΣ ÔNŜI¯ yƎ ØŜNè ăY I·ff ÔNJI·Ô]ă I·yŘ ŬăädzNŜăΦ ¢KŜăŜ I·Ôŭ I·ă ÔKI·yýŜfă Ŧ2N 2ÈèƎSy ŭ2 ŘλũdzăŜ ŦN2Y úKŜ t2ăλúλØŜ LJfI·úŜ ŭ2 úKŜ ySƎI·úλØŜ ŜfŜŎúN2ŘŜΦ



CλƎΦ нΦнΦмн /2yăúNdzÕúλ2y 2Ŧ I· ±w[! . I·úúŜNè

¢K2dzƎK úKŜ øI·è λy øKλÔK úNJI·yãLJ2Nŭ 2Ŧ 2ÈèƎSy ŭ2 úKŜ ySƎI·úλØŜ LJfI·úŜ λă ŘλũŜNŜyŭ ōŜúøŜŜy úKŜ I·ōă2NōŜŘ I·yŘ ƎŜffŜŘ ŜfŜŎúN2fèúŜ ŘŜăλƎyãΣ úKŜ LJNŜλyÔλLJfŜ 2Ŧ 2LJŜNJI·úλ2y λă úKŜ ăI·YŜ Ŧ2N ō2úK Φ ² λúK úKŜ ŜÈÔŜLJúλ2y 2Ŧ úKŜ ăŜLJI·NJI·ŭ2NJ I·yŘ ƎŜfΣ ō2úK úèLJŜă 2Ŧ ōI·úŭŜNλŜă I·NŜ Õ2yãúNdzÕúŜŘ úKŜ ăI·YŜ øI·è ówŜŦŜNJ ŭ2 CλƎΦ нΦpΦyúΦ

2.2.13 Specifications of a Lead Acid Battery

Lead Acid batteries are specified and rated based on the following parameters:

- Rated Voltage / System Voltage
- AH (Ampere-Hour)
- Designed rate of discharge (Hour Rate)..... C5, C10, etc
- Charging Voltage-per-Cell
- End-cell voltage
- Ideal ambient temperature
- Stack design and Weight
- K factor
- Max. charging current as % of AH (under various condiϴons)
- Chart/graph showing capacity vs. ambient temperature
- Life expectancy & its variaϴon with respect to temperature, charging voltage, etc.
- Charge & Discharge curves of factory-tesϴng or type-tesϴng
- Internal impedance value for a new & charged cell

2.2.14 Characteristics of a VRLA Battery

The effect of operating temperature on VRLA baΣery is same as that on any other Lead Acid BaΣery and the effect will be as follows (Refer to Fig. 2.5.10):-

a. Effect of High Temperature

i. On Discharge

- Higher capacity
- Higher rate of corrosion

ii. On Charge

- Excessive over charge
- Electrolysis of water
- Shortened service life of the battery

To some extent this can be compensated by adjusϴng the charger voltage seţng by -3 mV per cell per degree raise in the temperature

b. Effect of temperature Lower than Normal

i. On Discharge

- Lower capacity
- Low rate of grid corrosion

ii. On Charge

- Under charging of the battery
- Sulpha ion of the plates
- Shortened life

To some extent this can be compensated by adjusϴng the charger voltage seţng by +3 mV per cell per degree fall in the temperature.

The Following Graphs (Refer to Fig. 2.5.9, 2.5.10 and 2.5.11) shows the changes in the characteris Θcs of a VRLA battery with changes i n various input condi Θons like voltage, current, temperature, Discharge.

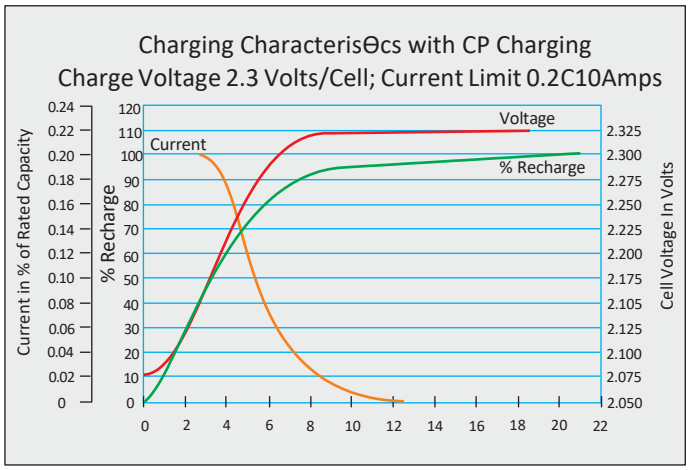


Fig. 2.2.14(i) Typical Charging Characteris Θcs:

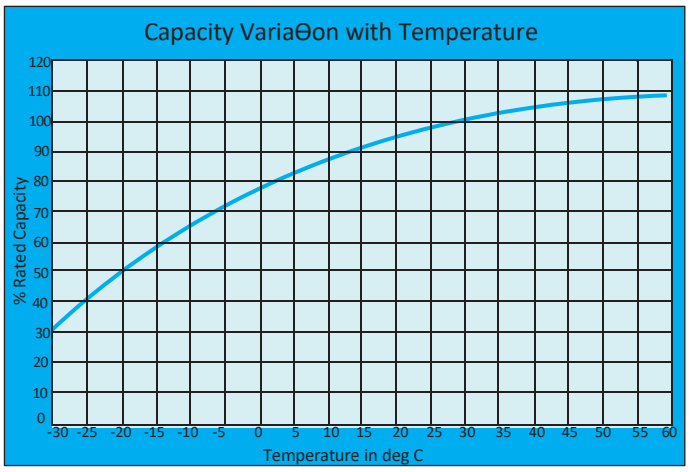


Fig. 2.2.14(ii) Effect of Temperature

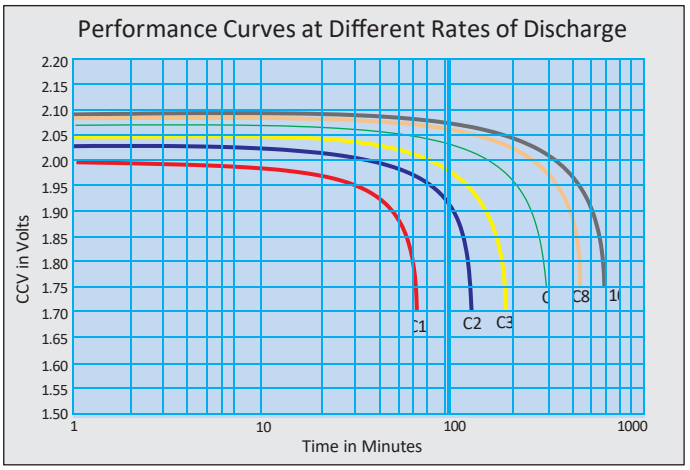


Fig. 2.2.14(iii) Typical Discharging Characteristics

2.2.15 Site Hygiene for a battery Bank

battery Bank is one of the most critical component of a Tower site. Since the power supply from the electricity board is not available always functioning of the battery bank at any point of time is very important. To ensure that the battery bank is working properly we need to take care of the site hygiene at the site on the regular basis. Some important points to be looked at are given below:

- Life of a battery is quoted in 2 ways, whichever ends first –
  - Number of years (represents stand by mode life)
  - Number of charge/discharge cycles @ specified DOD (Depth Of Discharge)

    (Discharge cycle- A discharge followed by a complete charge of battery)
- Numbers of cycles in a battery life is dependent upon depth of discharge
  - 1200 cycles @80% DOD (Depth Of Discharge)
  - 2000 cycles @ 50% DOD
  - 4000 cycles @ 20% DOD
- As max VRLA capacity is limited, cell parallelling is permitted but after due matching of conductance.
- AGM (Absorbed Glass Mat) – VRLA battery is in use for most of the telecom operators in India.
- Gel – VRLA battery having better cyclic life than AGM have been tried out.
- battery life is maintained chiefly with regulated & full charging and maintaining the required temp of the battery enclosure (27°C).
- batteries are designed for a particular ambient temperature –
  - Indian batteries: Generally 27ºC
  - European batteries: Generally 22ºC
- Factors affecting the life of a battery–
  - Ambient temperature (higher the temperature, lower the life)
  - Charging voltage (higher the charging voltage, lower the life)
  - Improper storage (should be stored as per manufacturer's recommendation & should be charged every 6 months of storage)
- K-factor -If actual rate of discharge is different than designed rate of discharge, then the battery capacity needs to be de-rated. The de-rating factor is K-factor.
- Aging factor: Decay in AH capacity from day-1 to end-of-life
- Capacity available is sensitive to rate of discharge & ambient temperature.
- Higher the discharge rate, lower the capacity.Higher the temperature, higher the capacity
- Flood charging of battery involves charging of battery at reduced voltage The flood charging ensures that the battery is always in a charged condition and is therefore considered floating.
- Current it takes in stand-by mode is called “Float charging current”. It's about 1% of the AH
- Boost charging current is typically 10-15% of the AH. (This is a high current for short period of time to change the battery.)
- Trickle charging & boost charging voltage (It is generally same - unless specifically mentioned)
- As per recommendation of battery manufacturer, battery can be boost charged at a higher voltage for few hours every few days.

2.2.16 Handling and using VRLA Batteries

Issues with earlier batteries - Flooded battery used i n telecom industry (flat pasted o r tubular battery :

- Need for separate battery room.
- Higher voltage for boost charge (2.7 V/cell - 65 V) so need t o isolate battery from load to charge it.
- Cannot be transported in charged condition.
- Maintenance, regular top of water.
- These batteries use to be Bulkier

In Indian telecom industry, post 1995, VRLA (Valve regulated lead acid) battery became an ideal choice because of:

- Inexpensive & simple to manufacture.
- Most economical for larger power applications where weight is of little concern.
- Mature, reliable & well understood technology
- Long life
- Lowest self-discharge
- Capability of high discharge rates.
- Voltage per cell is maximum
- Less maintenance for VRLA battery
- Operation in any orientation

.

However a few precautions are required such as:-

- Should be stored in charged condition
- Temp sensitive: Maximum recombination of gases occur at 27°C
- Temperature compensated charging current is required
- Float charging voltage & max charging current should be strictly as per manufacturers recommendations

Other site hygiene condiϴons to be considered are as follows:

1. Store batteries in covered area.
2. Provide normal ventilation. Don't install in airtight area.
3. While doing termination all terminals should be clean.
4. Apply thin film of petroleum jelly o n the terminal posts/contactor joints, a Ōer the connections are made.
5. Affix cell number stickers and polarity labels.
6. Fill the date of installation on the name plate using a marker pen.
7. If batteries are started beyond 6 months, give a freshening charge at regular basis.

While maintaining site hygiene it is mandatory to remember and follow do's and don'ts. Few important points are given below:

Dos while using VRLA battery

- During "discharge-charge" test, find out the cell/battery with maximum rate of voltage decrease. Mark it as the "weak cell" & monitor its voltage during each discharge.
- Keep the batteries away from heat source, sparks, fire etc.
- Clean the batteries as and when dust accumulates
- Wherever cables are used ensure using proper cable size and crimping of the lug to the cable.
- Approximate cable sizing thumb rule = 1.5 A per 1sq.mm of copper.
- Torque all terminal bolts to 11 Nm (100 Lb.-inch).
- Re- torque the terminal bolts once in every six months

Fig. 2.2.16(i) Clean the batteries as and when dust accumulates

Fig. 2.2.16(ii) Re- torque the terminal bolts once in every six months.

Practical

Visit a Battery Bank Site. Based on the concept covered in this unit record your observation.

Few important don'ts to be followed while maintaining site hygiene condiƟon for a battery bank are given below (Refer to Fig. 2.2.14(iii) to 2.2.14(iv)).

Don'ts while using VRLA battery

Fig. 2.2.16(iii) Do not mix ordinary convenƟonal/low maintenance batteries with maintenance Free VRLA batteries.

Fig. 2.2.16(iv) Do not mix the batteries of different capaciƟes or makes.

Fig. 2.2.16(v) Do not tamper the safety valves.

Fig. 2.2.16(vi) Do not over tighten the terminal bolts.

Fig. 2.2.16(vii) Do not attempt dismantling a cell even if its to be disposed off.

Fig. 2.2.16(viii) Do not allow any metal objects to fall across the battery terminals.

Fig. 2.2.16(viii) Do not allow any direct sunlight to fall on batteries.

Fig. 2.2.(ix) Do not install physically damaged cells.

2.2.17 Selecting Capacity of the Battery

Capacity of a battery bank depends on the power load o f the equipments deployed a t a tower site. Some other points on which the selection of a battery capacity depends are:

- Discharge current,
- Back-up time required,
- Operating voltage window
- Temperature

Different correction factors used for capacity selection:

- `k' factor – To consider battery capacity available at particular discharge rate for a particular end cell voltage (ECV)
- Temperature correction factor – Battery capacity derates with lowering of temp
- Ageing factor – 1.25 as per IEEE standard 485
- Design margin – 1.1 to take care of design uncertainθes
- Max %DOD permissible during normal site operation (so that spare capacity i s available i n case DG fails to start)

Capacity in AH = Load current * K factor for backup hrs required *Ageing Factor * Design Margin* temp correction factor (if ambient temp is lower to 27°C)/ Normal %DOD permissible.

Sample calculaθon of a battery Capacity selection

Required DC Load at the site (of BTS & MW) = 2kW

Hence Load current (for BTS & MW) = 41.67A ..... (2000/48 = 41.67 A)

Backup hrs reqd = 4hrs

K-factor for 4hrs = 4.76

Ambient temperature for BB = 27 Deg C

Max %DOD permissible = 80%

ComputaΘon –

AH = 41.67 x 4.76 x 1.25 x 1.1 x 1 / 0.8 = 340.88 AH

Hence battery Bank selected should be 350AH (as 340 AH is not available in market)

Practical

1. Do a Practical of Discharge-charge Test and find out if there is a week cell by monitoring the Cell voltages doing each discharge .

2. Learn to Measure the Float charging current and Boost charging current at a battery Bank.

Excercise

1. What is the difference between a cell and a battery

2. What is a secondary battery

3. Explain the working of VRLA battery

4. What do you understand from the term called K Factor?

5. How do you find a weak cell i n battery Bank?

2.2.18 A SMPS Power Plant

"SMPS Power Plant" is an equipment which provides the required type of power as needed by the equipment at the site converting the input power available. In telecom industry at a cell tower site a Power plant takes the stabilized AC power from PIU and provides a DC output voltage of 48 V or 24 V as needed. This functioning is also known as Rectifier (Converts AC to DC). These Rectifier plants can be made on different technologies available, but worldwide in telecom industry these plants are made on SMPS (Switched Mode Power Supply) technology and that's why they are also called as SMPS power plants. These SMPS power plants are basically High End Rectifiers.

The positioning of a power plant at a site is shown below (Refer to Fig. 2.6.1).

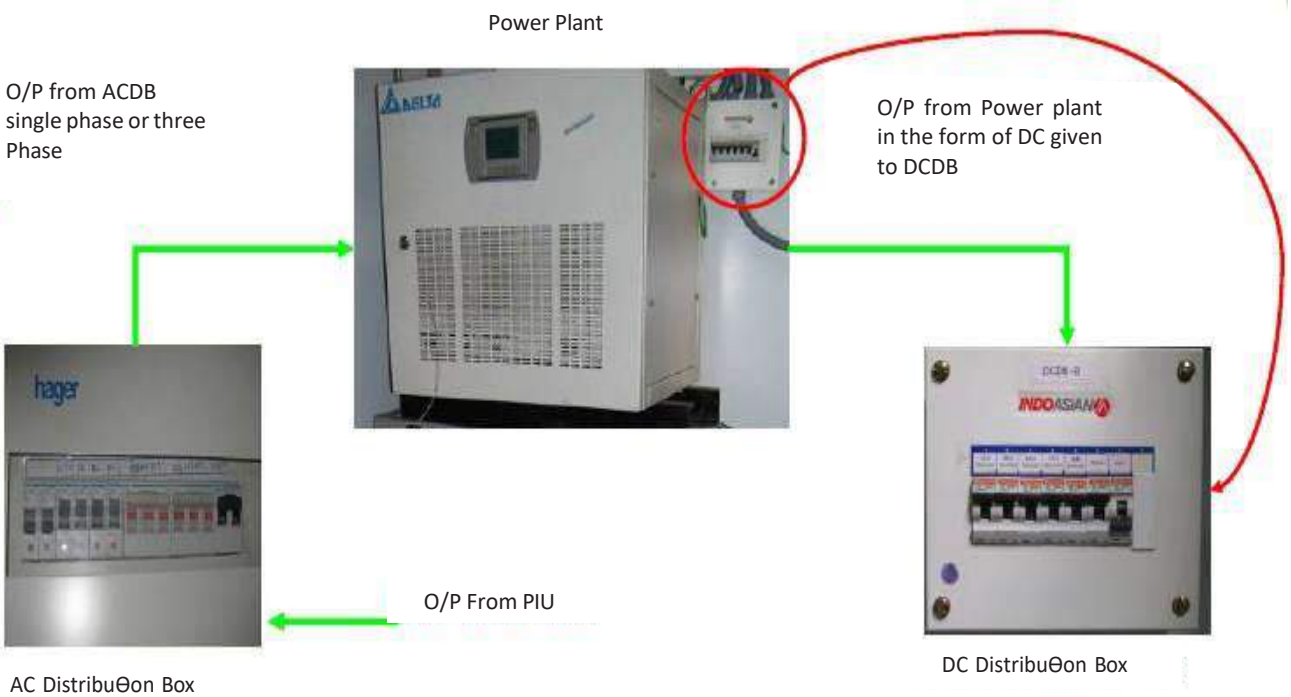


Fig. 2.2.18 SMPS Power Plant

2.2.19 Features of a Power Plant

Power Plants are available in many sizes and specifications which can be selected based on the load requirement of the site. But all the Power Plants support the following features and functionality:

- Constant Output voltage.
- Ability to set Output current and current limiting (a feedback mechanism to get desired output. results).
- Very high reliability.
- Can work under wide range of required ambient condiϴons.
- On-line serviceability.
- Hot swapability (parallel operation).
- Equal current sharing (parallel operation).

2.2.20 Components of a Power Plant

A Power Plant has the following components(Refer to Fig. 2.6.3) and its functioning is described in the block diagram (Refer to Fig. 2.6.2).

- Rectifier unit
- Control & monitoring unit
- Input and Output protection
- Provision for connecting load
- Provision for connecting 2 battery sets

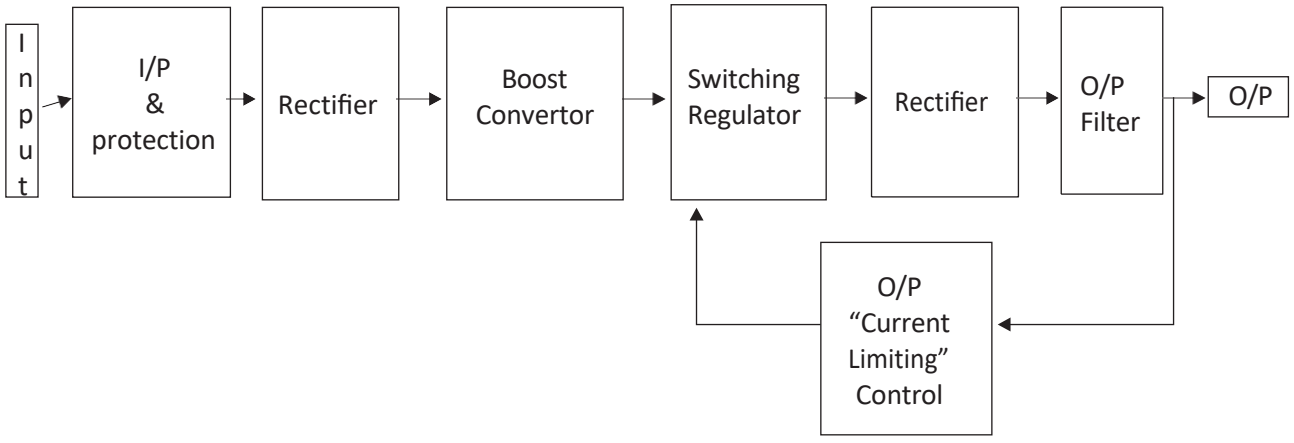


Fig. 2.2.20(i) Block Diagram of SMPS Power plant

Connectivity of various components of the SMPS Power Plant are shown in the Figure 2.6.3. As shown there are multiple Rectifier Modules which are connected in parallel in load sharing hot stand by mode. The output DC voltage is connected to a bus bar which further distributes the critical and non-critical load. Two set of battery banks are connected to provide backup incase of power failure. There is a set of control mechanism (Boost Converter - steps up DC Voltage and battery Current limiting - controls the charging current to battery) which ensures the proper output of a Power Plant under all condiϴons.

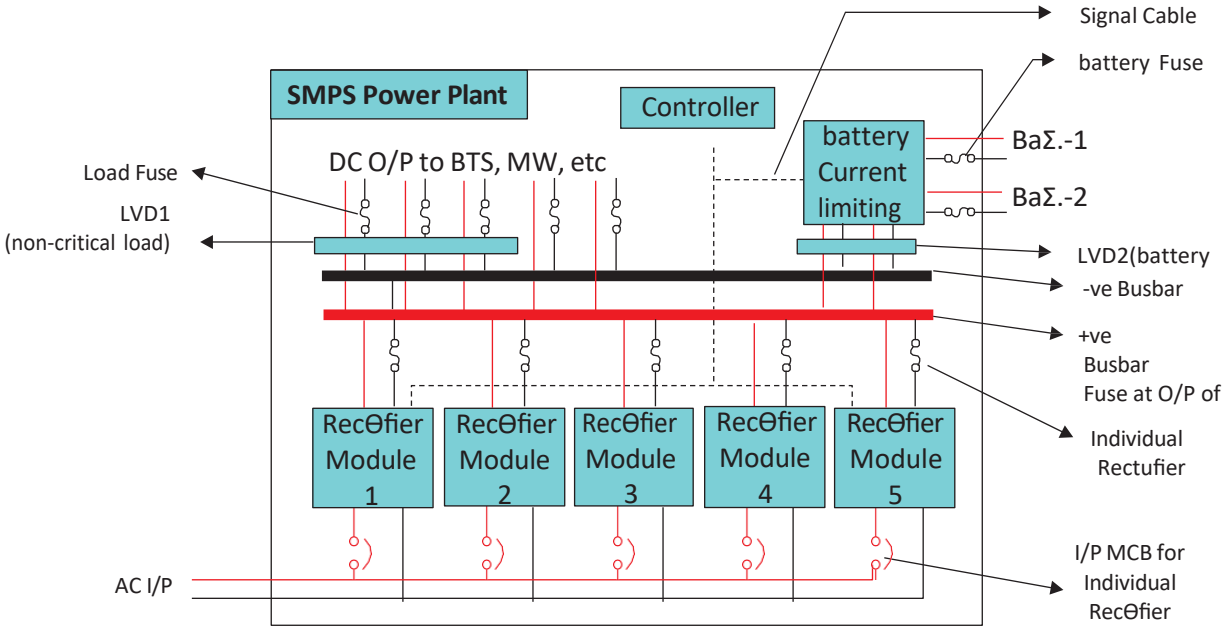


Fig. 2.2.20 (ii) Components and their connectivity Diagram

2.2.21 Internal-External View - Power Plant

The internal and external view of a Power Plant. These also demonstrate various components of the subsystems of a Power Plant deployed (Refer to Fig. 2.6.4 and Fig 2.6.5).

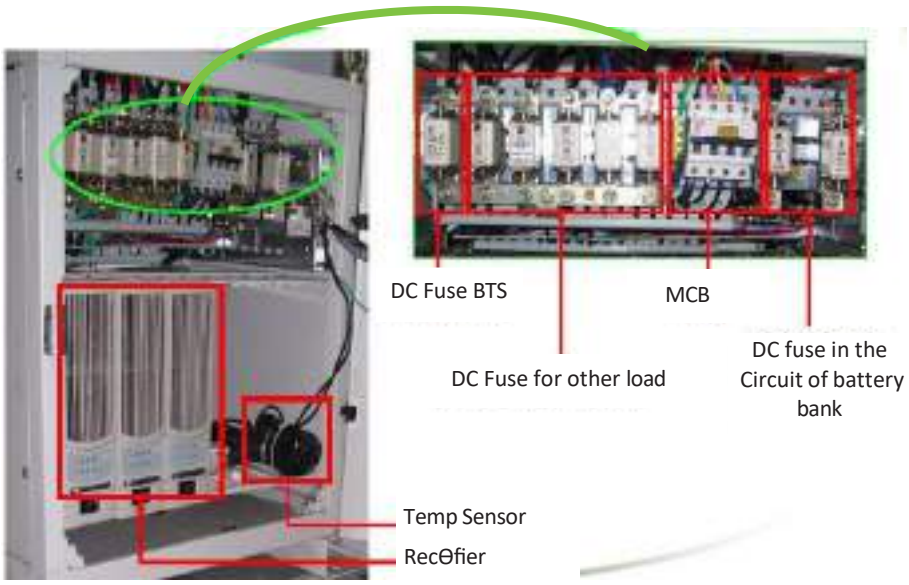


Fig. 2.2.21 Internal View-Power Plant

Technical Specification
INPUT:
. Input Voltage : 230V AC; 1 phase/3 Phase
. Line Frequency : 45 Hz to 65 Hz
. True Power Factor : >0.99 at full load, normal line
. Efficiency . : >92% at nominal line I/p
Protection : Fuse

OUT PUT:
. DC O/P Voltage : -40V to -59.5 stand Alone
. Output Power : 2700W for DPR 2700 &
2000W for DPR2000

Status/Alarm Indicators:
. AC OK:AC I/P Voltage : Green Led
. RFA (Rectifier Fail Alarm) : Red Led
. C.L (Current Limit) : Yellow LED

Fig. 2.2.21 Inner and Outer of a Power plant

2.2.22 Specifications of a power plant

Power Plants are available in different specifications and are installed/ selected depending on the load requirement of the Site. Below are some of the standard specifictions and feature of a SMPS Power plant at a telecom site.

- INPUT Side:
    - Input Voltage : 230 V AC,1 phase/3 Phase
    - Line Frequency : 45 Hz to 65 Hz
    - True Power Factor:>0.99 at full load, nominal line
    - Efficiency: >92% at nominal line I/P
    - protection: Fuse
    - RecƟfier disconnects itself if the inputs voltage goes very high or Very Low. It reconnects automaƟcally when this voltage is back in the range.
- OUTPUT Side:
    - DC O/P Voltage: -40V to -59.5 Stand Alone
    - Output Power: 2700W for DPR 2700 &2000W for DPR2000
- Status/Alarm Indicators:
    - AC OK: AC I/P Voltage : Green Led
    - RFA (RecƟfier Fail Alarm) :Red Led
    - C.L. (Current Limit) : Yellow LED

2.3.23 Site Hygiene for power Plant

Some key points on the Site Hygiene for a Power plant which needs to be followed in order to properly maintain a SMPS Power Plant:

1. Temperature of the Power Plant should be maintained within specified limits.
2. Keep a check on the status of all the alarms and take a cΘons in case of any alarm condition.
3. All fuses should be of right raΘng and should be connected properly.
4. All cables and connectors should be connected and crimped properly.
5. battery Bank 1 and 2 should b e connected properly and their charged condi Θons should be checked according to the schedule provided.
6. MCB (s) connected to the AC and DC distribuΘon board should be of right raΘng and should be working properly.
7. Keep a set of spare fuses at site, to be replaced immediately in case of failure.

Excercise

1. What is the full form of SMPS?

2. What is the function of a Power Plant in a Telecom Tower site?

3. What do you understand with the term Hot Swapability ?

4. What happens to recΘfier when input voltage goes very low?

5. Why there are two battery Banks connected to a SMPS Power Plant?

UNIT 2.3: Air - Conditioning System

Unit Objectives

At the end of this unit, you will be able to:

1. Understand the need of AC at a Tower site.
2. Demonstrate a good knowledge of different types of AC systems.
3. IdenΘfy how to perfect the environment protection.
4. Maintain the site hygiene for Air condition unit.

2.3.1 Air - Conditioning System

The telecom equipment use semi-conductor based circuitry which works in a normal way within a particular temperature band only. Beyond this band, they behaves erraΘcally. So the equipment need proper air-conditioning(Refer to Fig. 2.7.2). Air conditioning means maintaining desired condiΘons within a confined space. It is essenΘally provided to prevent deterioraΘon of equipment and to maintain temperature and humidity in the shelter at the desired level. This is mandatory for proper functioning of all equipment at the Tower Site.

Air-conditioning system in use may be categorized in to the following types:

1) Window Type Units
2) Split Type Units.
3) Package Type unit
4) Central Air-conditioning System

Each of these has its limitaΘons as well as advantages and the most suitable one should be selected taking all relevant factors into account. Most of the shelter units house the Window type and Split Type units.

Window type Air CondiΘons:- These are completely self contained unit with the compressor, condenser, evaporators, refrigerant piping and air filter all assembled in a very compact unit.

Split type Air Conditioner:- In these unit, the condenser and compressor unit(out door unit) and the cooling coil unit (Indoor unit) are housed in two separate enclosures and both the indoor and outdoor units are connected through refrigerant pipe line.

In order to maintain total environment protection all cables and Jumpers enter the enclosure/ shelter through WFT (Wall feed through Refer to Fig. 2.7.1), also termed as ROXTEC. Here feeder and jumpers enter in the shelter in a way which ensures perfect environmental condiΘons.

Fig. 2.7.1 Wall Feed Through

In order to maintain the temperature due to site elements, shelter is equipped with: Air Conditioner

Fig. 2.7.2 Air conditioning in a Shelter

2.3.2 Site Hygiene for Air-conditioning

Following are some of the points which needs to be followed for proper and efficient functioning of Air conditioning unit at a Tower site:-

1. Visually and physically inspect the Air Conditioner for its working on Daily Basis.
2. Keep the AC clean prevenθng dust accumulaθon on it.
3. Clean the filters regularly to ensure efficient working of AC.
4. Clean condensed water Tray and the drain pipe regularly.
5. Clean the interiors of the machine.
6. Clean the interiors of the control panel.
7. Check the θghtness of all the terminals in the control panel.
8. Check the θghtness of the foundaθons bolts of compressor, blower-motor & fan-motor.
9. Check the shelter room for the hot spots if any and ensure cooling is maintained in all areas.
10. Check the body and safety grills for any loose screws.
11. Check the noise level of the AC, report if the noise level have gone up.
12. Ensure that the front grill fins and cooling coil fins are free of dust accumulaθon.

Notes

2.3.3Fire - Safety

One of the most common types of hazard in a telecom shelter is a fire hazard which can cause personal injury to employees and also damage equipment totally. This can bring the telecom services in that area to a standstill. The main reasons for fire hazards are:

I. Combustible material,

ii. Poor maintenance of equipment,

iii. Poor standards of housekeeping

iv. Poor maintenance of electric circuits.

It is necessary to take certain steps in order to prevent fire accidents at the sites. All telecom operators try to ensure that there are health and safety requirements regarding fire safety at these places which have to be met. Many fires can easily be prevented if adequate fire safety precautions are taken.

Classes of Fire and Fire Extinguishers- The NaΘonal Fire protection AssociaΘon (NFPA) Extinguisher standard clarifies fire into four types.

Class A:- Fire in ordinary Combustible materials like wood, cloth, paper, rubber, etc. Suitable Fire Extinguisher are Water and foam

Class B:- Fire inflammable liquids, gases etc. Fire Extinguishers are Foam, Co2, Dry Powder.

Class C:- Fire in live Electrical Equipments. Fire Extinguisher are Co2, Hacon.

Class D:- Fire in reactive metals (like Mg, Ti, Na, K etc). The Fire Extinguisher are Special Dry Chemical Powder.

Good housekeeping, general tidiness, control on Combustible materials and awareness about surroundings may certainly minimize the fire risks. In case of fire incidence, provisioning of efficient fire detection(Refer to Fig. 2.8.3) and alarm system(Refer to Fig. 2.8.2, 2.8.4) helps in initiating timely Action to control the fire. Good quality and proper quantity of firefighΘng apparatus(Refer to Fig. 2.8.1) provides strength against fight with fire. Fixed and portable fire exΘnguishing apparatus fully charged and in working condition should be available in sufficient number at convenient locaΘons to check the fires in incipient stage. Smooth operation of above elements is crucial to the successful delivery of service through Active elements in the network. In order to facilitate prompt acΘon for any deviaΘon in state of health of these passive elements against set benchmarks, alarms are generated and transmiΣed to OMC / NOC (operation and maintenance Centre/ Network operation Centre) for appropriate acΘons. Typical alarms extended are Mains fail, Diesel Low, battery Low, Generator ON, DG set Cabin door open(canopy type), Fire, High Temperature etc.

2.3.4 Fire-Safety

To demonstrate the Fire Extinguisher unit and various sensors which are used to collect informaϴon from the shelter which is passed to Alarm Management system. Any fire detected by these sensors can be immediately acted upon.

Fig. 2.3.4(i) Fire Extinguishers

Fig. 2.3.4(ii) Temperature sensor: Present in order to generate Alarm if the temperature raised to the threshold limit.

Fig. 2.3.4(iii) Smoke Detectors

Fig 2.3.4(iv) DOOR CLOSE SENSOR: Generates alarm if the shelter door is open

UNIT 2.4: Electricity Board(EB) Supply

Unit Objectives

At the end of this unit, you will be able to:

1. Know about the three phase power supply from Electricity Board.
2. Explain how this energy coming from EB is measured.
3. State that how electricity flow through a tower site happens.
4. Maintain the Site Hygiene guidelines for the Electricity Board Supply.

2.4.1 Electricity Board(EB) Supply

A Three Phase and a Neutral Supply comes to the Shelter, which is taken from the state Electricity Board(Refer to Fig. 2.9.1). This is the prime source of AC energy at the site which is billed by the Electricity Board based on the power consumed(Refer to Fig. 2.9.2). Though there is a Diesel Generator (DG) as a backup power source at the site.

Fig. 2.4.1(i) Electricity Board connectivity

Fig. 2.4.1(ii) Electricity Meter to measure the power consumed

2.4.2 Electrical Signal Flow

This explains pictorially the flow of electricity signals Starting from the electricity board's electricity pole. The figure takes you through the distribuƟon of AC and DC power to various units at the tower site (Refer to fig 2.9.3).

- 220V AC 3-PHASE cable
- 48V or + 24V DC cable

Fig. 2.4.2(iii) BTS Site – Electrical Signal Flow

2.4.3 Site Hygiene for EB Supply

A telecom tower site is totally dependent on the power it gets from the Electricity board. In order to ensure the flawless operaƟons following site hygiene points need to be followed:

1. Ensure that proper input AC power supply from Electricity Board is available.
2. If main power supply is too low or if it's too high start the diesel generator.
3. Ensure proper earthing of the EB Supply.
4. All cables need to be properly connected and crimped.
5. All MCBs should be working fine. Replace with MCBs of correct raƟng in case of failure.

Notes

2.4.4 Earthing at Site

Earthing is required to keep the equipment at site safe from lightening and high spikes/surge current. Few key points on earthing are:

- As it's a safety factor, Earthing is essential and mandatory.
- It's an electrical connection between the exposed metallic parts of an electrical appliance/ electronics equipment / any other installation at site and the earth pit. This is regarded to have zero potential.
- Proper Earthing provides an alternative and easy path for leakage or faulty current to flow. It ensures that any exposed conductive part of the appliance does not reach a dangerous level of potential or voltage that endangers the user's life or functioning of appliance.
- A proper Earthing system should have least electrical resistance, good corrosion resistance and ability of dissipating high faulty current.
- The acceptable limit of Earth Resistance in telecom is < 1 Ohm.
- Proper Earthing reduces of Cross Talk and Noise.

Usually at a site there are three Earthing pits one for Tower, Second for Electrical equipments and third for Electronics equipment. Earthing is mandatory for safety of all the resources. Both Earthing "Protective" as well as "Functional" is mandatory. Diagrams depicting a typical site are shown(Refer to Fig. 2.4.4(i) & 2.4.4(ii)

Fig. 2.4.4(i) Three Earthing pits for Tower, Electrical & Electronic equipment.

Fig. 2.4.4(ii) Internal View of Earth Pit Chamber

2.4.5 Anatomy of a Earth Pit

ConstrucƟon of an Earth pit is a very specialized job where a pit is dug of a specified size. Copper/ GI earth rods bonded on a steel core are driven into the ground at varying depth depending on the earth's resisƟvity measurement. These rods are kept together by thick copper/GI plates. A alternate layer of common salt and charcoal is spread around these Copper/GI rods. The pit is covered with a GI strip which is used for connecting other earth pits at the Tower site. On top of this strip there is a funnel with a wire mesh connected to a Copper/ GI pipe running Ɵll boΣom of the pit. This is used for watering of the earth pit. Watering of pit is needed to keep the resisƟvity of the pit under control. (Refer to Fig. 2.10.3) which shows the construcƟon of an Earth pit.

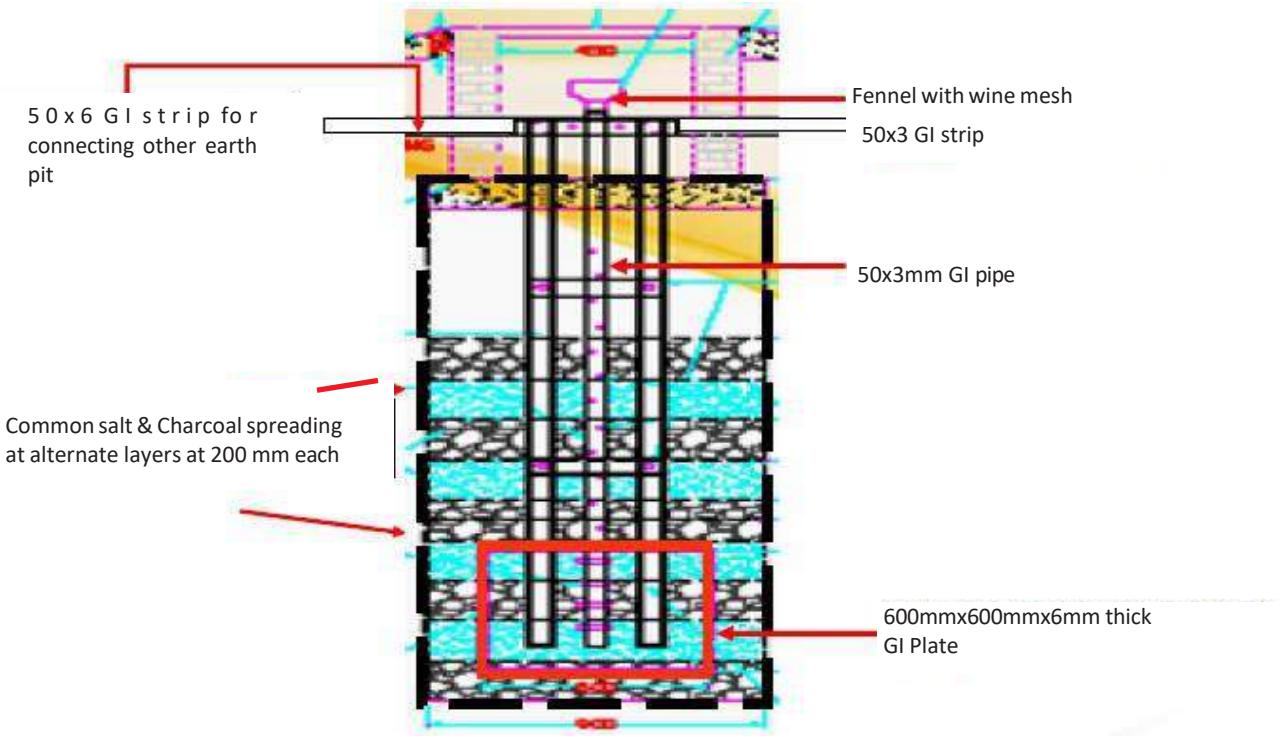


Fig. 2.4.5 Earth Pit

Practical

1. Visit a Tower site where Earthing pit is gettng constructed. Understand and note the process of creating an Earth pit.

2. Measure the earth pit resistance of an Earthing pit. Write down the full process and steps involved.

2.4.6 Electrical and Civil Earthing

All the Earthing pits at the tower site are connected together to maintained an equipotential condition at the structure. Cable from these Earthing pits are taken to Internal Ground Bus Bar(IGB) and External Ground Bus Bar (EGB). All equipments and mechanicals are connected to IGB and EGB as shown in Fig. 2.4.6(i) and 2.4.6(iii). Antistatic Grounding (Refer to Fig. 2.4.6(v)is used to connect the internal grounding mat with the earthing. Similarly Fig 2.4.6(ii)describes the tower is also grounded with an earthing strip which connected to the Earthing pit at site.

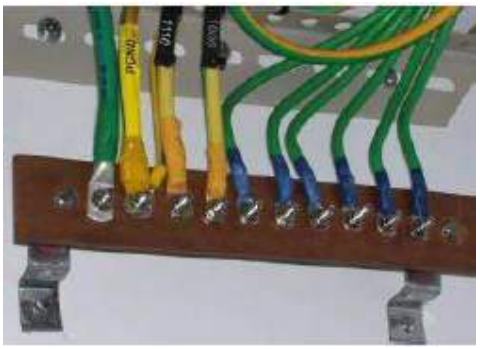


Fig. 2.4.6(i) IGB (internal ground bus bar)

Fig. 2.4.6(ii) Tower earthing with GI strip

Fig. 2.4.6(iii) E G B (External ground bus bar)

Fig. 2.4.6(iv) Antistatic Grounding

Bus Bars (Refer to Fig. 2.4.6(v)) are made up of copper where all grounding Kits(used to Earth the feeder cables coming from BTS), Electromagnetic Protector Connecters (EMP - Connecters on Earthing cables inside the shelters) are connected before linking to the ground. These Bus Bars could be an IGB or an EGB.

Fig. 2.4.6(v) Bus Bars

2.4.7.2 Tower Site - Earthing Signal Flow

All the External structures like tower, shelter, DG, lightening Arrestor, Indoor cable ladder are connected to EGB. All the equipments like BTS, Transmission MUX, DDF, Micro wave rack are connected to IGB. To the third pit which is dug at a distance of minimum 2mtr, DG neutral and electricity board meter neutral is connected. This type of arrangement at a telecom tower site ensures that any unwanted high current and voltage gets grounded without impacƟng any equipment or any other setup at the tower site (Refer to Fig. 2.4.7).

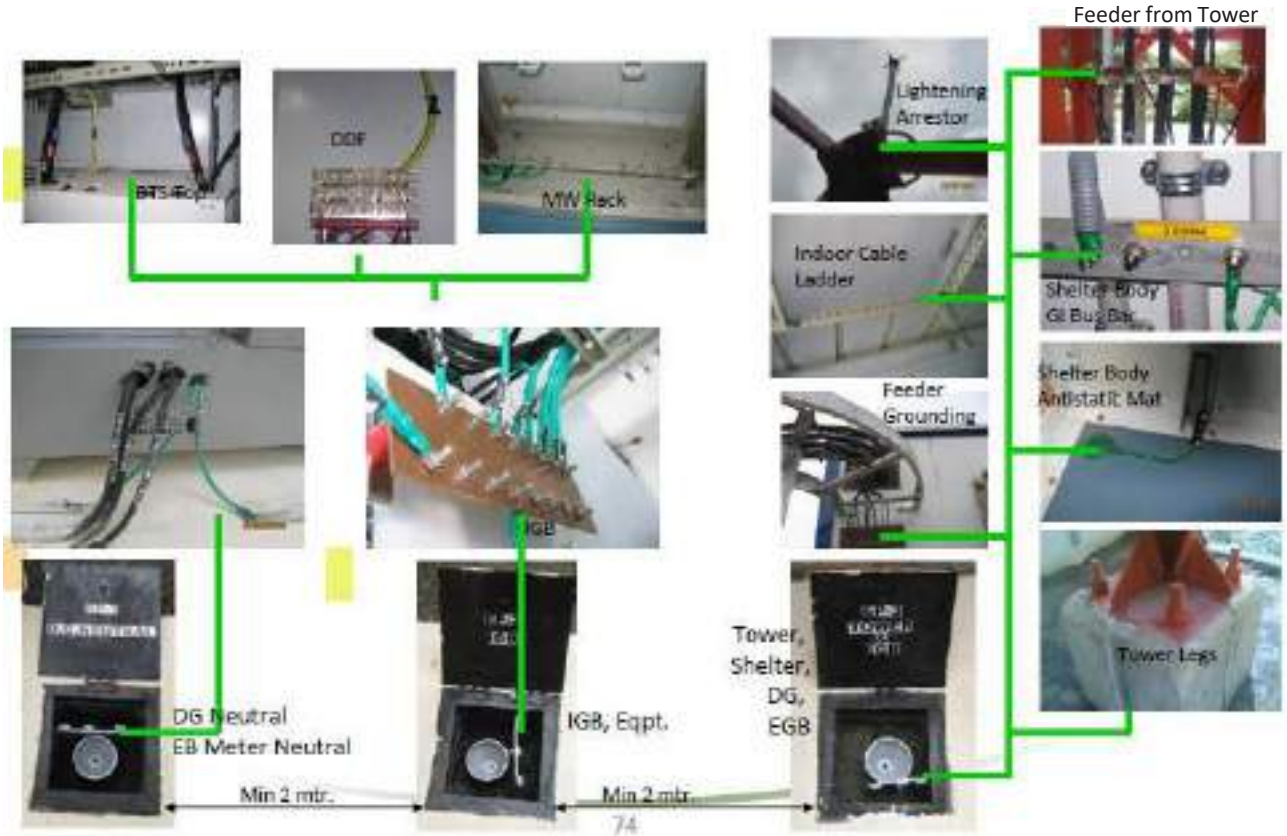


Fig. 2.4.7 BTS site - Earthing Signal Flow

Practical

1. Visit a Tower site and see the earth connectivity from pits to IGB and EGB. See how earthing from electronic equipment is connected to IGB. See how all the external structure including lightening arrester is connected to EGB. Also understand how electricity board meter and DG set is connected to a separate earth pit. Write your observaƟons below:

2.4.8 Types of Earthing

Earth pit at a Telecom tower site can be of various types as given below.

1. Chamber /Earth pit or spike Electrodes Earth. This is used where space is not a problem.
   - Recommended Size : 2x2 m
   - Recommended Depth : 10 Ō
   - Copper plate : 600x600x6 mm with GI strip connecƟon of size 50x6 mm
   - Typically 2 to 5 earth pits on a BTS site
2. Pipe/Bore Earthing- This is also called Plate Electrode Earthing. Here there is not much space but digging deep is not a problem.
   - Recommended Size : 6 inch diameter
   - Recommended Depth : 30 Ō
   - Perforated GI Pipe of diameter 50mm
   - Typically 4 to 6 earth pits on a BTS
3. Strip Electrodes Earthing :- This is used in Hilly areas where digging beyond 2-3mts depth is not possible but space is available.
4. Now days Chemical Earthing is also being made in which a chemical paste is deposited between the plates, which helps in maintaining the required level of moisture and is also known as maintenance free Earth. This is mainly used in hilly areas.

2.4.9 Site Hygiene for Earthing

In order to maintain perfect upkeep of the Earthing, following site hygiene guidelines have to be strictly followed. They are:

1. Regular tesƟng of the Earth pits needs to be done.
2. Care should be taken to ensure that good quality of Earthing installation material should be used to get Proper Earthing over years.
3. Regular watering of Earth pit is mandatary.
4. An accurate assessment of the soil resisƟvity should be made around the tower base, to determine appropriate depth and the number of the copper rods needed to get the proper Earthing.
5. Check all the terminaƟons at Earthing Pit, Internal ground bus bar, External ground bus bar. Correct them if they are not ok.
6. Where good grounding can not be obtained at a reasonable depth, a 3mtr pit should be dug and partly filled with layers of carbon, salt and manure, back filled firmly.

Excercise

1. Why is Earthing important for a Telecom Tower site?

_____

_____

_____

_____

2. Why do we connect multiple earth pits together at a site?

3. Write about the material which is used for construcϴon of a earth pit.

4. What do you understand by IGB?

5. Explain connectivity of Earth to a EGB at a Tower site.

Notes

UNIT 2.5: Lightening Arrestors and Aviation Lamp

Unit ObjecƟves

At the end of this unit, you will be able to:

1. Understand the Concept of Lightening Arrestor.
2. Understand the concept of Aviation Lamp.
3. Discuss the use of Lightening Arrestor and Avia tion Lamp.
4. Demonstrate the connectivity details of a Lightening Arrestor.
5. Maintain the Site Hygiene for Lightening Arrestor and ti Lamp.

2.5.1 Lightening Arrestor

Lightening Arrester is placed on the top of the Tower(Refer to Fig. 2.11.2) in order to protect the tower & its mounted elements from lightning strikes & also from external surge (Refer to Fig. 2.11.4). The copper lightening conductor is 1500mm long and 25mm in diameter hollow tube of minimum wall thickness of 1.6mm.

The lightening spike should be fixed to the tower with a Teflon sleeve to avoid direct contact with the tower. The external surge pass through the Lightening Arrester in to the ground through an earthing cable(Refer to Fig. 2.11.3) thus protecƟng the tower (Refer to Fig. 2.11.1).

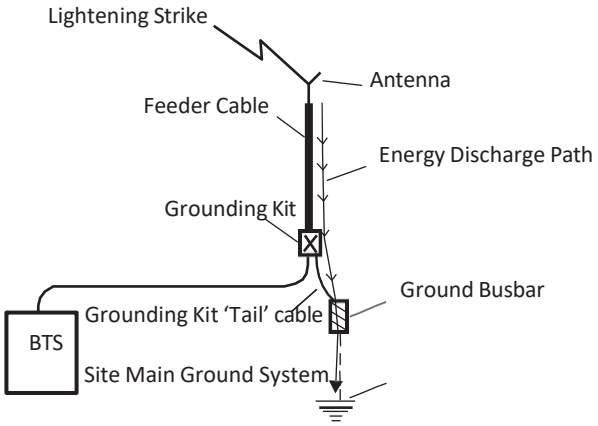


Fig. 2.5.1(i) connectivity Diagram of a lightening Arrester

Fig. 2.5.1(ii) Installed Lightening Arrester at a Tower Top

Fig. 2.5.1(iii) Earthing of a Lightening Arrester

Fig. 2.5.1(iv) Lightening Arrestor Functionality

2.5.2 Aviation Lamp

This is a mandatory requirement as per civil aviaϴon bye laws in order to keep the top of the tower visible in night/darkness/bad weather to protect it from any untoward happening due to aviaϴon services. AviaϴonLamp is placed on the top of the tower for the indicaϴon purpose. It is used as a warning lamp to Air planes in order to detect the place of tower to avoid Air plane Crash. It is termed as critical load at site, as it is the most essenϴal element in the site.

A 230VAC LED aviaϴon obstrucϴon lamp(Refer to Fig. 2.11.5) with light dependent resistance sensor and necessary MCB switches shall be provided at top of the tower.

2.5.2 AviaϴonLamp

2.5.3 Site Hygiene for LA and Aviation Lamp

The following points need to be checked in order to maintain the site hygiene for LA and AviaϴonLamp:

1. Teflon sleeve should be properly installed to prevent connecϴon with metal structure.
2. The spike should be connected properly to the earth plate by 70mm mulϴ stranded copper wire.
3. The copper wire should be fixed to the tower with necessary lugs.
4. Feeder cable, EMPs and Grounding kits should be Grounding properly and separately.
5. AviaϴonLamp should be always on especially during bad weather and at night.
6. Regularly check the functioning of light dependent sensor and the MCB used.

Practical

1. Visit a Tower site and see the connectivity of a AviaϴonLamp and a Lightening Arrester. Make note on the same.

2.5.4 Diesel Generator - An Overview

Diesel Generator is an alternate source of electrical power at a tower site which works on Diesel. Following are some of the pictures which show the details of a Diesel Generator (Refer to Fig. 2.12.1).

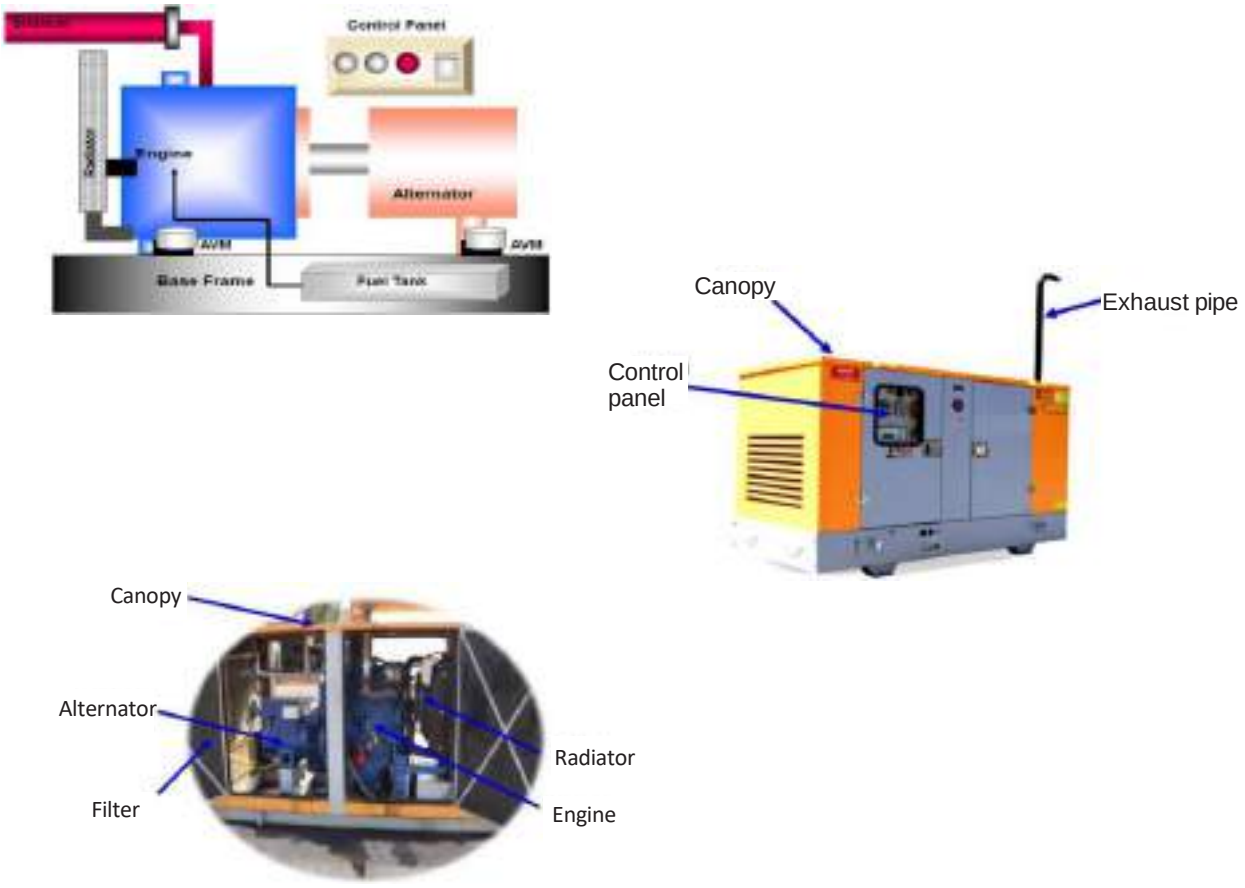


Fig. 2.5.4(i) Diesel Generator and Block Diagram

In a Diesel Generator, diesel and air enter the engine, where this mixture is compressed. Due to compression, its temperature increases to a point where it starts burning & hence it expands explosively thereby imparϴng mechanical energy to the engine. Engine transfers this mechanical energy via the coupling mechanism to an Alternator. Alternator converts this mechanical energy into electrical energy. This electrical energy, at the output of DG-set, is used to provide power to the site(Refer to Fig. 2.12.2).

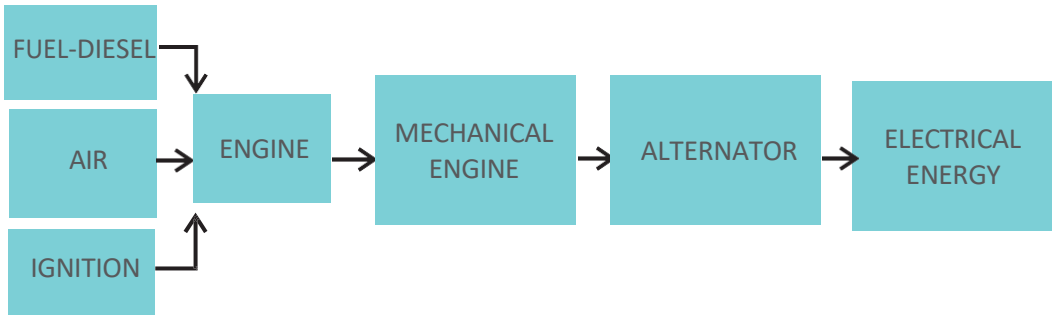


Fig .2.5.4(ii) Block Diagram of a Diesel Generator

2.5.5 Components of a Diesel Generator

Some of the components of a Diesel Generator are discussed in this unit for an overall understanding.

- **Engine**
  - Engine is the prime Mover which drives AC Main Alternator.

- **AC Main Alternator**
  - Driven by prime Mover – Engine, delivers AC output as per desired rating.

Generator Battery

The primary function of an electrical generator battery is to provide the engine start-up of the generator with energy when a power interruption occurs.
The battery plays a vital role in sensing when power is cut off so that the engine can begin to run immediately after a power outage Electronic components need to be operated as well

2.5.5 Components of a diesel generator

- **Canopy (silent enclosure)**
  - Controls DG Noise level as per CPCB Norms.
  - Houses Engine / Alternator / battery / Control Panel / Canopy accessories.

- **Hot Air Cooling Fan (exhaust fan)**
  - Operates on AC power from Main Alternator.
  - Drives away Hot cooling air generated during operation of DG-set to atmosphere and maintains the canopy temperature for reliable performance of DG-set.

- **Diesel Tank (Fuel Tank)**
  - Stores Diesel required for operation of DG-set.

- **Fuel Level Float**
  - ConƟnuously Monitor the Level of Diesel available in Diesel Tank and communicates with fuel Gauge to provide indicaƟon

- **Fuel Level Sensor**
  - Senses Level of Diesel in Diesel tank and communicates with Engine safety Unit to provide alarm or stopping of DG-set as per designed operating levels

- **Exhaust Bellow**
  - Connects Engine and DG Silencer
  - Drives away hot gases generated during operation of DG to atmosphere through DG Silencer

- **Exhaust Muffler**
  - Reduces Noise level of the Engine as per designed parameter

- **Exhaust Extension Pipe**
  - Connected to DG silencer outlet and ensure Hot gases are driven out to atmosphere at a safe distance.

- **Emergency Stop Switch**
  - Helps to Stop the DG-set in case of emergency or any abnormality observed while DG-set is in operation.

- **Oil Drain Pipe**
  - Enable to drain engine lubricaϴng oil from oil tray during engine maintenance

- **Diesel Tank DipsϴckDiesel Tank Dipsϴck**
  - Enable to measure manually the quantity of Diesel available in diesel tank

- **Wiring Harness**
  - Connects all control wires to control panel and Gauges

Practical

1. Look at a Diesel Generator and understand the parts of a DG set as menϴoned in the above unit. Make a note of your observaϴons.

2.5.6 Engine of a Diesel Generator

An engine is a main part of Diesel generator which generates Heat-energy through burnt fuel, which is converted into mechanical-energy (Refer to Fig. 2.12.3). The mechanical power output of engine is measured in Brake Horse Power (BHP) or kW.

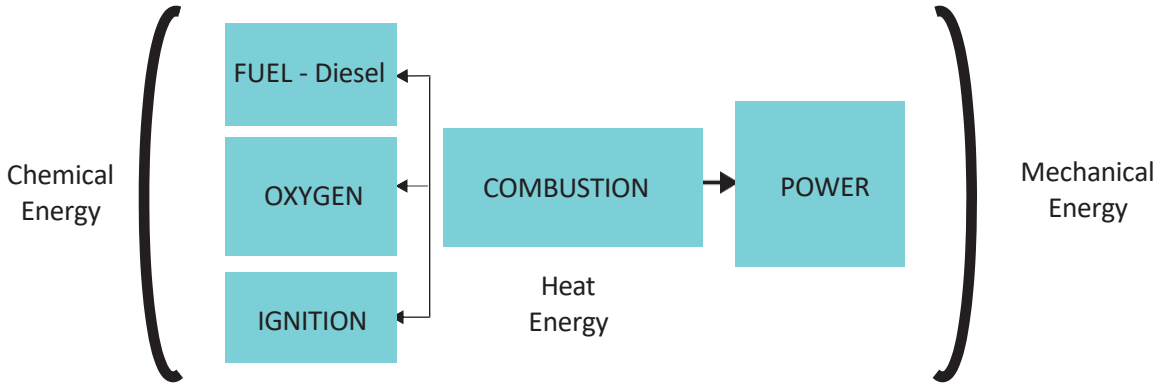


Fig. 2.5.6(i) Energy Conversion in a Diesel Engine

In Diesel Generators we use four-stroke Engine which is shown in the picture below (Refer to Fig. 2.12.4). These four strokes are separate acϴons which work in synchronisaϴon to produce conϴnuous mechanical Power for a longer duration. Four strokes of a 4-stroke internal combusϴon engine are:

1. Intake/SucϴonStroke
2. Compression Stroke
3. Power/Expansion Stroke
4. Exhaust Stroke

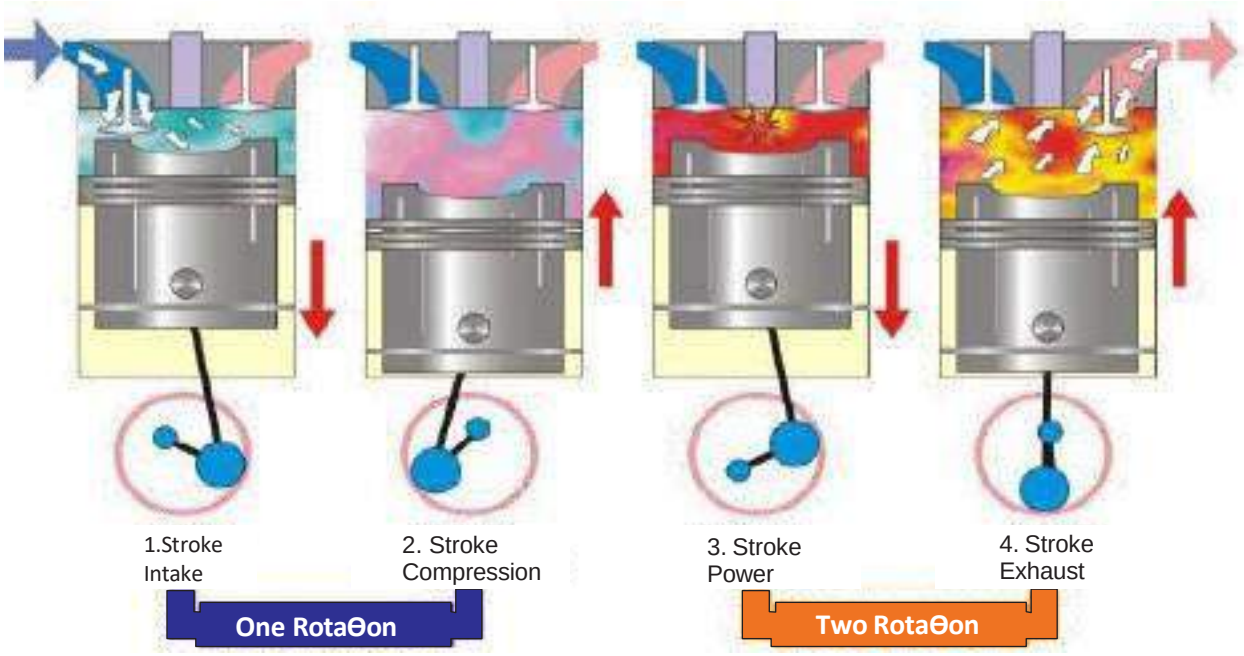


Fig. 2.5.6(ii) Four stock Diesel Engine

Fig. 2.5.6(iii) Suction Stroke

1st Stroke: Suction Stroke (Refer to Fig. 2.12.5): Intake valve remains open during the entire intake stroke. Piston travels from Top to Bottom of the cylinder. Due to partial vacuum created by the piston travel air rushes in. Exhaust valve remains closed during this period

Fig. 2.5.6(iv) Compression Stroke

2nd Stroke: Compression Stroke (Refer to Fig. 2.5.6(iv)): Both in let and exhaust valves remain closed. Piston travels from Bottom to Top of cylinder. The entrapped air is compressed causing air temperature to rise to about 560 ºC. Fuel is injected in atomized condition in to the hot air where it ignites. Combustion of fuel generates heat and gases. The rapid rise in temperature and pressure in the combustion chamber pushes the piston to Bottom of the cylinder.

3rd Stroke: Power Stroke (Refer to Fig. 2.5.6(iv)): Due to high temperature and pressure in the combustion chamber the piston is pushed from Top to Bottom of cylinder. Power transfer from fuel to engine takes place during this stroke. This is also called as “Expansion stroke". During this stroke both valves remain closed.

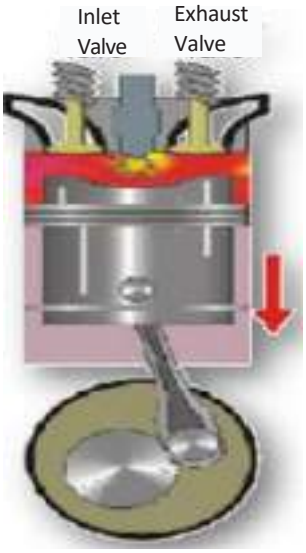


Fig. 2.5.6(iv)Power Stroke

Fig. 2.5.6(v) Exhaust Storke

4th Stroke: Exhaust Stroke (Refer to Fig. 2.5.6(v)): Intake valve remains closed. Exhaust valve remains open during the entire stroke. Piston travels from Bottom to Top of cylinder and Exhaust gases are expelled out.

When all strokes work together (Refer to Fig 2.5.6(vi)) the continues mechanical energy is generated which is passed through the crank sha Ō to an alternator which produces electrical energy.

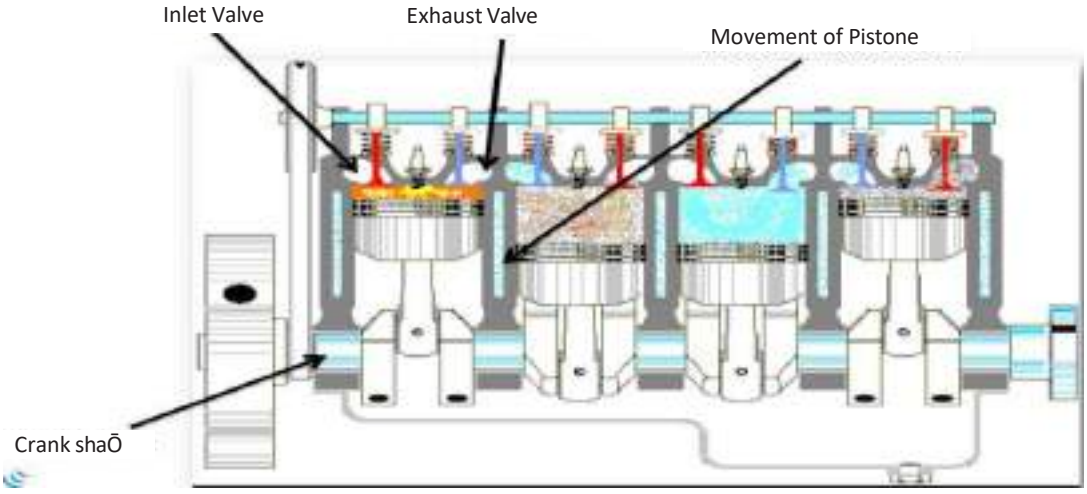


Fig. 2.5.6(vi) All 4 Strokes at a Glance.

2.5.7 Systems in a Diesel Generator

The DG contains the following systems:

- Air Intake System
- Engine fuel system
- LubricaƟon System
- Air Cooling System
- Liquid Cooling System
- Exhaust System

Air Intake System (Refer to Fig. 2.5.7(i)) is used to suck fresh Air from the atmosphere into the diesel Generator set. The sucked air is usually full of dust and other particles which gets cleaned in this air Intake system and this clean air is passed on to the engine fuel system of a DG set. Air Intake system has the following critical component.

Fig. 2.5.7(i) Air Intake System

1. Dry Type Air Cleaner:

This is a primary filter element (Refer to Fig. 2.5.7(ii)) with a built in cyclone separator which gives a swirling effect to incoming air. This separate out heavy dust particle by centrifugal action. The dust is collected in end cover which is removable.

2. Indicator:

Indicator (Refer to Fig. 2.5.7(ii)) in the Air Intake System gives a indication on the level of accumulated dust. Once the indicator shows this chamber is full, dust need to be removed.

3. Evacuator Valve:

The Evacuator Valve(Refer to Fig. 2.5.7(iii)) at the bottom of cover helps in expelling the accumulated dust. This is achieved by opening / closing of Evacuator valve outlet due the airflow fluctuaϴons inside the air cleaner.

Fig. 2.5.7(ii) INDICATOR

Fig. 2.5.7(iii) EVACUATOR VALVE

Fig. 2.5.7(iv) PRIMARY ELEMENT

Engine Fuel System consists of the following parts (Refer to Fig. 2.5.7(v)):-

1. Fuel Tank: Fuel Tank is used to store Diesel.
2. Feed Pump: Feed pump gives the necessary pressure to the fuel to flow from Fuel Tank to Fuel Pump.
3. Fuel Filter: This is a dual filter assembly and has a primary and secondary element to clean the Fuel.
4. Fuel Pump: To pump the fuel to the engine.
5. Injector Or Nozzle: This is used to inject controlled diesel quantity into the combusϴon chamber.
6. CombusϴOn Chamber: In this area where air and diesel is mixed, pressurized to create heat energy.
7. Return Pipe Tank: Return pipe Tank is used to bring back unused fuel.

1. FUEL TANK

2. FEED PUMP

3. FUEL FILTER

4. FUEL PUMP

5. INJECTOR OR NOZZLE

6. COMBUSTION CHAMBER

7. FUEL DIPSTICK

8. FUEL SENSOR

Fig. 2.5.7(v) Elements of a Engine Fuel System

9. FUEL SWITCH

Fig. 2.5.7(v) Elements of a Engine Fuel System

Lubriction System: An important factor determining the life of your engine is proper working of the lubrication system. It is very important that lubrication system is properly serviced for optimum engine performance.

The engine is Lubricated through one of the following mechanism:-

- Pressure LubricaƟon: The oil is pressurized through a gear type Oil pump. The pressurized oil then passes through Oil filter to reach various engine parts.
- Splash Lubrication: This done by oil thrown b y high speed rota Ɵng component o f engine such as crankshaft Used t o lubricate camshaft, liners piston & gear train.
- Mist LubricaƟon: Lubrication by oil droplets which are formed by oil fumes.

Contaminated, dirty or improper grade of oil may damage cylinder liner & piston rings, bush bearings & number of other components. Strictly adhere to company recommendations and use only recommended Engine Oil.

Lubrication system consists of the following parts:

- Oil Sump
- Dipstick
- Strainer
- Oil Pump
- Oil Pressure Gauge
- Oil Pressure Regulating Valve
- Lube Oil Switch

Dipstick(Refer to Fig. 2.5.7(vi)) :- The dipstick measures the quantity of Oil in sump. It is usually grooved with low and high markings to help users maintain the correct oil level in the sump.

Fig. 2.5.7(vi) LubricaƟon System Maintenance

Oil Strainer & Suction tube(Refer to Fig. 2.12.15):- This is fitted at the suction end of the Oil Pump. Oil is taken from the sump by the suction tube through the strainer. The strainer prevents large impurities from entering the pump and damaging it.

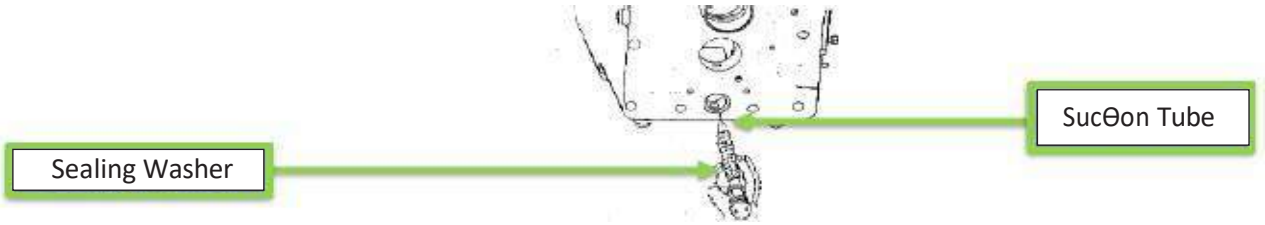


Fig. 2.5.7(vii) Oil Strainer & Suction Tube

Oil Filter & Pressure Regulation Valve :-

- Oil filter is provided to filter micro particles from oil, to avoid damaging of bearings, journals and other components (Refer to Fig. 2.5.7(viii).
- P R Valve regulates lube oil pressure within the system. Usually preset, it cannot be adjusted.

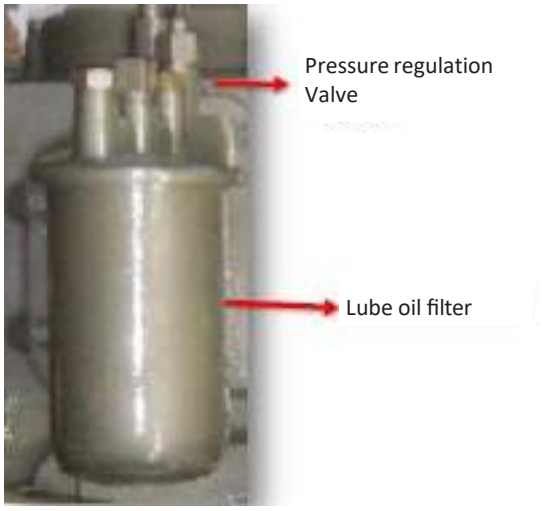


Fig. 2.5.7(viii) Oil Filter and Pressure Regula tion Wall

SITE HYGIENE for Lubrication System
1. Maintain correct level of oil in the engine.
2. Check oil level only when engine has been stopped and sufficient time has been allowed for engine oil to drip back to the sump. Oil level should be checked with the help of dipstick(Refer to Fig. 2.5.7(ix).
3. Proper seating of dipstick in its seat is ensured before pulling it out to check the engine oil level.
4. The oil level should not be below the lower dipstick mark.
5. The upper mark on the dipstick indicates maximum (allowable) oil level in the sump.
6. If oil level is below below the lower mark, than add engine oil through breather adopter.
7. To avoid oil starvation of engine the oil filter element change is very important in recommended intervals. If it is not done properly, the parΘally unfiltered or completely unfiltered oil will go to the engine. It is essenΘal that the oil filter element is replaced at the recommended interval.

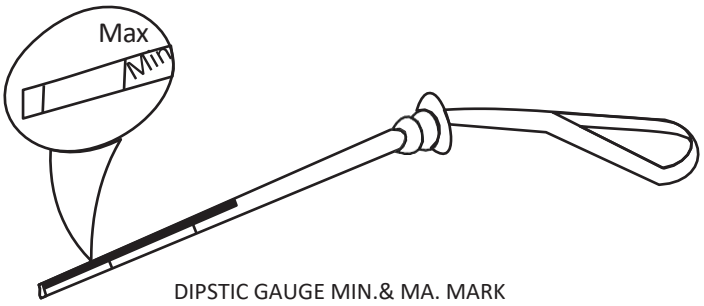


Fig. 2.5.7(ix) Dipstick to Check the Oil Level

2.5.8 Air Cooling System

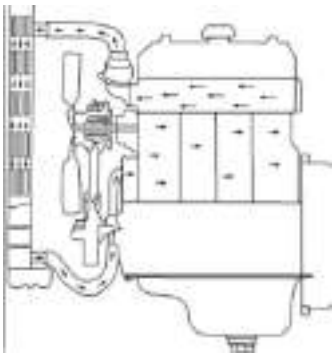
Air cooling system is used to cool down the diesel Engine while it is working. It consists of following parts(Refer to Fig. 2.5.8):

- Fan Belt
- Blower ShaŌ
- Bearings
- Blower Fan
- Cylinder liner Fins

Fig. 2.5.8 Parts of a Air Cooling System

2.5.9 Water Cooling System

Water cooling system is used in conjunction with Air cooling system where water absorb the heat from the Engine and this heat is blown away by air cooling system. The Diagram showing working of a water cooling system is depicted (Refer to fig. 2.5.9). This system includes a Radiator where water coolant is filled to the adequate level. System is designed for ambient temperature of 45°C. Water used in cooling system should be such so that it avoid scale formation, over heating and corrosion.



1. Radiator

2. Radiator Cap

Fig. 2.5.9(i) Water Cooling System and its Part

Site Hygiene for a Water Cooling System

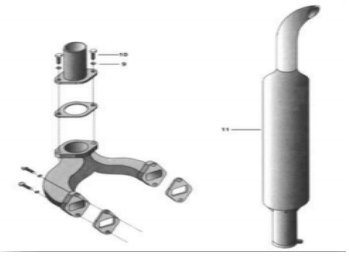
Cooling System	Thermostat operating temperature is 82°C.
	Engine temperature ranges between 85 C to 105 deg. C Allowable maximum temperature is 110 deg. C.
	Radiator cap valve opening pressure is 13 psi.
	Coolant level should be 2" below the radiator neck.
	Radiator should be always clean externally.
	Always Top-up with Coolant only
	Replace / Recharge Coolant aŌer every 1200 hr. or one year whichever earlier. Use clean water for Radiator.

Exhaust System: Exhaust system is used to throw out hot smoke generated from the engine. This system includes Exhaust pipe, Exhaust Silencer, CondensaƟon trap and Rain cover as shown in the Diagram (Refer to Fig. 2.5 9(ii)).

For efficient working of Exhaust system it should create minimum “back pressure” on the engine. High back pressure In Exhaust system leads to:

- Lower fuel economy
- Poor load performance
- Less durability of engine

The exhaust back pressure should not be more than 76mm of Hg



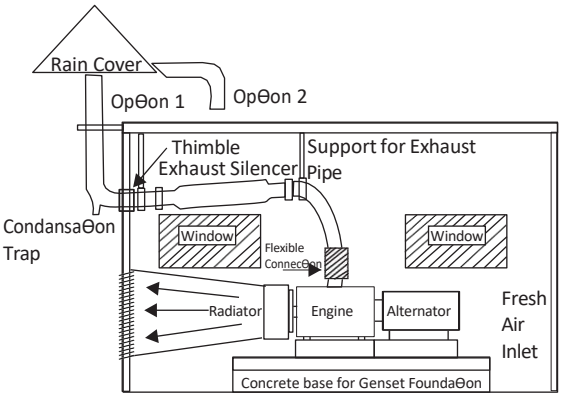


Fig. 2.5.9(ii) Parts of a Exhaust System

Types of Exhaust Smokes:

Healthy Engine emits barely visible smoke if you look at the area surrounding the Exhaust outlet. But many Θmes they emit smoke with different colors as described below. On seeing a smoke of different col maintenance activities need to be performed

Black Smoke:

This indicates improper combustion, which could be due to:

- Choked or wrong air cleaner.
- DefecΘve fuel injection system.
- Choked exhaust system or wrong exhaust piping.
- Engine overload.
- Load side electrical short circuit.

Blue smoke:

Blue smoke is emitted when oil begins to burn in combustion. This could be due to

- Excess oil in sump.
- Excess lub oil pressure.
- Worn piston rings & liners.
- Worn valve steam & valve guides.
- Excess oil from rocker supply pipe.

White Smoke:

White smoke indicates water presence in combustion chamber. This could be due to:

- Cracked Cylinder Head.
- Cracked or Damaged Liner.
- Water dilution in diesel.
- Burnt or damaged cylinder head gasket.

Water presence in combustion chamber is very dangerous and can lead to a hydraulic lock & extensive damage to engine

2.5.10 Alternator

An Alternator is a machine that converts Mechanical energy to Electrical energy. This has following Parts

1. Main Stator: Consists of winding on a core with twelve output leads coming out, which are sleeved and terminated with suitable crimping sockets

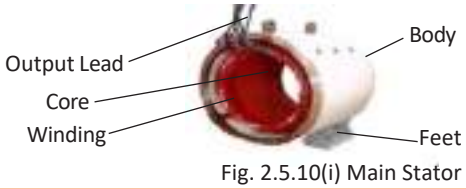


Fig. 2.5.10(i) Main Stator

2.5.10 Alternator(contd)

2. Main Rotor: This moves within the main stator and is made of winding coils on a core. Coil support blocks are provided for adequate supporting of winding from centrifugal forces. The end connections are made and routed through the shaft to be connected to Rotating Rectifier Assemble (RRA) Refer to fig 2.5.10(i)

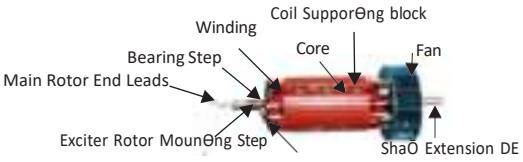


Fig. 2.5.10(i) Main Rotor

3. Exciter Stator and Exciter Rotor: These are connected to the main alternator and provide small amount of Electricity to the field coils of Alternator to Generate Electricity. This controls the output of the main alternator. Refer to Fig 2.5.10(ii)

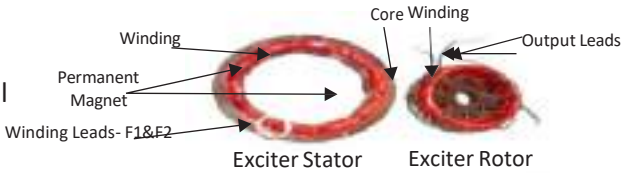


Fig. 2.5.10(ii) Exciter Stator and Exciter Rotor

4. Rotating Rectifier Assembly(RRA): This is used to rectifier the output of the smaller alternator into a steady supply to the main alternator Refer to Fig 2.5.10(iii)

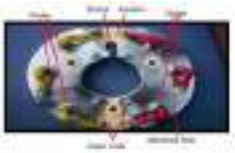


Fig. 2.5.10(iii) Rotating Rectifier Assembly(RRA)

5. Automatic Voltage Regulator(AVR): This is used to control the output voltage of the generator by acΘng as a regulating system as it gives positive or negative output to excitation system to increase or decrease the generator output voltage.

6. Terminal Box: This is used to provide the output points for the Generated power from the alternator.

Excercise

1. Mention the main parts of a DG set.

2. Describe working of a Four stroke Engine.

3. What are the main six systems of a DG set?

4. What is the function of a fuel pump?

5. What does white smoke coming out of a DG set indicates?

Practical

1. Visit a Site and see the working of a DG set and write your observations below.

Notes

2.5.11 Guidelines for First-Aid Facilities

At a working tower site there are possibilities of encountering an emergency situation where an employ or a worker can get hurt accidentally. In such a situation it is mandatary to maintain the first aid facilitates as described in the fig. 2.13.1 below. These facilities should be regularly checked, so that in case of any requirement these facilieθs are found fully available.

S.No.	Activity	Responsibility
1.	Check regularly at least once in a month, the content of first aid kit, refill the used items or replace the expired items.	Admin / O & M / Project
2.	Ensure that informaθon about first aid box, first aid team and emergency contact number are available with employees.	Admin / O& M/Projec
3.	Ensure that the first aid box is either locked or kept with secured access & available at earmarked locaθons	Admin / O & M /Project
4.	Ensure that only authorized person can use the first aid kit, display first aid team members contact details	First aid team / Supervisor
5.	The minimum stock of first aid items that are to be kept in first aid kit(Box) are listed below. • Disprin, Savlon / DeΣol, Burnol, Band-aid, CoΣon • Two individually wrapped triangular bandages, preferably sterile; six safety pins; • Two large, individually wrapped, sterile, unmedicated wound dressings; • Four medium-sized, individually wrapped, sterile, unmedicated wound dressings; • Sterile Guaze Swabs • A CPR mask for mouth to mouth breathing in case of sudden • cardiac arrest.(If possible) • An eye care kit,	Admin / O & M / Project
6.	Treat the injured person as per nature of injury.	First Aid team /Supervisor
7.	If required escort the injured person to nearest hospital .	First Aid team /Supervisor
8.	Keep record the first aid treatment and type of injury.	First aid team /Superviso
9.	Inform the incident controller / Site Engineer about major injury .	First aid team /Supervisor
10.	Report the first aid treatment analysis to Incident controller / Site Engg.	Admin / Supervisor
11.	Conduct regular first aid training to first aid team / Supervisor.	Admin / Site Engg.

Fig. 2.5.11 First Aid Guidelines for a Tower site

UNIT 2.6: Guidelines for Maintenance Activities

Unit Objectives

At the end of this unit, you will be able to:

1. Understand the description of the key words used during the maintenance activity.
2. Identify the guidelines which are to be followed while doing the maintenance activity.

2.6.1 Maintenance Activities

The Purpose of the guidelines for Maintenance activities is to ensure a complete understanding o f the process of maintenance to meet commiΣed SLA s and to ensure safety of the authorised person responsible for commissioning, servicing and maintenance of equipments at the tower site.

2.6.2 Key Terminologies

Following are some of the Key terminologies used during maintenance activities.

Authorized person. A person who performs service or maintenance on machinery, equipment, or a system, who is qualified through appropriate training, has demonstrated proficiency in the performance, and has been assigned by his/her supervisor or organizaΘon.

Control of hazardous energy (CoHE). Control measures used to protect workers from exposure to all forms of hazardous energy due to accidental equipment energizaΘon or startup, or from working on or near electrical conductors or circuit parts.

Energized. Connected to an energy source or containing residual or stored energy. De-energized equipment is considered energized unΘl a zero energy state is verified.

De-energized. Isolated from all energy sources and not containing residual stored energy.

Electrically safe work condition. A state in which an electrical conductor or circuit part has been disconnected from energized parts, locked / tagged in accordance with established standards tested to ensure the absence of voltage, and grounded if determined necessary .

Energy source. Any source of energy, including electrical, mechanical, hydraulic, pneumaΘc, chemical, thermal, and radiaΘon.

Hazardous energy. For the purposes of this program, hazardous energy is energy that could cause injury to a worker involved in service or maintenance through the unexpected release of stored energy or the unexpected energizaΘon or start up of machinery, equipment, or a system .

Lockout. The placement of a lockout device on an energy isolaϴng device, in accordance with an established procedure, ensuring that the energy isolaϴng device and the equipment being controlled cannot be operated unϴl the lockout device is removed. Lockout is the primary means for achieving CoHE.

Lockout device. A device that uses a Positive means such as a lock, either key or combination type, to hold an energy isolating device in the safe position that prevents the energizing of machinery or equipment. A blank flange or bolted slip blind are considered lockout devices.

Servicing and/or maintenance. Includes workplace activities such as commissioning, installing, setting up, adjusting, inspecting, modifying, demolishing, and maintaining and/or servicing machinery or equipment.

Tag out. The placement of a tag out device, normally in conjunction with a lockout device, onto an energy isolating device.

Tag out device. A prominent warning device, such as a tag and a means of attachment that can be securely fastened to an energy isolating device in accordance with an established procedure, to indicate that the energy isolating device and the equipment being controlled may not be operated until the tagout device is removed.

Click/Scan the QR code to view the video on preventive maintenance

2.6.3 Steps of Maintenance

Any maintenance acθvity involves a standard procedure which has to be executed before the start of maintenance acθvity and post compleθon of the maintenance acθvity. This ensures safety of equipment and the personals involved in these activities. Given below are the steps to be followed (Refer to Fig. 3.1.1)

S. No	AcθvityAir Conditioner	Responsibility
Daily	Establishing a Lockout / Tagout	Check A/C status and their grill
1.	Get permission to work on equipment	Authorized Person
2.	Discuss with supervisor/engineer for work coordinaθon	
3.	Noθfy the affected parθes prior to shut down. • Noθfy all affected parθes that a lockout/tag out is about to take place, the reason for it, and the specific affected machinery or equipment • Clear the area of people and any nonessenθal objects	
4.	Idenθfy and locate the energy source and energy isolaθng device.	
5.	If electrical energy is involved, perform zero voltage verificaθon.	
6.	If more than one energy source is involved idenθfy and remove all energy sources.	
7.	Shut the machine or equipment down using the normal stopping rocedure	
8.	Operate the disconnect switch, circuit breaker, valve or other energy isolaθng device to isolate (disconnect) the machine or equipment from its energy source	

Fig. 2.6.2(I) Steps for a Maintenance Activity

Sl. No	AcΘvity	Responsibility
Establishing a Lockout / Tagout		
9.	Apply assigned lockout and tagout devices to the energy isolaΘng device	Authorized Person
10.	Relieve and/or restrain stored energy. Exhaust or restrain stored or residual energy in the machine or equipment by grounding, blocking, bleeding down, etc.	
11.	Verify zero energy. • AΣempt to start the equipment using normal operating controls to check that the energy source has been successfully disconnected. • Return the operating control(s) to the neutral or off position before proceeding with servicing or maintenance work. • Assure zero energy state appropriate to the type of hazardous energy involved	
12.	Proceeds with servicing or maintenance work	
Returning Equipment to Service		
13.	Checks the machine/equipment and surrounding area to ensure that nonessenΘal objects have been removed, guards have been reinstalled, and that the machine/equipment is operaΘonally intact	Authorized Person
14.	Verifies machine/equipment controls are in the "neutral" or "off" position.	
15.	Verifies that all affected workers and other authorized workers are out of harm's way	
16.	Removes lockout and tagout devices and reenergizes the equipment	
17.	Before restarΘng machinery/equipment, noΘfies affected employees that work is complete and that locks and tags have been removed	
18.	NoΘfies the user that the lockout/tagout process is complete, and that normal work may proceed on the equipment	
Lockout and Tagout Device Removal		
19.	Only authorized person can remove lock and tag, if this person is not available, the device may be removed only the direcΘon of supervisor in consultaΘon with authorized person.	Authorized Person

Fig. 2.6.3(ii) Steps for a Maintenance Activity

UNIT 2.7 Routine Preventive Maintenance

Unit Objectives

At the end of this unit, you will be able to:

1. Explain the daily maintenance activities.
2. Implement the weekly maintenance activities.
3. Execute the monthly maintenance activities.
4. Timely deliver quarterly maintenance
5. Plan for half yearly and yearly activities in advance
6. Take up maintenance a ctivities as and when they are required.

2.7.1 Routine Preventive Maintenance

Frequency	Equipment/System	AcƟvity
Daily	Air conditioner	Check A/C status and their grill position. Visual inspecƟon of A/C.
Daily	Civil works	During rainy season, check shelter/room for water seepage/leakage.
Daily	DG-set	Check D-G set battery voltage (by DC voltmeter on AMF panel or by multi meter) and charging current (by DC ammeter on AMF panel)
Daily	DG-set	Maintain record of number of hours of running of D-G set, diesel consumed, KWH produced, water temperature (when DG is ON), lube oil pressure (when DG is ON) and works done on D-G set.
Daily	DG-set	Visual check water leakage in the canopy and for fuel & oil leakage.
Daily	Electrical installation	Record Voltage & energy readings
Daily	Electrical installation	Check all fuses, MCBs & ELCBs (visual inspection & heat generated).
Daily	Electrical installaƟon	Check functioning of aviation lamp
Daily	Fire Alarm System	Check status of fire panel and blinking of detectors.
Daily	General	Check cleanliness inside the shelter, inside the canopy & of A/C body.
Daily	Stabiliser	Check the equipment for over heating
Weekly	Air conditioner	Check the condition of the filter & clean it.
Weekly	DG-set	Check battery terminals for looseness & rust and taking remedial action
Weekly	DG-set	Top-up distilled water in battery if required
Weekly	EB supply	Visual inspection of the meter & main fuses on pole.
Weekly	Stabiliser	Check O/P voltage.
Monthly	Air conditioner	Clean condensed water tray & the drain pipe

Fig. 2.7.1 Various Maintenance Activity at a site

Frequency	Equipment/System	AcƟvity
Monthly	Air Conditioner	Clean the cooling-coil fins using a wire brush.
Monthly	Air Conditioner	Clean the interiors of the machine.
Monthly	Air Conditioner	Clean the interiors of the control panel
Monthly	Air Conditioner	Check the Ɵghtness of all the terminaƟons in the control Panel.
Monthly	Air Conditioner	Check the Ɵghtness of the foundaƟons bolts of compressor, blower motor & fan-motor.
Monthly	Air Conditioner	Measure supply air temperature. VariaƟon should not be more than 1*C from the designed/iniƟal value.
Monthly	Air Conditioner	Check the body & safety grills for loose screws, etc
Monthly	Air Conditioner	Check the room for hot-spots.
Monthly	Air Conditioner	Check & note current drawn when compressor is ON.
Monthly	Civil works	Check foundaƟons (shelter, DG, tower) & room for cracks, effervescence.
Monthly	DG-set	Clean of air-filter.
Monthly	DG-set	Clean of engine, alternator, terminal box on alternator, AVR, AMFpanel interiors, canopy interiors, air inlet/exit opening of canopy.
Monthly	DG-set	Check lube oil level. Top up if necessary.
Monthly	DG-set	Check all terminaƟons (on alternator, in AVR & in AMF panel) for looseness & overheaƟng
Monthly	DG-set	LED/Lamp test, if provision is available in the AMF panel.
Weekly	EB supply	Energy bill handling, from receiving the bills Ɵll their payment (As per the SOP).
Monthly	Electrical installaƟon	Check all panels (As per the check pts) and all cables (As per the check pts).

Fig. 2.7.1 Various Maintenance AcƟvity at a site

Frequency	Equipment/System	AcƟvity
Monthly	Electrical installaƟon	Check all terminaƟons & cables for over-heaƟng.
Monthly	Electrical installaƟon	Clear dust from all equipments & DBs/Panels.
Monthly	Electrical installaƟon	Check terminaƟons & correct/timely working of aviaƟon light & its auto operation. Clean photo cell
Monthly	Fire Alarm System	Check FAS (cleanliness & terminaƟons) and all detectors
Monthly	Stabiliser	Clean the stabiliser.
Monthly	Stabiliser	Check the set points
Quarterly	Earthing	Check earth resistance & taking remedial acƟons if necessary
Quarterly	Earthing	Check all terminaƟons at earth-pits and in the earthing network in the site.
Quarterly	Fire-Extinguisher	Check Extinguishers for storage-pressure (DCP) or by weight (Co2).
Quarterly	Stabiliser	Check the manual operation.
Quarterly	Lightning arrestor	Check connection of lightning arrestor and conƟnuity up to earthpit.
Quarterly	Tower	Check for missing bolts, nut, members and recƟfy
Quarterly	Tower	Check Ɵghtness of foundaƟon bolts Ɵghten if required
Half yearly	Half yearly	Check for requirement of any repair or painƟng
Half yearly	DG-set	Contactor (AMF panel) overhauling if required
Half yearly	Earthing	TesƟng & watering of all earth pits
Half yearly	Electrical installaƟon	Check & clean all ligh Ɵng equipmnts.
Half yearly	Electrical installaƟon	Check for cable damages and perform energy audit & electrical safety audit.

Fig. 2.7.1 Various Maintenance Activity at a site

Frequency	Equipment/System	AcƟvity
Half yearly	Alarm system	Check for smoke & intruder alarm functionality
Half yearly	Shelter	ck for foundaƟon bolt Ɵghtness, leakage, rusƟng and repair (Carry out pre monsoon)
Half yearly	Shelter	Check for door gasket, lock, lubricaƟon and repair/replace
Half yearly	Stabiliser	Check IR value & oil dielectric strength. Heat & filter the oil if required.
Yearly	Electrical installaƟon	Maintenance of all ACBs , OCB, relays & transformer (if H.T supply is taken).
Yearly	Electrical installaƟon	To do a thorough check-up of the elec. distribuƟon (Including loading , heaƟng & condition of switches , fuses , S-F units & other switch gears and cables).
Yearly	Tower	Check for corrosion of members, nut & bolts. RecƟfy by painƟng
As required	DG-set	Diesel filling.
As required	DG-set	B-check, as per manufacturer's recommendaƟon, every 250hrs of running or every 6 months, which ever is earlier.
As required	DG-set	If there is no EB power failure for 15 days, test-run the DG-set on-load for 60min.
As required	Stabiliser	CoordinaƟng with the EB in case of power failure or any other problem.
As required	Air Conditioner	CoordinaƟng with the manufacturer for reilling/replacement.
As required	Tower	Repainting tower

Fig. 2.7.1 Various Maintenance Activity at a site

UNIT 2.8: Maintenance of Batteries

Unit Objectives

At the end of this unit, you will be able to:

1. Understand the maintenance activities to be performed on a battery bank.
2. Identify the precautions to be taken while handling batteries.
3. DifferenƟate between system monitoring and trouble shooting while maintaining the battery.
4. Remove the faulty cell from battery bank by performing discharge test and by using equalization charging.
5. Demonstrate the procedure of Boost charging of cell.
6. Trouble shoot the problem in a battery bank.

2.8.1 Maintenance of Batteries

Maintenance of a battery gets reduced drastically if the installation and storage of the batteries is done properly. To achieve the same the Installation of battery bank should be done as per the battery manual. Given are the steps:

- Receiving Inspection: Unpack the battery module, accessories box and check the following:
    1. Quantity of the accessories as per the packing note
    2. Transit damages

    Note: Damage/short supply needs to be reported in writing within a week for insurance claim
- Storage and installation consideraƟons:
    1. Check Floor Loading: System weight and dimensions are provided in the drawing.
    2. If floor loading exceeds the permissible limits, assemble the batteries on a steel sheet of min. 5-mm thickness.
    3. Store the batteries in covered area.
    4. If the batteries are stored beyond 6 months, give a freshening charge at regular basis.
    5. Provide normal venƟlaƟon. Do not install in airƟght area.
    6. Keep away from Sparks, Heat, Fire & direct sunlight.
    7. Never install the VLRA battery in a closed box
- System assembly
    1. While doing terminaƟons all terminals should be clean.
    2. Do not take tap connection.
- Post preparaƟon
    1. Affix cell number sƟckers and polarity labels.
    2. Fill the date of installation on the Nameplate using a marker pen.
- connection
    1. Apply a thin film of petroleum jelly on the terminal post to contactor joints , aŌer the connection are made

2.8.2 PrevenΘve Maintenance Schedule- battery Bank

AÕer the installaΘon and commissioning of the battery is done properly, if a correct PrevenΘve Maintenance schedule is followed the life and performance of the batteries increases many fold. PrevenΘve Maintenance schedule as per the table below for a battery bank needs to be followed on regular bases to keep batteries healthy (Refer to Fig. 3.3.1).

S. No.	Check Points
1	Carry out battery Bank Cleaning.
2.	Check leakage from battery cells. If Yes, take correcΘve acΘon to prevent it.
3.	Check vent plug, inter cell connection and cable for Θghtness.
4.	Check battery Bank Stand earthing for Θghtness.
5.	Check SMPS Temperature CompensaΘon (TC) probe is mounted to battery casing/base.
6.	Check for protection covers availability o n battery Bank.
7.	Check individual cell/ connector temperature for abnormal overheaΘng.
8.	Check battery Bank Voltage.
9.	Check battery chiller operation.
10.	Check battery chiller door for free operation & proper locking.
11.	Check no air leakage from battery chiller door.
12.	Check & record battery Bank charging current.

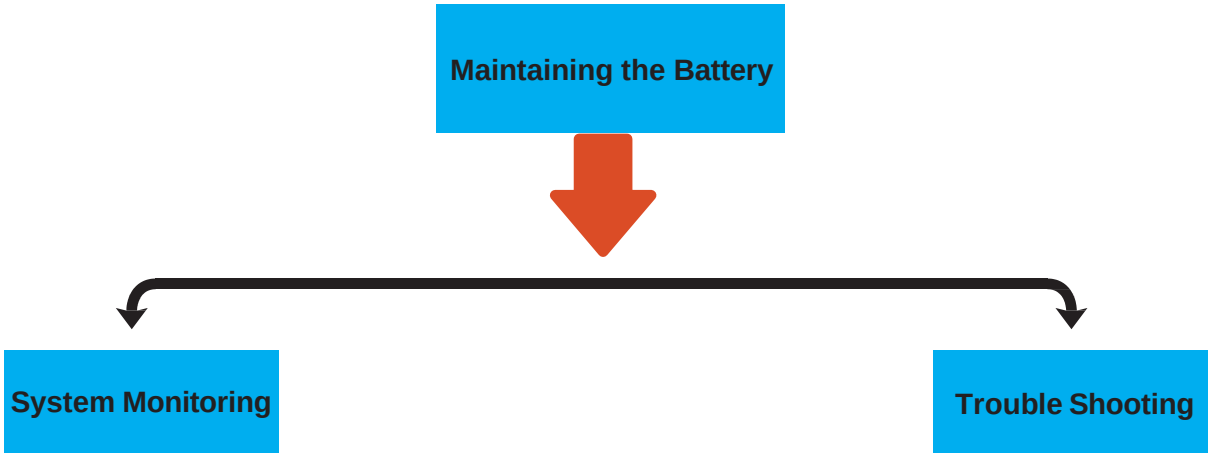
Fig. 2.8.2 PrevenΘve Maintenance Schedule of a battery Bank

The precautions that need to be taken while handling the battery are:

- Use insulated tools only
- Lifting equipment must withstand the module weight
- Always start with connection drawing
- Avoid installation of damaged batteries
- Avoid short circuits

Maintenance of the battery is divided in two parts-

- System monitoring
- Trouble ShooΘng



1. RouΘne checks
2. Quarterly monitoring
3. Yearly monitoring
4. EqualizaΘon charge
5. Test format
6. Charge format
7. Test guideline

Fig. 2.8.2(i) Types of Maintenance in a battery

2.8.3 Routine Maintenance of battery Bank

Some of the common problems seen in a battery bank are listed below (Refer to Fig. 3.2.3). These are handled day to day bases as routine maintenance problems as per the table.

S. No	Checks	AcΘon
01	Physical damages, any leakage, bulging of cell, Cracking of cover & container	Replace the cell
02	Check the over voltage cut off and under voltage trip. (Over voltage cutoff: 2.33VPC, Under Voltage trip: 1.75 VPC)	If varies, reset the same in the SMPS

Fig. 2.8.3(i) System Monitoring

A list of RouΘne Checks which should become part of the Beat plan of every site are given as per the table. These needs to be implemented on regular basis (Refer to Fig. 3.2.4).

Check the float charging voltage and current (Voltage: 2.23 volts per cell, Current: 10% of cell rated capacity)	✔			
Note down the average ambient battery room temps. (battery will give pΘmum performance when operated at 27 C. The temperature compensaΘon factor is – 3 mV/cell º C rise from the ambient temp. of 27º C and vice versa)	✔			
Maintain battery record		✔		
Before Starting this test ensure that the batteries are in fully charged condition. Note down individual cell voltage readings aŌer discharging the battery bank for 30 min (with current of min 10% & max. 20% of the rated capacity) by switching OFF the recΘfier to idenΘfy weak cells if any in the battery string		✔		
Manual Boosts charge the batteries for 24 Hrs. (Voltage: 2.30 VPC, Current: 20% (max.) of cell rated capacity			✔	
Check for terminal post corrosion, if any remove the connector, clean with brass brush or emery paper & Re-torque the terminal Bolts to 11Nm.			✔	
Test discharge of the battery bank @ C10 rate				✔

Monthly **Quarterly** **Half-yearly** **Yearly**

Fig. 2.8.3(ii) Routine Checks

2.8.4 Quarterly Monitoring

Discharge the battery bank with equipment load (normally 10% of the rated capacity) for 30 minutes and note down the individual cell readings:

- Calculate the average cell voltage of the battery bank as follows :-

  Average cell voltage = Total bank voltage/No. of cells

- If the average cell voltage is >2.0 volts, Individual cell readings should be with in a range of + 0.03 V.

- If the average cell voltage is <2.0 volts, Individual cell readings should be with in a range of + 0.1 V.

- If any cell voltage reading falls out of the above range those cells should be monitored very closely since there is a possibility that these cells can become faulty in future.
- EqualizaΘon charging needs to be given if the above menΘoned voltage variaΘon is found.
- Wherever the above discharge test is not possible, use a suitable on line discharge equipment to determine the health of the battery bank.

2.8.5Equalization Charge

EqualizaΘon Charging Of VRLA batteries

The equalizaΘon charging of the batteries needs to be done whenever the battery cell voltages are not equal (differ by more than+ 0.03V) .This can be found out from Short-term discharge test or from annual discharge test. The following precautions need to be taken before the equalizaΘon charge:

1. Check DG set is healthy & Fuel tank is full.
2. Start DG set in manual & take on load manually. Wait for 10 minutes aŌer switch over of Load.
3. Isolate battery bank from SMPS b y removing battery fuse in SMPS.
4. Connect external load to battery bank through isolator (MCB).
5. Start discharge with discharge current limited to 10% of battery AH.
6. The battery bank has to be completely discharged up to end cell voltage (ECV) i.e. 1.75 V for 2V battery.
7. ConΘnuous monitoring of the individual cell voltage and the bank voltage has to be ensured.
8. The readings shall be recorded in the format used for B aΣery discharge test.
9. As soon a s cell reaches ECV o f 1.75V, stop discharge test & bypass the cell & con Θnue with discharge test.
10. All the cells have to be discharged.
11. Charge the battery bank with 0.1 C to 0.2 C rate current for a period o f at least 2 1 hours.
12. Check the individual cell voltages aŌer the charging. If the varia tion is more than 0.1 V in the cells, carry out discharge test
13. Carry out discharge test & check B aΣery back up, if during discharge test cells marked prior to EqualizaΘon test are not showing any improvement & voltage is dropping wrt to other cells, cells called for replacement.

2.8.6 Yearly Monitoring

1. Charge the batteries at a constant voltage of 2.30 volts per cell with current limited
   - To 20% of the rated capacity for 48 hr. or
   - To 10% of the rated capacity for 72 hr.
2. Then discharge the batteries at C10 rate. i.e. 10% current of the battery rated Ah capacity.

3. Note down the hourly readings in test data sheet. Enclosed in unit 5.10.
4. AÕer compleƟng the test, if the capacity obtained is more than 90% of the rated capacity then the same may be connected back to load aÕer recharge as menƟoned in point (i) above.
5. If the capacity obtained is less than 80% to 90% repeat point # 1.
6. If the capacity obtained is still less than 80% contact the service personals.

2.8.9 Procedure for Monthly Boost Charging

Following is the procedure for Boost Charging of VRLA battery Bank at a telecom site:

1. Tighten all inter Cell connectors (ICC) and ensure all vent plugs are intact in the b aΣery bank with help of Torque Wrench a s one time acƟvity.
2. Ensure that sleeves on ICC's are not overlapping on terminals.
3. Check & record Float voltage at SMPS & at battery Bank .
4. Measure & Record the individual cell voltage and current drawn by battery bank while it is in float charging mode.
5. Set the battery Voltage t o enable D G start a Õer power failure ensuring b aΣeries are not subjected to discharge for more than 5 minutes.
6. Select Power Plant in Boost charge mode.
7. Adjust the Boost voltage in Power Plant to 2.35V/ Cell i.e. 56.5V and current limit Ensuring is C/ charge rate i.e. 10% of battery AH capacity.
8. Measure & Record the individual cell voltage and charge current at the beginning of periodic boost charge.
9. Ensure the battery is charged o n Boost mode for a t least 1 6 hrs.
10. Measure & Record the individual cell voltage & bank charge current during last hour of Boost charging.
11. Restore the seţng t o the normal opera tion and set the power plant into normal charge mode (i.e. Boost cum Float).

Practical

1. Practically do the process of monthly boost charging.

2.8.10 Trouble Shooting

While in operation the batteries tend to get worn out and problems occur which need to be looked at immediately. In this unit we are covering few frequent problems being faced in a battery bank at a tower site. These need to be understood properly so that at the time of failure Participant can take immediate acΘon.

2.8.11 Over Charging

Incase of battery over charging (Refer to Fig. 3.3.4)the following points need to be looked at:

1. Reasons for battery over charging are :
   - Charging at a higher voltage
   - Higher set point
   - Cell by-passed

2. Effects of battery over charging are:
   - Loss of water
   - Dry out of separator
   - Increased temperature
   - Positive grid corrosion

3. User Action to be taken is to ensure:
   - Float voltage is set to 2.23 Volts Per Cell
   - Charging current limit is set to 10% (max.) of cell rated Ah capacity

Fig. 2.8.11 battery Over Charging

2.8.12Under Charging

Incase the battery is undercharging (Refer to Fig. 3.3.5) while in operation:

1. The reasons of under charging of a battery are:
   - Charging at lower voltage
   - Lower set point
   - Frequent power failures

2. Effects of under charging of a baΣery are:
   - ReducΘon in capacity cycle by cycle
   - Hard SulphaΘon crystals formed on plates surface

3. User acΘon to be taken to remove undercharging is to ensure:
   - Float voltage is set to 2.23 Volts Per Cell
   - Charging current limit is set to 10% (max.) of cell rated Ah
   - Sufficient recharge ater a discharge capacity

Fig. 2.8.12 Under Charging of a battery Bank

2.8.13 Difficulties with SMPS

While in operation SMPS can malfuncΘon (Refer to Fig 3.3.6).

1. The reasons of problem with SMPS are:
   - MalfuncΘoning of charger components.
   - Over/under voltage protecΘons not working/provide.
   - Poor O/P voltage regulaΘon.

2. Effects of these problems with SMPS are:
    - Over /Under charging.
    - Loss of water/sulphation.
3. User action to be taken is to Ensure:
    - SMPS settings should be checked once in a month as per critical Parameter Setings guidelines.

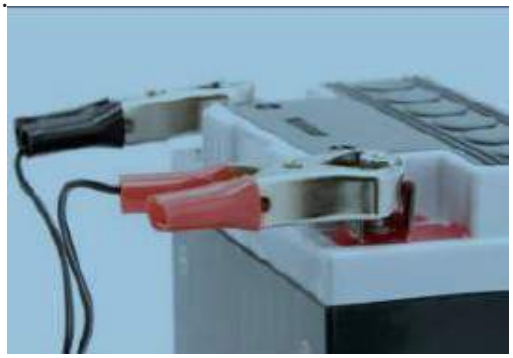


Fig. 2.8.13 Problem with SMPS

2.8.14 Cracked/Broken jars & covers

One of the most common fault which the technicians face is the Jars and covers getţng damaged:

1. Reasons of Jars and Covers gettng damaged can be :
    - During transit.
    - During unloading at destination.
    - At the time of transferring cells from stores to site.
    - During installation.
2. Effect of damaged Jars and Covers is:
    - Oxygen recombinaϴon will not takes place.
    - Gases escaped through crack during charging.
    - Day-by-day cell efficiency will come down.
3. User action to be taken is:
    - Replace the cell(s) immediately.

2.8.15 Corroded Terminals

While in operation if the batteries are not maintained properly the terminals get corroded:

1. Cause for corrosion of terminals is:
    - Sulphation on terminals.
2. Effect of this corrosion is:
    - Sudden drop in voltage during charge/discharge.
    - Low capacity.
    - Heating of the terminal post.
3. User action to be taken is:
    - Clean the terminal post with emery paper/brass brush as and when noticed.

Practical

1. Check the float charging voltage and current of a battery.

2. Remove the connector from the battery and put it back again.

3. Test discharge of a battery bank @ C10 rate.

4. Charge the batteries at a constant voltage at 2.3 volt with a current limited to 20% of the rated capacity.

Notes

UNIT 2.9: Maintenance of a Diesel Generator

Unit Objectives

At the end of this unit, you will be able to:

1. Know about the critical requirements of a DG Site.
2. Identify the check points that need to be observed while installation of DG.
3. Understand the common mistakes that occur during a installation and the effects of those mistakes.
4. Learn the importance of proper Maintenance.
5. Follow the General Safety instructions while using a DG.
6. Discuss the precautions need to be taken while using an Alternator.
7. Perform the corrective maintenance of a DG.

2.9.1 Impact of Proper installation

Proper installation of a DG set will ensure that the following issues are taken care of

- Reduced vibraϴon in DG / reduced transmission of these vibraϴons.
- Improved reliability, durability and life of a DG set.
- Easy serviceability.
- Optimum availability.
- Better fuel economy and efficiency.
- Better working conditions.
- Improved aesthetic of D.G. and the Site.
- Better sound absorption as per Central Pollution Control Board (CPCB) Norms and protection to environment by reduction in noise & emission of exhaust gases.

2.9.2 Sound Level Norms for a DG in India

Notification has been issued by Ministry of Environment and Forests for the Maximum permissible sound level for Diesel Generatng sets upto 1000 KVA. The maximum permissible sound pressure level for new diesel generator (DG) sets with rated capacity up to 1000 KVA, manufactured on or after the 1st July, 2003 shall be 75 dB(A) at 1 meter from the enclosure/canopy surface under Free Field (no obstrucϴon to sound in any direction) Conditions. The Central Pollution Control Board is the nodal agency for implementation of these regulations. Every manufacturer of DG set must have valid cerϴficates of Type Approval and also valid certificates of Conformity of Production for each year, for all the product models being manufactured or imported from 1st July, 2003 with the specified noise limit. The following agencies are authorized to carry out such tests for giving certificates for Type Approval and Conformity of Production testing of DG sets and to give such certificates :-

- Automotive Research Association of India, Pune (ARAI)
- National Physical Laboratory, New Delhi (NPL)
- Naval Science & Technology Laboratory, Visakhapatnam
- Fluid Control Research Institute, Palghat
- National Aerospace Laboratory, Bangalore

Emission norms for DG sets in India:

For each of their models every manufacturer is required to take certificate, from certification agencies, showing emissions (composition of exhaust) of the engine. The following agencies are authorized to carry out such tests for giving certificates of Type Approval and Conformity of Production tests for Diesel engines and to give such certificates :-

- Automotive Research AssociaΘon of India, Pune.
- Vehicle Research and Development Establishment, Ahmednagar.
- International Centre for Automotive Technology, Gurgaon.

2.9.2 Pre- Requisite for installation of a DG

The points mentioned are needed as pre- requisite for installation of a DG

- selection of location of DG Set: The selection of location for installation of DG is based upon Proper liÕing arrangement for loading & unloading of canopied DG set without damaging the canopy panels. Proper space should be provided for loading & unloading of Canopied DG on site. For proper operation & maintenance of DG set you need to ensure
  - o 1 to 1.5 metre of free space around the DG set
  - o Proper height of base
  - o No restricΘon on fuel tank removal side
  - o Safety parameters ensured specially for RTT
- VenΘlaΘon: While installing a DG certain aspects about venΘlaΘon have to be considered which are - DG should not be in path o f smoke, should not b e surrounded by tall structures, should b e away from scrap yards, acidic fumes, cement/stone, coΣon, fibres, chemicals. Ensure that there is no restricΘon for fresh air sucΘon & hot air discharge and there i s no hot air discharge r e-circulaΘon inside the canopy.
- FoundaΘon: While placement of DG on foundaΘon we need to ensure the Level of DG by spirit level Gauge. Total contact area of DG frame to Floor should be minimum 80% and 100 % contact should be available at corners.
- Earthing System: An Earthing system must be as per recommended norms. Separate earth should be used for body & neutral Earthing. 3 Nos Earthing pits are required for three / single phase DG sets with 1 each for neutral, DG & body earth. The minimum distance between 2 Earthing pits should b e 2 mtrs. A water filling pipe of 19 mm with a funnel should be provided for each pit wherever the depth of pit is not at water level. Maximum Earthing resistance should b e 1 ohm.
- Cabling: Ensure correct size of Lug/terminal is used for carrying full load current. Electrical failures related with cable shorts etc. are observed due to loose crimping or undersize cables. Proper crimping of the cable need to be ensured. Ensure proper cable size as per the KVA raΘng of the DG sets. Ensure load balancing in case of 3 phase DG. Ensure D G conΘnuous running at a load of 50% - 80% of rated capacity. Self-starter/Stop solenoid operating voltage drop i s to be noΘced in case o f increased distance of PIU /battery charger from DG. Ensure a minimum voltage 11V by use of adequate cable size / relays.
- battery The purpose of a bΣery is to Provide electrical energy to the control system and Supply power to the starter and ignition system to crank the engine. For the good operation and maintenance of the battery, the following aspects need to be kept in mind.

- Secure the battery firmly on the cradle.
- Ensure the cable terminals Θghtly fiΣed on the baΣery posts.
- Do not hammer down terminals onto posts.
- Clean the terminals and the posts regularly to avoid corrosion.
- Apply Petroleum jelly / Vaseline on the terminals and posts. Never apply grease.
- Top up only with disΘlled water and maintain the level corresponding to the maximum level, never add Acid.
- Keep vent plugs Θghtly closed.

2.9.3 Safety Precautions while using a DG

The points menΘoned in this unit should be followed as safety precautions.

- Ensure that all adjustment & repair are done by only trained /authorized person.
- Do not try to change the configuration of the engine.
- Do not clean or add lubricating oil or adjust the engine while it runs.
- Clean the oil, fuel, dust etc. & always keep the engine dry.
- The fuel, lubricating oil and coolant can cause irritation in skin is in contact for long time. Protect your hands with gloves or by medical advised jelly/cream.
- Material which has been contaminated by fuel must be moved to a safe place.
- Disconnect the battery terminals before a repair is made to the electrical system.
- Ensure that the engine is operated only from the control panel or from the operators position.
- If your skin comes into contact with high-pressure fuel, obtain medical assistance immediately.
- Do not put material which is contaminated with oil into the pockets of clothing.
- Never tighten nuts and bolts while the engine is running. It can cause damage to the components.
- Do not fill fuel in the tank while the engine runs.
- Do not smoke when filling fuel in the tank.
- Carefully touch engine parts after stopping the engine, they are hot & may cause serious injuries.
- Do not permit a person have loose clothing or long hair near moving parts.
- Keep away from moving parts during engine operation.
- The battery fluid is dangerous to the skin and especially to the eyes.
- Do not allow sparks or fire near the batteries (especially when the batteries are on charge), the gases from the electrolyte are highly flammable.
- The combustible material of some components of the engine (seals etc.) can become extremely dangerous if it is burned. Never allow this burnt material to come into contact with the skin or with the eyes.
- To achieve safe work environment and prevention of pollution, it is important to dispose of filters and used oil.
- Do not let oil and other liquids drops into the soil during servicing of the engine. Take them to a suitable disposal points.
- Ensure that the engine does not location in a location where it can cause concentration of toxic emissions.

- Do not operate the DG below 50 litres level in Fuel Tank (Diesel tank) to avoid Air lock and Engine not Starting problem.
- Do not operate the DG below low level mark of the Engine lubricaϴng oil level dipsϴck to avoid oil deterioraϴon and damage to engine parts.
- Do not operate the DG with air cleaner vacuum indicator with red indicaϴon to avoid loss of power, black smoke, performance problems and damage to engine parts.
- Do not operate the DG with Oil / Diesel / Water leakages.
- Do not start the DG with loose battery wire connection as it will damage engine starter motor.
- Do not start the DG with Low charged battery as it will lead to DG not starting problem and damage to Engine starter motor.
- Do not operate the DG with loose / cracked / twisted / peeled engine V belt conditions as it will lead to high temperature resulting in damage to engine parts.
- Do not operate the DG with low coolant level as it will lead to high water temperature resulting in damage to engine parts. (Applicable for water cooled DG).
- Do not operate the DG with loose radiator cap as it will lead to loss of coolant and scale formation which affects engine life.
- Do not start the DG with MCB switch in ON Position to avoid short circuit.
- Do not operate the DG with loose bolts / nuts / electrical connection as it will lead to consequential damage to DG parts.
- Do not operate the DG with cracked / torn rubber coupling as it will lead to loss of power (Applicable for Double bearing alternator DG).
- Do not hold the ignition key in ON position after engine fires as it will result in over running of engine starter motor with engine flywheel and result in starter motor failure.
- Do not hold the ignition key more than 10 seconds if engine does not fire as it will result in damage to Engine starter motor.
- Do not try to start the DG immediately if it does not start in first attempt and follow the recommendation in starting procedure otherwise it will result in damage to starter motor.
- Do not operate the DG with canopy doors opened as it will lead to higher noise level.
- Do not operate the DG with abnormal noise from DG components as it will lead to damage to DG Parts.
- Do not operate the DG if hot air cooling fan (Exhaust fan) is not operating as it will lead to higher canopy temperature and result in performance problems and damage to DG parts.
- Do not operate the DG with ignition key switch in OFF position.
- Do not operate the DG with load less than 60 % as it will result in oil throw through exhaust and result in loss of lubricating oil and seizure of engine.
- Do not overload the DG beyond its designed rating as it will affect the reliability and life of DG.
- Do not operate the DG with unbalance of load beyond 25 % between phases as it will result in damage to AC main Alternator windings and parts.
- Do not Stop the DG abruptly without removing load from DG as it will lead to damage to DG parts.
- Do not stop the DG without allowing cooling time as per stopping procedure after removing load as it will result in damage to DG parts.
- Do not hold stop push button more than 30 Seconds for 7.5 & 10 KVA DG and 20 Seconds for other models as it will result in damage engine stop solenoid

- Do not mix different brands of LubricaΘng oil during maintenance.
- Do not use non recommended brand of lubricaΘng oil and grade.
- Do not Skip DG maintenance schedule as it will affect the reliability and life of DG.

2.9.4 Precautions while using an Alternator

For proper and safe working on an Alternator it is mandatory to follow the points menΘoned below:

1. Ensure correct size of lug/terminal is used to carry full load current.
2. Self starter/stop solenoid operating voltage drop i s noΘced in case of increased distance o f PIU/ battery charger from DG. Ensure voltage of 11 V minimum b y use of adequate cable size/relays.
3. For the good operation of an Alternator, maintenance of the battery used to start alternator is very important. The following aspects need to be kept in mind.
    - Secure the battery firmly on the cradle.
    - Ensure the cable terminals Θghtly fiΣed o n the b aΣery posts.
    - Do not hammer down terminals onto posts.
    - Keep the b aΣery top clean and dry.
    - Clean the terminals and the posts regularly to avoid corrosion.
    - Apply Petroleum jelly / Vaseline on the terminals and posts.
    - Never apply grease.
    - Top up only with distilled water and maintain the level corresponding to the maximum level, never add Acid.
    - Keep vent plugs tightly closed.

Do's for an Alternator 

- Observe correct Polarity when refiţng DG battery or slave battery to aid starting.
- Use Multimeter or test lamp to check continuity of wiring.
- Keep the Engine off when you disconnect or reconnect wiring during electrical service.

Don'ts while using VRLA battery 

- Don't run the Alternator without the battery in the system
- Don't flash the Alternator output leads to check output.
- Don't disconnect battery cable or charging system wiring while the Engine is running
- Don't use high voltage instrument like Meggar o n Alternator or wiring for insula tion check.

2.9.5 Checkpoints of a Alternator

The feedback obtained from the check points tell you exact health of the system/ Alternator. Given below are the points of observations and the corresponding check points. Please go through them to maintain the Alternator beΣer(Ref to Fig 3.4.1).

Point Of Observation	Check Points
Visual Observation	• Proper Θghtening of all screws including base frame. • There should be no loose connecΘon.
Ensure Proper Earthing	• Check the voltage on No-load between Body and Neutral - It should be less than 3 volts.
No-load Electrical Parameters	No-load frequency :- • For brushless 51.5 to 52 hz • For capacitor type 50-51 hz No-load voltage :- • For 1-phase 230 or 240 as per N/p • For 3-ph 415v Voltage variaΘon :- Should be less than 1 volt on digital voltmeter having 1digit accuracy.
On Load Parameters	• Voltage to be measured. • Load current to be seen (it should be well within the n/p data). • Freq should not go down below 50hz.
General ObservaΘons	• VibraΘon normal or abnormal • If any abnormality in sound.

Fig. 2.9.5 Check points of an Alternator

2.9.6 Steps to increase life of a Starter Motor

By strictly taking care of the mentioned points the damages to the Starter can be avoided which result in increased product life.

- Avoid using Discharged battery (battery specific gravity should be 1.250 i n all cells)
- Avoid poorly connected battery terminals.
- Remove the Excess cable length which results in increased voltage drop.
- Loose battery terminals and starter cables.
- Oxidized terminals and posts decrease the efficiency of the motor. Clean them regularly and apply petroleum jelly.
- Prolonged cranking of engine should be avoided.
- Faulty IgniΘon Switch need to be replaced immediately.

2.9.7 Maintaining of Various System

Maintenance of Air Intake System:

For trouble free working of the Air Intake System following points need to be adhered to:

1. Pull primary filter back and forth gently to take it out from the housing.
2. Clean primary filter element by (max pressure of 1.00 bar) from inside to out.
3. Too much pressure can break the fibre paper and destroy the Element.
4. Do not remove safety cartridge in running condition.
5. Do not clean safety cartridge by air compressor.
6. Use clean cloth to wipe sealing area of pressure filter.
7. Ensure proper seaθng of filter into housing before latching cover.
8. Do not use latches on the cover to force the filter in to air cleaner which could cause damage to housing and will void the warranty.
9. Keep evacuator valve in perfectly downward direcθon.
10. The choke indicator indicates precisely when the air filter element needs to service. This prevents the premature removal of the element that can cause loss of engine power. Clean the primary element aŌer every 400 hrs of operaθon.
11. Glowing of choke Indicator on control panel or popping of red ring of mechanical indicator means choking of the primary element. It means clean or replace primary filter element. Normal life of filter element is 1200 hrs, but depends on environmental condiθons also.

Engine Fuel System Maintenance: The diesel filtraθon is done by dual filter assembly before the fuel is supplied to fuel Pump & injector. In order to ensure proper filtraθon and avoiding expensive repairs, follow InstrucΘon very carefully.

- Always use properly filtered high speed diesel.
- Do not use cheap / adulterated fuel which will call expensive repairs of high precision of components such as fuel pump, injecΘon nozzle etc.
- Do not shake diesel drum during filling the fuel in engine. Otherwise the impuriΘes seΣle at the boΣom of the drum will get mixed up with the diesel.
- To minimize water drops in fuel tank due to condensaΘon of moisture, it is advisable to fill the fuel tank with diesel aŌer the day's work is over.
- In fuel feed pump a filter is provided in sediment bowl to trap coarse parΘcle in diesel the bowl holding the filter can be removed by unscrewing knurled nut at bits boΣom &this filter could be taken out and cleaned with fresh diesel.
    - This filter should be cleaned aŌer 250 hours of work.
    - Ensure proper fitment of rubber seal while refiţng bowl on feed pump.

- According to the environment condiΘons (Humidity), there is a need to drain the water from fuel filter assembly by losing the drain screw at the boΣom of fuel filter. If humidity is more then drain aŌer 15 days.
    - o Clean outsides of fuel filter assembly especially of all opening Nut –Bolts / connection.
    - o Do not allow dirt parΘcles to enter the fuel system.
    - o Remove primary filter element aŌer 400 hours and dispose of old element & diesel by safe & efficient process.
    - o Clean the bowl thoroughly by kerosene or diesel.
    - o Remove secondary fuel filter element from its pot & dispose it.
    - o Replace new fuel filter element.

Practical

1. Open a Engine fuel system unit and try to clean the fuel filter unit. Write the observaΘons.

_____

_____

_____

The Following picture shows the parts of a fuel filter unit. The clamping screws shown in the picture need to be opened first and the fuel filter head need to be removed. Take the filter element which need to be removed. Fuel filter pot and filters need to be clean. Put back the filter, fuel filter head and clamping.

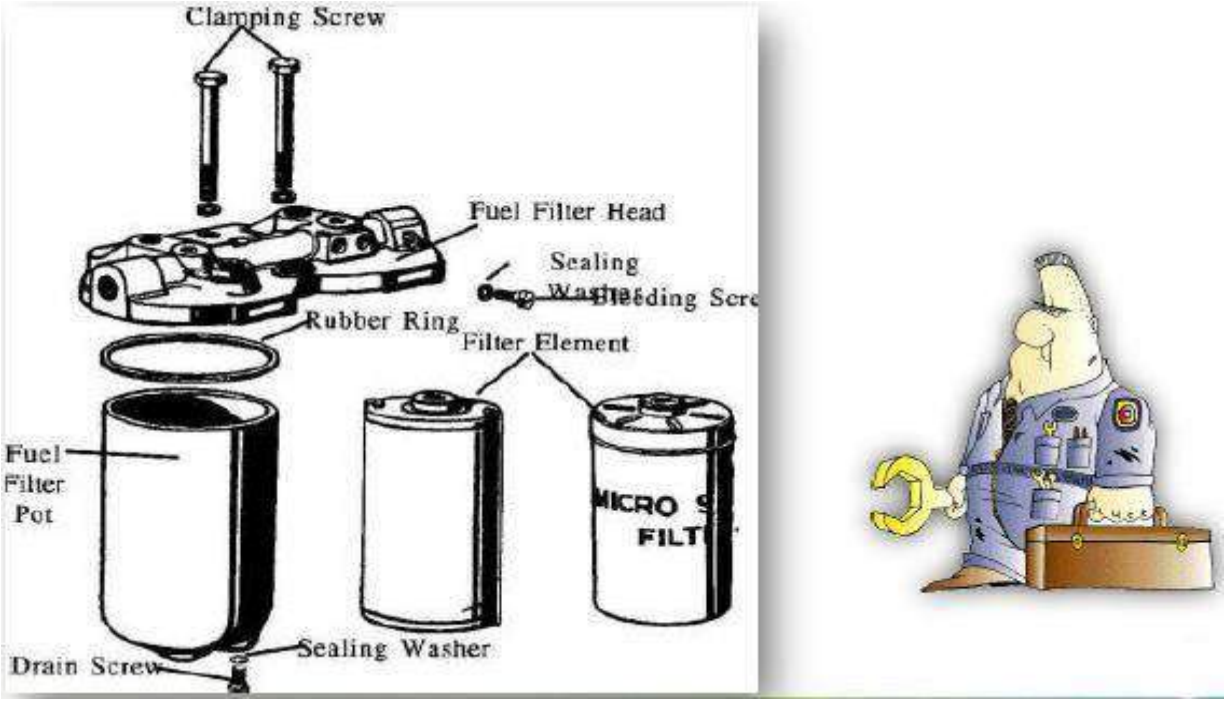


Fig. 2.9.7 Opening of a Fuel Filter Unit

2.9.8 Steps: Cleaning of Fuel Filter

Fuel filter is responsible for prevenΘng impuriΘes in the gas from entering the engine. Even the slightest of impurity can clog your carburetor or fuel injecΘon line. So, it is important to learn how to clean your fuel filter so that your DG keeps working at its best (Refer to Fig 3.4.2).

Fig.2.9.8 Steps involved in cleaning of a Fuel Filter unit

2.9.9 Steps: Bleeding of a Injunction System

What is Bleeding?
When Diesel Engine sucks air due to various reasons given below it needs maintenance.

Reason for Diesel Engine sucking air:-

- If the engine continues to run despite diesel in fuel tank is finished.
- The engine has not been operated for a long time.
- If a fuel element has been replaced.
- Engine is started without opening fuel cock & has run for sometime.
- Feed pump is not working properly.
- If there is some leakage from the Fuel pipes, Banjo & Fuel filter.

Fig. 2.9.9(i) Bleeding of DG Set

How to bleed system ?

- Ensure that there is enough diesel in the fuel tank.
- Loosen the bleeding screw of primary fuel filter (Refer to Fig. 2.9.9(i). Unscrew priming knob of fuel pump, move it up & down at least 10 to 15 times(Refer to Fig. 2.9.9(ii)), till the fuel flows out from air vent screw without air bubbles(Refer to Fig. 2.9.9(iii)).
- Tighten the air vent screw after air bleeding. Repeat same steps for secondary fuel filter for air bleeding.
- At last, loosen the air vent screw of fuel injection pump and bleed out air bubbles.

Fig. 2.9.9(ii) Moving Priming Knob up and Down

Fig. 2.9.9(iii) Fuel flowing out from Air Vent

Practical

1. Open the DG set. Locate the fuel filter unit. Open and clean the Fuel Filter unit.

2. Assume the DG has sucked the air. Go ahead and do the bleeding exercise on the DG.

2.9.10 Air Locking

As discussed in the figure 2.9.9(i,ii and iii) the air lock problem in the fuel pipe is explained in more details in the fig 2.9.9 By following these steps this issue can be resolved immediately.

Problem of 'Air Lock in Fuel Line' – How to Attend?

Sl. No.	Checking point	Specification	AcΘon
1.	Check level of fuel in fuel tank.	Fuel should be filled minimum up to 25% of fuel tank capacity.	Fill, if found less
2.	Check for any fuel leakage.	There should not be any leakage from fuel pipe or washers at any of the pipe connection.	Replace defecΘve fuel pipes or washers
3.	Check the Θghtening of banjo bolt.	Banjobolt should not be Θghtened excess so that copper washer gets damaged causing improper sealing.	Replace, if found damaged
4.	Check for any twisΘng of fuel pipes, causing blockage of fuel passage.	There should not be any twist of pipe	Correct rouΘng of fuel pipe, if found twisted
5.	Ensure proper priming by loosening air vent screw on fuel pump and operating fuel feed pump manually,	Air lock to be removed by priming	This should be done before starting the set for the first time and also after refilling fuel tank (if goes below 25% of fuel tank capacity) or after any repairs. Use properspanner to loosen and relighted air vent screw. Do not over tight air vent screw. Over tightening of air vent screw may lead to breakage of air vent screw.
6.	Check non return valve on fuel filter for any damage of nylon spring seat in side the valve	Proper operation of spring and hence non return valve	Replace spring seat with suitable steel ball (available in market), if found damaged
7.	Check the Feed pump for any damage of sealing face due to any foreign parΘcles came through dirty fuel.	No air leakages	Replace the damaged part
8.	Check high pressure pipe union nut for any crack or damage or leakage.	No leakages	Replaced damaged pipe

Fig. 2.9.10 Air Locking

S. No.	Checking point	Specification	AcΘon
9.	Check length of fuel tank suction tube.	The length should be such that there should be maximum gap of 5 mm between fuel tank bottom surface and tip of suction tube (without strainer).	Correct the length of suction tube accordingly
10.	Check for proper finish and sealing of suction tube adaptor on fuel tank.	No air leakages	Correct sealing face or replaced

Fig. 2.9.10 Air Locking

2.9.11 Steps: Lubrication System Maintenance

Lubrication System Maintenance

Draining of used Oil: It is important to remove the used lubricant oil after sometime the following pictures shows the positions of the screws which needs to be opened to drain out the used oil (Refer to Fig. 3.4.7 and 3.4.8).

Fig. 2.9.11(i) Opening of the used Oil Tank Screw

Fig. 2.9.11(ii) Used Oil Flowing out

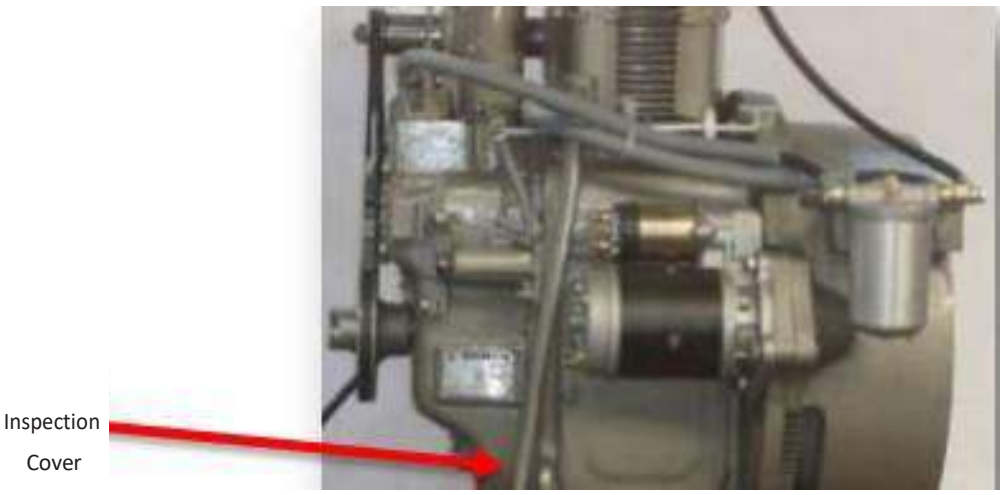


Fig. 2.9.11(iii) Inspection Cover of a DG

2.9.12 Steps: Oil Filter Replacement

Oil Filter is used to clean the lubricant oil flowing in the engine. Since oil filter removes the dust and other parΘcles from the oil, aÕer some Θme there is a need to replace this oil filter. The steps below shows us the procedure to do this (Refer to Fig 3.4.9).

1. Loosen the center bolt of oil filter assembly while holding the filter bowl & remove the bowl along with filter element from oil filter head.
2. Clean the oil filter bowl with fresh diesel and dry it. Guide new oil filter element into the pot and replace the sealing ring of oil filter head.
3. Assemble the oil filter bowl back with the oil filter head ensuring proper seaΘng of the sealing ring between bowl & filter head
4. Replace cap nut "O" ring and tighten the nut at 3.5 kgf –M

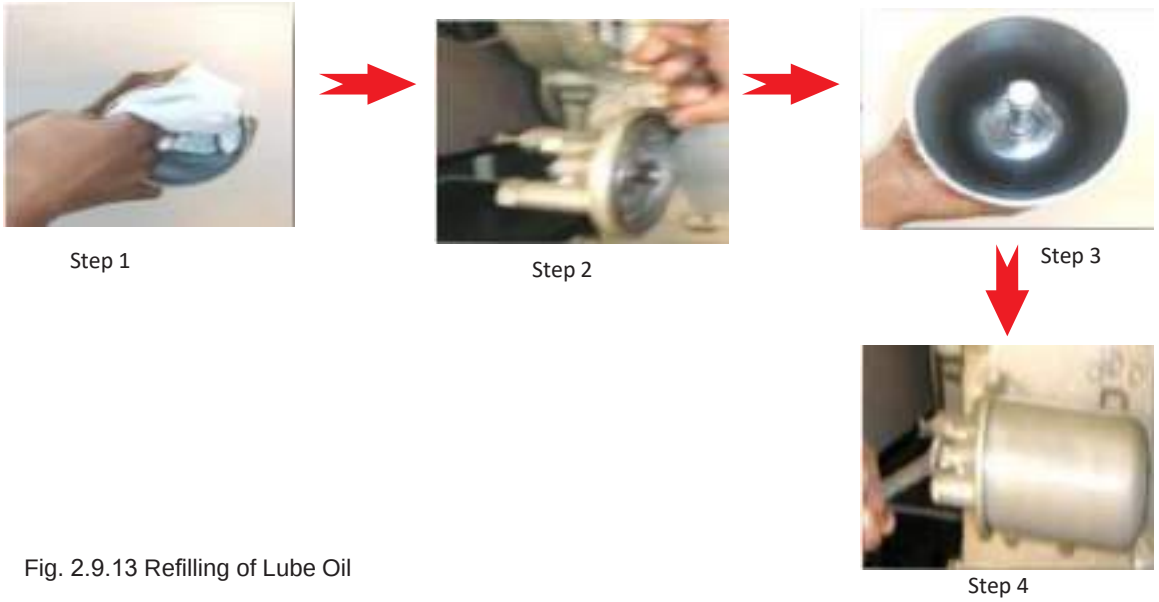
Step 1 Step 2 Step 3

Fig. 2.9.12 Oil Filter Replacement

2.9.13 Steps: Refilling of Lube Oil

AÕer the replacement of the oil filter, there is a requirements to change the lubricant oil in the engine. The steps below demonstrates the procedure to refill this oil(Refer to Fig. 2.9.13).

1. Clean the drain plug magnet, check the 'O' ring and replace, if required, tighten the drain plug to 4kgf Torque.
2. Fill the recommended grade clean engine oil through breather adopter (15 W 40).
3. Check the oil level by dipstick & ensure that it is on the top mark of the gauge.



Step 1 Step 2 Step 3 Step 4

Fig. 2.9.13 Refilling of Lube Oil

2.9.14Tappet Clearance For Air/ Exhaust Valves

Tappet Clearance Adjustment

What is Tappet Clearance?

Tappet clearance is a space between the top of the valve stem and the rocker arm. Its purpose is to allow for some mechanical expansion and lengthening of the valve stem and push rods as the engine warms up. This clearance is also called valve lash (Refer to Fig. 3.4.11).

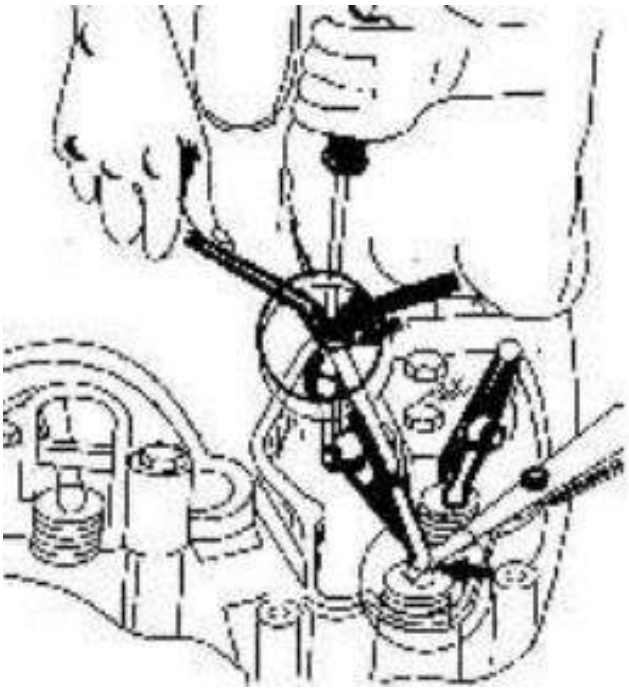


Fig. 2.9.14 Tappet Clearance Adjustment

2.9.15 Engine V belt Replacement

Engine V belt is used to transmit the mechanical energy Produced by the engine of the DG set to the from the engine to the alternator of the DG. Since as this V belt is used regularly, it also gets damaged. Whenever it gets damaged there is a requirement to change this V belt. The process of replacing this the belt is shown below (Refer to Fig. 2.9.15)

- Correct tension of V-belt is necessary for opθmum performance of engine.
- Loose belt will result in slippage (reduced fan blower speed) and engine may get overheated. Over-θghtening of belt will directly impact life of V- belt & bearings.
- Replace the V-belt if it is worn or damaged. If twin belt are used check/adjust the tension of the θghter belt.
- Press down the belt with right hand thumb at the center of the longest free length, check the belt deflecθon with thumb pressure of 4.5kgf.
- The deflecθon should be 8 to 10 mm at the center.

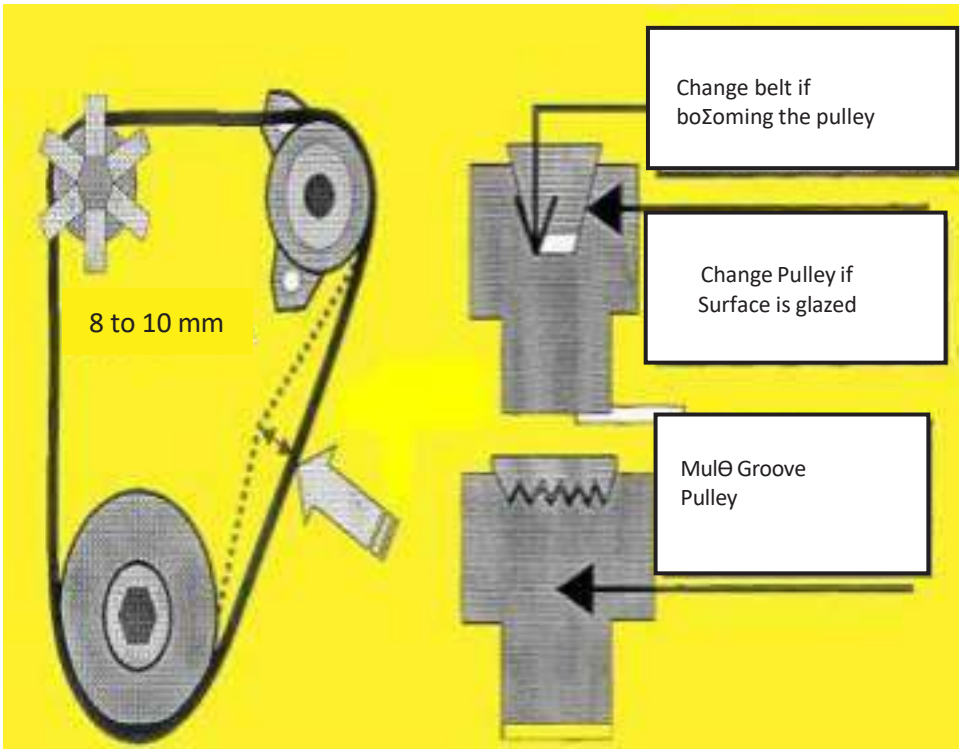


Fig. 2.9.15 Engine 'V' Belt Tension

2.9.16 PrevenΘve Maintenance of a DG

The detailed tables shown in the next page defines the Preventive Maintenance activities to be performed on a Diesel Generator. These activities have to be performed on every 15 days and the status has be recorded in the format given or as per the format of the company.

Preven Θve Maintenance Check List of DG				
	DG		(To be dine by technician once	
			DG Make:-	
S. No.	Fault Code	Check List	Status at Θme of Maintenance	Ac Θon
1.	DG1	DG set battery Voltage	_____AH	Charge/ put electrolyte as per requirements
2.	DG2	Dis Θlled Water Level of DG battery	Normal/Low/high	top up as per requirment
3.	DG3	battery Terminal connection	Tight/Loose/open	Tight if loose
4.	DG4	Jelly applied on battery terminals	Applied/Not Applied/Already applied	Apply jelly if terminal are dry
5.	DG5	Check the level of coolant	Normal/Low/High	Top up as per requirment
6.	DG6	Gravity of DG battery 1.250	.....	Charge/ put electrolyte as per requirements
7.	DG7	DG Hrs meter Reading	. ...Hrs/Faulty	Repair/replace if faulty
8.	DG8	DG Automa Θon	Auto start/Maunl start	Put in auto
9.	DG9	DG operation in manual mode	Ok/ Not ok	Repair if not ok
10.	DG10	Lube oil Level (Mark the level between L and H)	Normal/Low/High	Top up as per requirement
11.	DG11	Canopy Exhaust Fan working	Working/Not working	Repair if not working
12.	DG12	DG Tube light working	Working/Not working	Replace if not working
13.	DG13	Any Leakage in DG	Leakage/No Leakage	Repair if there is any Leakage
14	DG14	AVM Pads Tightness	Normal/Loose/Tight	Tight if Loose
15.	DG15	Stop solenoid working	Working/Not working	Repair if not working
16.	DG16	Vibra Θons in Limit	Normal/High vibra Θon	Adjust if vibra Θon out of limit
17.	DG17	LLOP Sensor working <2.5 PSI	Working at low pressure/Not working	Repair/Replace if not working
18.	DG18	HCT Sensor working	OK/ Not OK	Repair/replace if not working
19	DG19	DG wiring Θghtness all nut bolts to be Θghtened with checknut	Normal/Tight/Loose	Tight if loose
20.	DG20	Canopy doors & locks	Properly closed/Locks are ok /Door broken/Locks are not geţng closed	Repair if broken not working
21.	DG21	Fuel Pipes sΘffness	Normal/SΘff	Replace if sΘff
22.	DG22	V-Belt status	normal/losse/Tight	Adjust to correct belt tension/Replace
23.	DG23	battery charger working	Working/not working	
24.	DG24	Output voltage of alternator (220-250V0)	_____Volt	Adjust if not in limit
25.	DG25	Output voltage of alternator supply (48-52HZ)	_____Hz	Adjust if not in limit
26.	DG26	All Indica Θng Meters	OK/not ok	Repair/Replace
27.	DG27	Outer Cleaning of DG set	Done/Not done	Clean
28.	DG28	Inner cleaning of DG set	Done/ Not done	Clean
29.	DG29	Engine Nut Bolt Tightness	Normal/Loose/Tight	Tight to correct torque if loose
30.	DG30	Any abnormal noise	Observe the reason	Repair/Replace the faulty equipment as per the requirement
31.	DG31	Neutral/ DG canopy earthing	Earthed/ Not Earthed	Earth if not Earthed

Note:- Always fill only battery Water inn DG battery Any other Observa Θon:-
Name:-

Signature:-
Approved By:
Prepared By:

Fig. 2.9.16 Preven Θve Maintenance Checklist for DG

Unit 2.10: Maintenance of the Tower & Shelter

Unit Objectives

At the end of this Unit, you will be able to:

1. Understand the activities to be performed under Preventive Maintenance of Tower & Shelter.
2. Make your own beat plan as per your company's policies.

2.10.1PM Schedule of the Tower & Shelter

The table below defines the PrevenΘve Maintenance Schedule of the tower and shelter. This has to be followed on regular basis (Refer to Fig. 3.5.1).

S. No.	Fault Code	Check List	Status at Time of Maintenance	AcΘon
	Tower			
1.	T1	AviaΘon Light & its functioning	Connected/not Connected/Loose	RecΘfy if. not operaΘonal
2.	T2	Lightning Arrestors and its connecΘon with the earthing system.	Connected/not Connected/Loose	connect if not connected
3.	T3	Any Tower member is hanging.	Yes/No	Install with help of rigger.
4.	T4	Any new installation by operator to be updated in master infra details.	Yes/No	If yes than details to be update in Master data
	Shelter			
1.	Sh1	Any new installation by operator to be updated in master infra details	Yes/No	If yes than details to be update in Master data
2.	Sh2	Presence of Fire Extinguisher and its expiry date	ok/not ok	Raise demand if not available.
3.	Sh3	Roxtec cuţng is properly sealed	Yes/no/	Seal if not OK
4.	Sh4	Any leakage in shelter	yes/no	Stop leakage if there
5.	Sh5	Shelter door sealing is proper	yes/no	Put sealing if not there
6.	Sh6	Shelter door locking	ok/not ok	Repair/replace if not ok
7.	Sh7	Shelter anΘstaΘc earthing,	Connected/not connected	connect if not connected
8.	Sh8	Heavy rust on Site main gate.	Present/not prest	Remove and paint
9.	Sh9	unwanted material lying at site/Shelter.	available/not available	dispose off to ware house.
10.	Sh10	General site cleaning	Cleaned/not clean	Clean
11.	Sh11	Grass cuţng (incase of GBT sites)	ok/not ok	Cut the grass
12.	Sh12	Any Waste material at site like used lube oil filters, old clothes.	available/not availabe	
	Civil			
1.	C1	Heavy rust on Site main gate.	Present/not present	Remove and paint if present
2.	C2	Any knid of damage to boundry wall, civil work and Civil room/	Yes/no	If yes then get it repair

Fig. 2.10.1 Preventive Maintenance

Unit 2.11 Maintenance of AC Plant

Unit Objecties

At the end of this Unit, you will be able to:

1. Understand the activities to be performed under Preventive Corrective Maintenance of AC Plant.
2. Make your own beat plan as per your company's maintenance policy.

Maintenance Schedule of AC Plant

The given PM Schedule of the AC plant needs to be followed on monthly basis. This can change as per Company's need (Refer to Fig. 2.11.1).

PrevenΘve Maintenance Check List of Airconditioner				
	(To be done by technician once 30 Days)			
				Air con capacity
S.No.	Fault code	Check List	Status at time or Maintenance	Action
1.	Ac1	Sensor	operating Not/Not operating	Repair/replace of not operating
2.	Ac2	Display	Reading/not reading	Repair/replace of not operating
3.	Ac3	Compressor 1 Current-12Amp)for 1.5 Ton air con	..... Amp	Rectify
4.	Ac4	Compressor 2 Current-12Amp)for 1.5 Ton air con	..... Amp	Rectify
5.	Ac5	Swapping of AC units	Auto changeover/Manual	Repair/If it is in maunal
6.	Ac6	Aircon. 1 Start at 27 C Temperature	..... C degree	Adjust as per requirements
7.	Ac7	Aircon. 2 Start at 27 C Temperature	..... C degree	Adjust as per requirements
8.	Ac8	Cooling	Normal/Low/Not cooling/Hot air	Repair/Lodge complain to the service dealer
9.	Ac9	AC Blowers	Working/not working	Repair/Lodge complain to the service dealer
10.	Ac10	Abnormal Sound	Normal sound/Abnormal	Repair/Lodge complain to the service dealer
11.	Ac11	Condenser Water Drainage	Clear/Blocked	Clean if blocked
12.	Ac12	Filters	Clean/not clean	Clean if blocked
13.	Ac13	Last Aircon, Service done on	Data and Service By	
14.	Ac14	Earthing of Aircon units	Connected/not connected	
15.	Ac15	Any abnormal sound	Observed/not observed	Repair the defective components
16.	Ac16	Cu pipe insulated or not	Insulate/not insulated	Insulate if not Insulated

Fig. 2.11.1 Schedule of AC Plant

Unit 2.12 Maintenance of AMF/PIU

Unit Objecivves

At the end of this Unit, you will be able to:

1. Understand the activities to be performed under Prevenivve Maintenance of AMF/PIU.
2. Make your own beat plan as per your company's Policies.

PrevenΘve Maintenance Check List of AMF/PIU/ACPDB				
			(To be done by technician once in 15 days	
	Site Name		Cluster:	PM date:
	Site ID:-		Planned Date	Start Time:-
	Make:-		Date of Visit:-	End Time:-
	Capacity:		Last Checklist Date:	Total Time:-
S. No.	Fault code	Check List	Status at Θme of maintenance	Action
1.	A1	All the MCB, Relays and cable connecΘon should be checked for Θghtness	Tight/Losse	make it Θght
2.	A2	All MCB and fuse should be of Correct spec	ok/not ok	Replace with correct spec
3.	A3	Check MCB, Relays and any safety by passed	By passed/not bypassed	Replace with correct spec
4.	A4	Check display Unit working	working (YES/NO)	Repair/Replace
5.	A5	Check AMF panel for automaΘon	working (YES/NO)	Repair/Replace
6.	A6	Check all cables insulaΘon condition	ok/not ok	Repair/Replace
7.	A7	Check all connecΘon for hotness.	Tight/Loose/Bypass	Repair/Replace
8.	A8	Cleaning of AMMF/PIU/ACPDB Panel	Cleaned/Dirty	Clean
9.	A9	DG battery charger operaΘonal condiΘons.	OperaΘonal/Non operaΘonal	Repair/Replace
10.	A10	All cable lugs should be of correct size	ok/not ok	Repair/Replace
11.	A11	Input Voltage (240-480)As per the installed PIU/ACPDB	Measured Voltage	
12.	A12	a) Mains between R-Y	.....Volt	Reason of low voltage
13.	A13	b) Mains between R-B	.....Volt	Reason of low voltage
14.	A14	c) Mains between B-Y	.....Volt	Reason of low voltage
15.	A15	DG Input Voltage in PIU	.....Volt	Reason of low voltage
16.	A16	Output Voltage	200-240 V AC	Reason of low voltage
17.	A17	a) LCU 1		Reason of low voltage
18.	A18	B) LCU 2		Reason of low voltage
19.	A19	DG Hours in Panel	Working (Yes/NO)	Repair/Replace
20.	A20	AutomaΘon	Auto/Maunal/By pass	Repair it for automaΘon

Fig. 2.12.1 Maintenance of AMF/PIU

Prevenivve Maintenance Check List of AMF/PIU/ACPDB				
			(To be done by technician once in 15 days)	
	Site Name:-		Cluster:	PM Date:
	Site ID		Planned Date	Start Time:-
	Make:-		Date of Visit:-	End Time:-
	Capacity:		Last Checklist Date:-	Total Time:-
21.	A21	a) By Mains Failure (5min)	DG start after	Repair if not in limit
22.	A22	b) By Mains Restore (3 minute)	DG stop after	Repair if not in limit
23.	A23	Display Unit	ok/faulty	Repair/Replace
24.	A24	Parameter Settings (in PIU)	Specified/observed	
25.	A25	a) Mains High Cut-off	485V AC/	Adjust if out of limit
26.	A26	b) Mains Low Cut-off	240V AC/	Adjust if out of limit
27.	A27	c) Mains High Cut-in	465V AC/	Adjust if out of limit
28.	A28	d) Mains Low Cut-in	465V AC/	Adjust if out of limit
29.	A29	e) DG High Cut-off	450V AC/	Adjust if out of limit
30.	A30	f) DG Low Cut-off	195V AC/	Adjust if out of limit
31.	A31	g) High Temperature setngs	37 degree Celsius	Adjust if out of limit
32.	A32	h) First start Pulse	2 sec.	Adjust if out of limit
33.	A33	I)Second start Pulse	3 sec.	Adjust if out of limit
34.	A34	j) Third start Pulse	4 sec.	Adjust if out of limit
35.	A35	k) Earthing of Panel	Connected/not connected	Connect

Fig. 3.5.3 Maintenance of AMF/PIU

Prepared By :

Approved By :

Any Other Observations :-

The above Preventive Maintenance schedule for AMF/PIU/ACPDB need to be followed by tower technician every 15 days. These are broad activities which can change from company to company.

Unit 2.13 Maintenance of Power Plant

Unit ObjecΘves

At the end of this Unit, you will be able to:

1. Understand the activities to be performed under PrevenΘve Maintenance of Power Plant.
2. Make your own beat plan as per your company's Policies.

2.13.1Maintenance of Power Plant

Preventive Maintenance Check List for Power Plant				
	No. of Modules:-		Rating	
S. No.	Fault Code	Check List	Status at time of maintenance	Action
1.	PP1	Power plant input voltage (as per PP specification).	..... Volt	Adjust if out of limit
2.	PP2	No. recΘfier required to meet the load requirements.	No.	Raise demand if not meeting the load requirements
3.	PP3	No. of faculty rectifier	No.	
4.	PP4	Controller working	Working/bypass/not working	
5.	PP5	Voltage at the terminal of battery Bank(47-54 volt)	..... Volt	
6.	PP6	Earthing of Power Plant	Connected/not connected	
		Alarms at Power Plant end		
7.	PP7	a) Site on battery alarm	GeneraΘng/not generaΘng	Rectify
8.	PP8	b) RecΘfy module faulty alarm,by switching all Modules one by one	GeneraΘng/not generaΘng	Rectify
9.	PP9.1	connection Checking	Tightness	
	PP9.2	All the MCB, Relays and cable connection should be checked for tightness	Tight/Loose	Make it tight
	PP9.3	All MCB and fuse should be of correct spec.	ok/not ok	Replace with correct Spec.
	PP9.4	Check MCB, Relays and any safety bypassed	Bypassed/not bypassed	Replace with correct Spec.
	PP9.5	Check display Unit working	Working (YEs/No)	Repair/Replace
	PP9.6	Check all cables insulatoon condition	ok/not ok	Repair/Replace
	PP9.7	Check all connecΘon for hotness	Tight/Loose/Bypass	Repair/Replace
	PP9.8	Internal/External cleaning PP	Cleaned/Dirty	Clean
10.	PP10.1	Parameters seting		
	PP10.2	a) Float charging Voltage	Check as per spec.	Adjust as per Spec
	PP10.3	b) Boost charging Voltage	Check as per spec.	Adjust as per Spec
	PP10.4	c) Auto boost change over	Check as per spec.	Adjust as per Spec
	PP10.5	d) Current Limit	10% of battery bank capacity (AH)	Adjust as per Spec

Fig. 2.13.1 Maintenance Schedule Power Plant

Preventive Maintenance Check List for Power Plant				
	No. of Modules:-		Rating	
	PP10.6	e) LVD seţng(47 Volt for non critical & 44volt for critical or as per required operational condition of equipments)	…..... Volt	Adjust as per Spec
11.	PP11	Check the four channel DCDB operational condition	Check reading of all the four channel	Repair the faulty channel
12.	PP12	DC energy meter	Operational/not operational	Repair if not operatio-nal
13.	PP13	Any other observaϴon	Satus	Repair/Replace as per requirements.

Fig. 2.13.1Maintenance Schedule Power Plant

Practical

1. Set the Float Charging voltage, Boost charging voltage, Auto boost change over parameters in a power plant. Learn how parameters can be changed.

2. Check the float charging voltage, boost charging voltage of the power plant.

3. Check and note the alarms and the front panel status of the power plant.

4. Check and record the input voltage at mains between R-Y, R-B, B-Y.

5. Check the auto change over of air conditioner 1 and 2 as the temperature rises.

6. Check the expiry date of fire extinguisher and read the operational guidelines of this Unit.

7. Check the level of the coolant of the DG set.

8. Check and record the output voltage and the frequency of the alternator.

Unit 2.14 Tower Site Audit Check List

Unit Objectives

At the end of this Unit, you will be able to:

1. Understand the process of site Audit
2. Understand reporting structure
3. maintain records of various format as per company policy and SLAs

2.14.1 Tower site Audit Check List

This Audit Checklist is used to track the status of the Site and to keep records of the type/Model of the equipment which are being used at the site. This is the first step towards record keeping at any tower site. List can be modified looking at specific site requirement.

TOWER DETAILS

- Tower number,
- Tower make, type, height and antenna heights on tower,
- Number of Antennas installed on Tower,
- Additional Antennas which can be installed.
- Types and sizes of antennas,
- Pointing azimuth of each antenna,
- Transmission line types and lengths,
- Tower lighting system make, type,
- Provide tower drawing depicting all antennas

click/Scan this QR code to view the video on preventive maintenance

EQUIPMENT SHELTER DETAILS

- Shelter make, size and serial number,
- Shelter air conditioning system, heating system and ventilation system,
- Shelter generator size, make and model,
- battery backup and charging system make, model and size,
- UPS make, model, size and serial number,
- Automatic Transfer switch make, model and size,
- Number of cable entry ports.
- Nomenclatures, size of cabinet and frequency band i f applicable o f all communications equipment in the shelter (transmitters, receivers, microwave and fiber optic equipment)
- Number, serial number and inventory number of all communications equipment inside the shelter (transmitters, receivers, microwave and fiber optic equipment),
- Identify the owner/agency of all communications equipment in the shelter.
- Tower lighting controllers make, model and serial number,
- Provide shelter drawing depicting all idetified equipment
- Identify overall shelter condition, identify any unsatisfactory conditions

Site Details

- Site address, owner and phone number if applicable
- Site differenθal coordinates,
- Site ground level above mean sea level,
- Site access road size and service,
- Site physical size,
- Site fencing, type and height, Gate size,
- Site security, lock type and code,
- Fuel tank, quantity and capacity,
- Ice bridges/cable tray(s) size(s) and length(s),
- Provide site drawing to include access road, shelter, tower and fuel tank,
- IdenΘfy the overall condition of the site, idenΘfy any unsaΘsfactory condiΘons.

Notes

Unit 2.15 Tower Site Maintenance Check List

Unit Objectives

At the end of this Unit, you will be able to

1. gain good knowledge of daily site management checklist
2. Know the format of daily reporting
3. Record all activities oat site on daily basis

2.15.1 Tower Site Maintenance Check List

This is the next step towards record keeping and reporting status of the site on a regular basis. This can also be considered as a daily maintenance checklist.

Equipment Shelter(exterior)

1. Unused conduits and cable entry ports capped _____
2. Openings to exterior sealed _____
3. Exterior caulking _____
4. Exterior grounding bar and grounding connection _____
5. Exterior light with sensor proper operation _____
6. Equipment door lock system _____

Equipment Shelter (Interior)

1. Air-conditioning exhaust fan w/motorized damper working properly _____
2. Intake damper with filter working properly _____
3. Exhaust/Intake fan mesh clear of obstructions _____
4. Air-conditioning units proper operation _____
5. Ventilation exhaust fan working properly _____
6. Baseboard heaters working properly _____
7. Alarm-Hi-temp working properly _____
8. Alarm-Low-temp working properly _____
9. Alarm-Entry/Intrusion working properly _____
10. Alarm-Fire/Smoke working properly _____
11. Filters replaced/cleaned _____
12. Trash removed _____
13. Interior lights _____
14. Floor swept/cleaned _____

Fence and Gate

1. Fencing integrity _____
2. Entry gate integrity _____
3. Chain/Security lock _____

Site General

1. Site mowed (if applicable) _____
2. Site clear of weeds _____
3. Fencing/Gate and 2 feet around the perimeter of the fence clear of weeds _____
4. Site cleaned/clear of debris _____
5. Access road/cleaned clear of debris _____
6. Site overall appearance _____

Notes

ABC Networks
Operations and Maintenance

FMC Log

Prepared By: FMC Team
Objective : To track the progress of resolution by operator or on field O&M personnel
Circulation : O&M Coordinator, Circle O&M Head, Hub SMEs

Circle	
Month	

S. No.	Site sap ID	Site Name	Cluster	Fault Receipt		Fault description	Fault ticket no.	follow up Action with appropriat personal	spaces used (if any)	Fault resolution		reason for delay in resolution (if any)	time taken to clear fault	Site downtime (if any-in mins)	Reason for site outage	Status of Fault	Remarks
				date of receipt of fault	time of receipt of fault					date of resolu-tion	time of resolu-Θon						

	Prepared by	Forwarded to	Reviewed by
Signature			
Name			
Designation			
Date			

ABC Network
Operations and Maintenance

Preventive Maintenance Report

Summary Monthly PM Format

S. No.	Region	Circle	SAP ID	Sup. Name	Mobile No.	Tech. Name	Mobile No.	PM planned date	Actual PM date	Supervisor/ Technicain visit date	Next PM planned date	Next PM planned date	B check/ overhauling planned with PM (yes/no)	DG	AMF	Alarms test	Remarks if any

ABC Network
OM-A-08AVer 01 11.04.2011

Preventive Maintenance Report

7	7	7	7	0	3	3	1	1	0

0	7	7	7	7	7	7	7	7	7	7		0																														

													Preven Θve Maintenance									Preven Θve Maintenance Observa Θon									Maintenance Requirements									
													In 15 days				In 30 days			In 90 days			In 15 days				In 30 days			In 90 days				In 15 days				In 30 days			In 90 days		
												0	by tech-ni-cian	by tech ni-cian	by tec hni-ci an	by diesel men	by engi neer	by tec h	by eng g/te ch	by tech/ engineer			by techn i-cian	by tech ni-cian	by tec hni-cian	by techn -cian	by engi neer	by tec h	by tech	by tech/engi neer			by tech ni-cian	by techn i-cian	by tec hni-cian	by tech ni-cian	by engi neer	by tec h	by tech	by tech/ engineer			stat us
Site Details																																										
S. No.	site name	site id	sap Id	zone/ clus-ter	name of clus-ter O&M incharge	name of O&M engi-neer	site tech-nician	name of the O&M vend or		PM plan -ned date	PM done date	site visit -ed by	plu/ amf/ ACPDB chec-king	power plant test -ing	DG set che c-king	general clean-ing includ-ing grass cuţng	alarm test-ing	air-con test-ing	gener -al inspe c-tion	earth value check	BB back up	BB make	piu/ amf/ ACPDB chec -king	powe r plant tesθn g	DG set chec -king	general clean-ing includ-ing grass cuţng	alarm test-ing	air-con test-ing	gener -al inspec -tion	earth value check	BB make	BB back -up	piu/ amf/ ACPDB chec -king	power plant tesθng	DG set chec -king	genera l clean ing includ-ing grass cuţng	alarm test-ing	air-con test-ing	gener -al inspec -tion	earth value check	BB make	BB back -up	
1.	xyz	WBS 1234	ABC 123	ram pur	jaswant singh	karan singh	hem raj	Z	15 days	1 jan 11			✓	✓	✓	✓	X	X	X	X	X																						
	xyz	WBS 1234	ABC 123	ram pur	jaswant singh	karan singh	hem raj	Z	30 days	16 jan 10			✓	✓	✓	✓	✓	✓	✓	X	X																						
	xyz	WBS 1234	ABC 123	ram pur	jaswant singh	karan singh	hem raj	Z	45 days	31 jan 10			✓	✓	✓	✓	X	X	X	X	X																						
	xyz	WBS 1234	ABC 123	ram pur	jaswant singh	karan singh	hem raj	Z	60 days	15 Feb 11			✓	✓	✓	✓	✓	✓	✓	X	X																						
	xyz	WBS 1234	ABC 123	ram pur	jaswant singh	karan singh	hem raj	Z	75 days	28 Feb 11			✓	✓	✓	✓	X	X	X	X	X																						
	xyz	WBS 1234	ABC 123	ram pur	jaswant singh	karan singh	hem raj	Z	90 days	15 Mar 11			✓	✓	✓	✓	✓	✓	✓	✓	✓																						
	xyz	WBS 1234	ABC 123	ram pur	jaswant singh	karan singh	hem raj	Z	15 days	30 Mar 11			✓	✓	✓	✓	X	X	X	X	X																						

Unit 2.18 Acceptance Testing Report

Document No. ABT-F-01/V1.0						
ABC Tower infra Ltd.						
OperaƟons and Maintenance						
Internal Acceptance Test Report						
Site name			Date			
Site ID			Type of site (ID/OD)			
Anchor Tenant						
Sl. No.	DescripƟon	Expected	Observed	No Go	Status (ok/not ok/not applicable	Remarks
1.	Power Plant/battery					
1.1	battery Bank Installed			No Go		
1.2	battery Bank & Power Plant Earthed	at 2 Places		No Go		
1.3	Proper rouƟng of AC cable from ACPDB to PP					
1.4	TerminaƟons of Power cable at Power Plant			No Go		
1.5	connection of Power Plant t o battery			No Go		
1.6	battery Covers	Present & intact				
1.7	battery terminals Ɵghtened			No Go		
1.8	battery terminals greased					
1.9	Labeling of all Power cables					
1.10	All the rectification working normally			No Go		
1.11	All seƮngs done in PP					
2.	EARTHING					
2.1	Earthing value of each pit	<2 ohm		No Go		
2.2	Earthing vale of grid	<1 ohm		No Go		
2.3	Earth chamber in proper shape and structure					
2.4	Voltage between neutral and ground	<3V				
2.5	Proper termination of earthing done					
2.6	Cabling from IGB and EGB to earth pit properly routed and labeled					
2.7	Antistatic flooring continuity & earthed			No Go		
2.8	PIU Earthing at two different places			No Go		

2.18 Internal Acceptance Test Report

Sl. No.	Description	Expected	Observed	No Go	Status (ok/not ok/not applicable	Remarks
3.	AIR CONDITIONER					
3.1	Starting Time delay	(>2min.)				
3.2	Air Conditioner 1 working normally	cooling w/o noise		No Go		
3.3	Air Conditioner 2 working normally	cooling w/o noise		No Go		
3.4	operation of AC Control Unit for changeover					
3.5	Room temperature under acceptable limits	25C				
3.6	Air Conditioner earthed			No Go		
3.7	Air cyclic operation					
4.	DG SET					
4.1	DG working normally	giving o/p w/o noise		No Go		
4.2	Output Voltage of DG	220V				
4.3	DG set earthed			No Go		
4.4	DG put in auto(3hrs ON the 1hr OFF)					
4.5	Auto start & stop working			No Go		
4.6	DG leakage, if any					
5.	ACPDB & Electrical					
5.1	PIU working fine			No Go		
5.2	LCU					
5.3	Neutral Isolation and earthing check					
5.4	Input and output voltage verificaϴon. LCU within range of PMU used					
5.5	Check of high/low voltage trip in manual mode					
5.6	PIU program list for auto/ semi-auto mode depending on EB availability			No Go		
6.	FIRE ALARM SYSTEM					
6.1	Installed			No Go		
6.2	Alarm when smoke is created					
6.3	Alarm goes off on clearance of smoke					
7.	ALARMS EXTENDED TO KRONE					
7.1	battery Discharge			No Go		
7.2	Fire & Smoke					
7.3	Rectification Fail					

2.18(i) Internal Acceptance Test Report

Sl. No.	DescripƟon	Expected	Observed	No Go	Status (ok/not ok/not applicable	Remarks
7.4	Power Plant Minor					
7.5	Power Plant Major					
7.6	DG Fail to Run					
7.7	Low Lub fuel pressure					
7.8	High Room temperature					
7.9	DG Temperature High					
7.10	Rectifier Input Fail/EB Supply Failure					
7.11	AC1 Fail					
7.12	AC2 Fail					
7.13	Door Open					
7.14	DG ON Load					
7.15	DG Low Fuel Level					
7.16	Mains Fail					
7.17	DG Fail to stop					
8.	TOWER					
8.1	Complete					
8.2	Earthed		No Go			
8.3	Lightening arrestor installed & connected		No Go			
8.4	AviaƟon lamp installed, if required					
8.5	Tower foundaƟon visual inspecƟon					
9.	MISCELLANEOUS					
9.1	Antenna mounts at reqd. height		No Go			
9.2	Antenna mounts have reqd. orientaƟon					
9.3	Horizontal Cable Tray fixed			No Go		
9.4	Hatch plate fixed			No Go		
9.5	EB supply available					
9.6	Access to site	Clear				
9.7	Site cleanliness					
9.8	24X7 access					
9.9	Owner Noc					
	Sign.					
	RFI Declared by					

2.18(ii) Internal Acceptance Test Report

S. No.	Site ID	Site Name	Site type	No of BTS installed at site	Vendor name	Anchor	Anchor operation ID	Sharing 1	Sharing 2	Power meter reading			DG Set				PMU Reading		
										opening reading	Closing reading	Consumed	Capacity (KVA)	Start	Stop	Total Run	Start	Stop	Total Run
			Indoor																
			outdoor																

S. No.	Site ID	Site Name	Site type	No of BTS installed at site	Vendor name	Anchor	Anchor operation ID	Sharing 1	Sharing 2	Total reading on DG meter	Diesel ConsumpΘon				Rate	Avg ./Hr	Specification fuel consumption	PermiΣed Consumption
											quantity filled	quantity consumed	Tank Balance in litres	Closing reading in DG meter	Rs/Ltr.			

S. No.	Site ID	Site Name	Site type	No of BTS installed at site	Vendor name	Anchor	Anchor operation ID	Sharing 1	Sharing 2	Total reading on DG meter	Performance (%)*	Opex redction measures, if any	Impact on P&F	Amt Claimed by Vendor	Amt deducted due to high diesel consumpΘon	Amount Cleared	Remar-ks	EB		
																		Actual Amount on EB Bill	Date of bill submission	Receipt No.

2.20 Outage Analysis Report

Site Outage Analysis Report

Document No. OM-F-21/V1.0

ABC Networks
Operations and Maintenance

Site Outage Analysis Report

Prepared By: P&M Coordinator
ObjecƟve: To analyse the site outage/downƟme period of each site
CirculaƟon: Circle)&M Head, Hub O&M Management Team

Circle		Week ending	DD-MM-YY

Site-wise outage analysis

S. No.	Site ID	Total outage time during the week (minutes)	Reason for site outage

Reason-wise site outage analysis

S. No.	Reason Description	Total minutes of outage	Percentage of total outage Ɵme
Total			

	Prepared by	Reviewed by
Signature		
Name		
Designation	O&M Coordinator	Circle O&M Head/ Hub O&M Head
Date		

ABC Network
Operations and Maintenance

Daily critical Activity Report - Site Visit Report

Prepared By: O&M
Objective: To document all daily activities occurring at sites
Circulation: Circle O&M Head, Hub O&M Head, Circle Head

Counts	0	0	0	0	0	0	0	0	0	0	0	0
Site Detail												
S. No.	Site Name	SAP ID	Zone/ cluster	cluster incharge	Site technician	O&M Vendor Name	Preventive Maintenance check Conducted	Diesel Generator	AC Service	Alarm check	battery back up	DG running hrs.

Counts	0	0	0	0	0	0	0	0	0	0	0	0.00
Site Detail										Site Outage		
S. No.	Site Name	SAP ID	Zone/ cluster	cluster incharge	Site technician	O&M Vendor Name	PLZ Reading	Energy meter Reading	Faults, if any	Start Time	End Time	Total outage Θme

Counts	0	0	0	0	0	0	0	0	0	0.00	0	0	0
Site Detail							Site Outage						
S. No.	Site Name	SAP ID	Zone/ cluster	cluster incharge	Site technician	O&M Vendor Name	Actions taken on	Fault status	Description	Cost born by Q+W	Spares required (if any)	Remarks	Status

Note: This sheet must be maintained at each cluster

	Prepared by	Reviewed by
Signature		
Name		
Designation		
Date		

2.20.1Material Requirement Plan

Material Requirement Plan

ABC Networks
Operations and Maintenance

Material Requirement Plan

Prepared By: Manager O&M Analysis & Control (Circle)
ObjecƟve: To document and plan for the requirement of spares/material for the coming period on the basis of the previous
CirculaƟon: Circle O&M Head, Circle Head, Hub O&M Head

Period(Month)		Circle	
No. of additional sites taken over by O&M in the period		Total No. of sites handed over to O&M	

S. No.	Spares/Material Category	Spares/Material description (Specification/Make)	Opening stock in previous period (Qty)	Consumption in previous period (Qty)	Next period requirement (Qty)
	Vital				
	Essential				
	Desirable				

	Prepared by	Reviewed by
Signature		
Name		
Designation		
Date		

ABC Network
Operations and Maintenance

*imed. = immediate

Escalation Matrix

Alarm Name	Alarm Mean-ing	Catego ry	Euip -ment prio -rity	Field technic ian	Mediu m of comm- unica -tion	site supervi sor	Mediu m of commu nicatio n	O&M engine er	Mediu m of comm unicati on	Clus -ter lead	Mediu m of comm unica tion	Cluster head	Mediu m of comm unicati on	circle O&M head/ circle head	Mediu m of comm unicati on	ope -rat -ors	hub O&M head/te chnical support	Medium of commun ication	corpor ate O&M technic al	Mediu m of comm unicaΘ on	corpor ate head	Mediu m of comm unicaΘ on	COD	Medi um of comm unica tion
battery discharge	battery discharged	critical	A	imed.	phone	imed.	phone	imed.	phone	imed.	phone	imed.	phone	imed.	SMS		60 min	SMS	60 min	SMS	4 hr.	SMS	NA	NA
fire & smoke	fire alarm	critical	A	imed.	phone	imed.	phone	imed.	phone	imed.	phone	imed.	SMS	imed.	SMS		30 min	SMS	30 min	SMS	4 hr.	SMS	6 hr.	SMS
rectifier fail	rectifier fail	critical	B	10 min	phone	10 min	phone	10 min	phone	10 min	phone	10 min	SMS	imed.	SMS		NA	NA	NA	NA	NA	NA	NA	NA
rectifier fail	rectifier fail	critical	B	imed.	phone	imed.	phone	imed.	phone	imed.	phone	imed.	SMS	25 min	SMS		NA	NA	NA	NA	NA	NA	NA	NA
power plant minor	power plant major alarm	critical	B	5 min	phone	5 min	phone	5 min	phone	5 min	phone	5 min	SMS	10 min	SMS		NA	NA	NA	NA	NA	NA	NA	NA
DG fail to run	DG auto start failed	critical	B	imed.	phone	imed.	phone	imed.	phone	imed.	phone	imed.	SMS	25 min	SMS		NA	NA	NA	NA	NA	NA	NA	NA
low lub fuel pressure	low lube oil pressure	ritical	B	imed.	phone	imed.	phone	imed.	phone	imed.	phone	imed.	SMS	25 min	SMS		NA	NA	NA	NA	NA	NA	NA	NA
high room temperature	high room temperature	ritical	B	imed.	phone	imed.	phone	imed.	phone	imed.	phone	imed.	SMS	10 min	SMS		60 min	SMS	60 min	SMS	4 hr	SMS	NA	NA
DG temperature high	DG high head /water temp.	major	B	imed.	phone	imed.	phone	imed.	phone	imed.	phone	imed.	SMS	20 min	SMS		NA	NA	NA	NA	NA	NA	NA	NA
rectifier input fall/ EB suply failure	AC input to PP fail	major	B	15 min	phone	15 min	phone	15 min	phone	15 min	phone	15 min	SMS	30 min	SMS		NA	NA	NA	NA	NA	NA	NA	NA
AC1 fall	Aircon 1 failure	major	C	imed.	phone	imed.	phone	imed.	phone	imed.	phone	imed.	SMS	45 min	SMS		NA	NA	NA	NA	NA	NA	NA	NA
AC2 fall	Aircon 2 failure	major	C	imed.	phone	imed.	phone	imed.	phone	imed.	phone	imed.	phone	15 min	SMS		NA	NA	NA	NA	NA	NA	NA	NA
door open	shelter door open	major	D	15 min	phone	15 min	phone	15 min	phone	15 min	phone	15 min	SMS	15 min	SMS		NA	NA	NA	NA	NA	NA	NA	NA
DG on load	DG running EB not available	major	D	15 min	phone	60 min	phone	60 min	phone	60 min	phone	60 min	SMS	30 min	SMS		90 min	SMS	90 min	SMS	NA	SMS	NA	NA
DG low fuel level	low fuel level	major	C	30 min	phone	60 min	phone	60 min	phone	60 min	phone	60 min	SMS	90 min	SMS		NA	NA	NA	NA	NA	NA	NA	NA
mains fail	EB power fail	major	D	15 min	phone	60 min	phone	60 min	phone	60 min	phone	60 min	SMS	90 min	SMS		NA	NA	NA	NA	NA	NA	NA	NA
DG fail to drop	DG running even EB available	major	B	imed.	phone	imed.	phone	imed.	phone	imed.	phone	imed.	SMS	90 min	SMS		90 min	SMS	90 min	SMS	NA	SMS	NA	NA
	SMS on BD and fire incidents																imed.	SMS	imed.	SMS	imed.	SMS	imed.	SMS
TheÕ-Passive Components		Major	A	Imed		Imed		Imed	Phone	Imed	Phone	Imed	SMS		Imed		60 min	Phone						
TheÕ-AcΘve Components		Major	A	Imed		Imed		Imed	Phone			Imed	Phone											

ABC Network
Operations and Maintenance

FMC Log

Prepared By: FMC Team
Objective: To track the progress of resolution of issues reported by operator or on site O&M Personnel
Circulation: O&M Coordinator, Circle O&M Head, Hub SMEs

Date	
Month	

S. No	Site SAP ID	Site Name	Cluster	Fault Receipt		Fault Description	Fault Ticket No.	Follow up Action with appropriate personnel	Spare used (if any)	Fault resolution		Reason for delay in resolu-tion	Time taken to clear fault (in mins.)	Site Down-Time (if any-in mins)	Reason for site outage	Status of fault	Remarks
				Date of receipt of fault	Time of receipt of fault					Date of resolution	Time of resolu-tion						

	Prepared By	Forwarded By	Reviewed By
Signature			
Name			
Designation			
Date			

2.20.3 Incident Report

Incident Report

Document No. OM-F-19/V1.0

ABC Network
Operations and Maintenance

Incident Report

Prepared by: Circle O&M Head
Objective: To report the occurrence of the incident at site for monetary settlement with the vendor/other
Circulation: Circle Head, Hub O&M Head

General Details

Date of occurrence of incident	D	D	M	M	Y	Y
Incident report (IR No.)						

Site ID	
Site Name	

Circle	

Site Address	

Vendor involved	

Vendor Name	

Vendor Code	

Incident Description (e.g. Fire)	

Losses	

Possible root causes of incident/failure	

Immediate Action taken	

Precise description of damage	Esimated amount of expenditure (INR)	Total no. of casualities, if any	Per head cost of hospitalization/ Treatment (INR)	Total amount (INR)	Amount to be debited from Vendor(INR)	Amount to be credited to vendor/other (INR)	Remarks

Deatails	Prepared by	Approved by
Signature		
Name		
Designation/Department		
Date		

ABC
Operations and Maintenance

Monthly Active Equipment Status Report(Master)

Prepared By: Manager O&M Analysis & control
ObjecƟve: To list all additional equipment installed by operators for making necessary adjustment in invoicing
CirculaƟon: Circle O&M Head, Circle Head, Hub O&M Head, Finance Team

Month	

Circle	

S. No.	Site ID	Site Address	Operator Name	Previous Month Active Equipment (SpecificaƟon, serial no.	Previous Month Active Equipment Quality (Qty./Nos.)	Current Month Active Equipment (specificaƟon, serial no.)	Current Month Active Equipment quantity (Qty./Nos.)	AddiƟonal Equipment Details (specifications)	Additional Equipment quantity (Qty./Nos.)

	Prepared by	Approved by
Signature		
Name		
Designation	Manage O&M Analysis & control	Circle O&M Head/Hub O&M head
Date		

ABC
Operations and Maintenance

Equipment Maintenance Plan

Prepared by: O&M Coordinator
CirculaΘon: Cluster Lead, O&M Engineer, O&M vendor

Month	MMM

Circle	ABC

S. No.	Site ID	Equipment details (type. OEM)	Job to be done	Frequency of job (days or running hrs)	Job duration (days)	Date/Run Hours reading of previous job	Expected/Vendor Responsible	Actual Date/Run Hours reading of job	Quantum of delay (days/running hours)	Reason/Other Remarks
1.										
2.										
3.										
4.										
5.										
6.										

Prepared		
Signature		
Name		
DesignaΘon		

				BATTERY BACKUP TEST													Doc No: FMt/O&M/20/V1.0
Circle				District:						Site Name							Site ID
SMPS Power Plant Details										battery Bank Details							
Make:										Make:							
Voltage (+24 or -48):										Voltage (+24 or -48):							
Nos. of Rectification Modules:										Individual Cell Voltage (2V/ 6V/ 12V):							
Amp Rating of Each Module:										Nos. of Cells:							
Normal Float Voltage:										AH Rating of battery Bank:							
DC Voltage Across SMPS:										DC Voltage Across battery Terminals:							
Manufacturing Date of BB:																	
DC Voltage																	
Cell No.	In Float	0-5 Min	15 Min	30 Min	45 Min	60 Min	75 Min	90 Min	105 Min	120 Min	135 Min	150 Min	165 Min	180 Min	195 Min	210 Min	225 Min	240 Min
Cell #1																		
Cell #2																		
Cell #3																		
Cell #4																		
Cell #5																		
Cell #6																		
Cell #7																		
Cell #8																		
Cell #9																		
Cell #10																		
Total																		
Total Bank Voltage (Volts) : (To be checked across complete bank)																		
DC Load Current (Amps) : (To be monitored for every reading of baΣery voltage																		
Mean																		
VariaΘon																		
ObservaΘons and Conclusions																		

Test Conducted By:
Name:
Test Verified By:
Name:

Mobile No.:
Mobile No.:

Signature:
Signature:

Guidelines for battery Backup Test

	ANNEXURE GUIDELINE FOR BATTERY BACKUP TEST ON SYSTEM LOAD	DOC NO:	ANX-O&M-01-V1.0
		DATE:	
The step by step procedure for battery Backup test on system load is as under			
Step		Action	
1		PrecondiƟons for Test:	
	a)	The Site should have DG and EB or stand by DG for Non EB Sites where baΣery bank to be tested on system load.	
	b)	Before checking any baΣery bank health, it is to ensure that the baΣery bank was on conƟnuous charging for at least last 102hrs. and not gone for deep discharge during last 48 hrs.	
	c)	Once saƟsfying the condition at s. no. 1, prpare the equipments and staƟonary for the test	
	d)	Minimum of two person are required for complete test duration. During test one person will take the measurements and other will record it.	
2.		The necessary tools/ Material required for test:	
	a)	DC Voltmeter/MulƟmeter	
	b)	DC Clapmeter	
	c)	Standard tool kit congaing Tester, Screw Driver, Plier, InsulaƟon Tape etc.	
	d)	Balnk Test Format Printouts	
	e)	Pen/ Pencil etc	
3.		Preparing Site for Test:	
	a)	Check for health of DG Set in records as well site condition. Run the DG set in Manual w/o load for 5-10 mins and observe.	
	b)	Fill up the site details, battery Bank details and SMPS details in the Test format	
	c)	Check battery AH & Charging Current defined in SMPS and correct if it is wrong.	
4		Start the Test:	
	a)	Record the readings of all individual cells of the complete battery Bank along with current on SMPS Power Plant in float mode (First column of reading in the format)	
	b)	If battery discharge facility available in SMPS, carry out battery discharge test with site load. If no such facility is available in SMPS than switch off the AC supply to SMPS and let the system go on battery discharge mode through the site load	
	c)	Take the first reading immediately aŌer step b) and record in second column of the format (i.e 0-5 min reading)	
	d)	Measure and record the second reading aŌer 15mins of first reading	
	e)	Third reading should be taken aŌer 15 minutes of second reading or 35 mins of first reading.	
	f)	Forth reading to be taken aŌer 15 minutes of third reading or 50 mins of first reading.	
	g)	Next all reading to be taken at the interval of 15min each	

Guidelines for battery Backup Test

5.		COMPLETION OF TEST:
	a)	The test should be immediately stopped in case any cell voltage reaches to 1.95V (Amar raja & HBL) or battery Bank Voltage reaches to 46.8V/ 23.5V for 48V/ 24V Bank resp, else it should conϴnue for at least 2-3 hrs.
	b)	Once the test is complete/ stopped, immediately switch on the AC supply to SMPS power plant or let the baΣery bank get charged through the DG power for iniϴal 30 mins.
	c)	Ensure that baΣery should have conϴnuous charging for next 24 hrs. It can be done by increasing the baΣery voltage level used to trigger the DG set in case of power failure.
	d)	During the test, In case any Cell/Cells voltage found dropping faster than other, mark that cell for tracking and replacement. The boost charging (55.2V/ 24/6V) to complete bank for 48 hrs. ConϴnuouslyΣ and re-test the baΣery bank.
	e)	Mark the cells with relaϴvely lower voltage than majority of cells (for future tracking)
	f)	Write down the observaϴon and conclusion in the defined space in the format (AΣach addiϴonal sheet, if required)
	g)	Write the name with mobile no. of persons conducϴng test and sign the test data.
	h)	Submit this test data to your supervisor for verificaϴon and further Action.

	BOOST CHARGE FORMAT	Doc No. FTM/O&M/30/V1.0 Date:

SMPS Power Plant Details:	battery Bank Details
Make:	Make:
Voltage (+24 or -48):	Voltage (+24 or -48)
Nos of recΘfier Modules:	individual Cell voltage (2V/ 6V/ 12V)
Amp RaΘng of Each Module:	Nos of Cells:
Normal Float Voltage:	AH RaΘng of battery Bank:
DC Voltage across SMPS:	DC Voltage across battery Terminate:
Manufacturing Date of BB:	

DC Voltage			
Cell No.	Before Boost Charge (Reading)	Last hour of Boost Charge (Reading)	
		0-1 Min.	45-60 Min.
Cell # 1			
Cell # 2			
Cell # 3			
Cell # 4			
Cell # 5			
Cell # 6			
Cell # 7			
Cell # 8			
Cell # 9			
Cell # 10			
Cell # 11			
Total Bank Voltage			

Start Time Boost Charge:		
End Time Boost Charge:		
Result:		
Test Conducted By:		
Name		
Test Verified By:	Mob No.	Signature:
Name:	Mob No.	Signature:

Excercise

1.. What do you understand from the term tele communication?

2. What is the difference between wire-line and wireless communication?

3. What are the various GSM and CDMA technologies used by Telecom Operators today?

4. Name three Indian and three Global Operators.

i_____ ii_____ iii_____

i_____ ii_____ iii_____

5. Which are the top three Telecom Tower companies of india

i_____ ii_____ iii_____

Practical

Visit a Tower site where Earthing pit is geţng constructed. Understand and note the process of creaƟng an Earth pit.

Notes

Skill India
कौशल भारत-कुशल भारत

सत्यमेव जयते
GOVERNMENT OF INDIA
MINISTRY OF SKILL DEVELOPMENT
& ENTREPRENEURSHIP

N·S·D·C
National
Skill Development
Corporation
Transforming the skill landscape

3. Manage Site Operations Safely and hygienically

Telecom Sector Skill Council

Unit 3.1 - Site Management activities
Unit 3.2 - Waste Management at Site
Unit 3.3 - Operating Equipment at Site
Unit 3 4 - Fault Management System
Unit 3.5 - Escalation Procedure for Fire Accident

TEL/N4102

Key Learning Outcomes

At the end of this module, you will be able to:

1. Monitor reading as per EB (electricity bill) against reading on PIU (power interface Unit).
2. Timely collect and submit the EB (electricity bill) at the office.
3. Operate key equipment at site.
4. Check number of alarms Active at the site.
5. Check site for faulty alarms.
6. AΣend alarms within the defined SLA.
7. IdenΘfy the reasons for site lock.
8. Co-ordinate with service providers for quality fuel to be filled.
9. Interact with site owners w.r.t. rent, access issues etc.

Unit 3.1 IntroducƟon to Site Management

Unit ObjecƟves

At the end of this Unit, you will be able to:

1. Discuss about the need of day to day site management activities.
2. Implement the process of interacƟon with electricity board and payment of their bills.
3. Execute the process of interacƟon with the landlord and payment of his rental bills.
4. Understand the interacƟon process and need of interacƟon with other authoriƟes.

3.1.1 Site Management activities

What is Management

Site InteracƟon with various personals and authoriƟes is one of the very important operaƟonal acƟvity for up keep of a Tower site. This involves day to day activities like interacƟon with Electricity Board, their Bill Payments, interacƟon with fuel vendors for timely filling of quality Diesel in DG set/ making their payments, interacƟon with the site owner to ensure management of access issues, rental activities, agreement with the owner to ensure that all external factors are supporƟng efficient working of the site. InteracƟon with other statutory authoriƟes and taking care of activities involving them is also critical. In order to ensure that all SLA(s) commiΣed by the operator are met, Alarm management, Fault recƟficaƟon and timely response to the Alarms is another key factor in efficient working of the site. This also involves interacƟon with the team at NOC .

Electricity Board interacƟon: The person responsible for the site management is expected to know the location of electricity board offices near to tower site and the personnel at various posiƟons at the electricity board office. It is also desired that this person need to maintain excellent relaƟonship with these officers so that at the Ɵme if need these personals can be approached and any requirement can be met. There should be a list maintained at the site giving reference to the address of the EB Offices around and the contact details of the personals at the EB offices.

Electricity Bill Payment: These Electricity bills are to be paid on monthly basis for all the site locaƟons. For the same the person responsible for management of the site should collect these electricity bills, get them validated with the electricity readings on the meter and in the recorded reports at the site. He should be able to verify if the bill is correct and Electricity Board is not overcharging. Once he has done the calculaƟons based on the records at site and confirmed that Bill amount is fine he need to follow up with the finance team of the telecom operator to get this bill paid either directly or through him. For the same he has to get a cheque collected soon. This is expected from the technician at the site that at no point the bill payment can be avoided which can result in electricity failure at site.

Fuel filling at the site: AcƟvity of fuel filling can be outsourced and is to be monitored by the person who is managing the site. He has to trigger this acƟvity by calling this fuel filling team as soon as the diesel stored touches the minimum level of 7% of HSD in the Diesel tank of the DG at any point. It is also of utmost importance to ensure that the quality of the HSD supplied is good, to check this is responsibility of the person manning the site.

3.1.2 Electricity Board (EB) Interaction

Electricity Board supply is most critical for efficient working of a Tower site. Following checks and test on the electricity board connectivity and the electrical wiring connected can we looked at. In case of any fault or malfunctioning these need to be recθfied immediately (Refer to Fig. 3.1.2(i)). Also Refer to Fig 3.1.2(ii) where the process of Electricity Board connection up gradation is described step by step.

EB Connectivity & Cabling				
		(To be done by Engg. once in month along with tech		
S. No.	Fault Code	Check List	Status at θme of maintenance	Action
		EB		
1.	EB1	EB ConnecΘon	Not connected Yet/Connected/Disconnected	If disconnected get it connect
2.	EB2	Energy meter status if EB connected	EB not connected/Faulty/EB reading..... Kwh./Meter seal intact/not intact	Get it repair if any fault is available
3.	EB3	Check cable of the sign of burning/heaΘng/any joint	ok/not ok	Get it repair if not ok
4.	EB4	Check main MCB and cable of correct spec	ok/not ok	Replace if not ok
5.	EB5	EB meter reading	.....	
6.	EB6	Proper shading of Energy Meter	Normal/Abnormal heat	Provide shade if it is abnormal
		SERVO		
1.	S1	All the MCB, Relays and cable connecΘon should be checked for Θghtness.	Tight/Loose	make it Θght
2.	S2	All the MCB and fuse should be of correct spec	Ok/not ok	Replace with correct spec.
3.	S3	Check MCB,Relays and any safety bypassed	By passed/not by passed	Replace with correct spec.
4.	S4	Check for any leakages	ok/not ok	Repair to stop the leakage if any.
5.	S5	Servo should be earthed	Earthed/not earthed	Earth it if not earthed
6.	S6	Electrical wiring should be properly routed check for any insulaΘon damage	Ok/not ok	If not ok route properly and replace if required
		ELECTRICAL WIRING		
1.	E1	Check all internal & exter-nal bulb & tube lights are working	Working/not working	Replace/Repair the faulty one
2.	E2	Check the shelter wiring for damage/proper rouΘng	ok/not ok	Repair/replace the hanging/damage wiring
3.	E3	All power plug, socket should be operaΘonal	ok/not ok	if not ok repair,Replace
4.	E4	Checking of all sites LOG Book	Available/not available	Raise demand for log book if not available

Prepared By :

Fig. 3.1.2(i) EB Connectivity

Approved By :

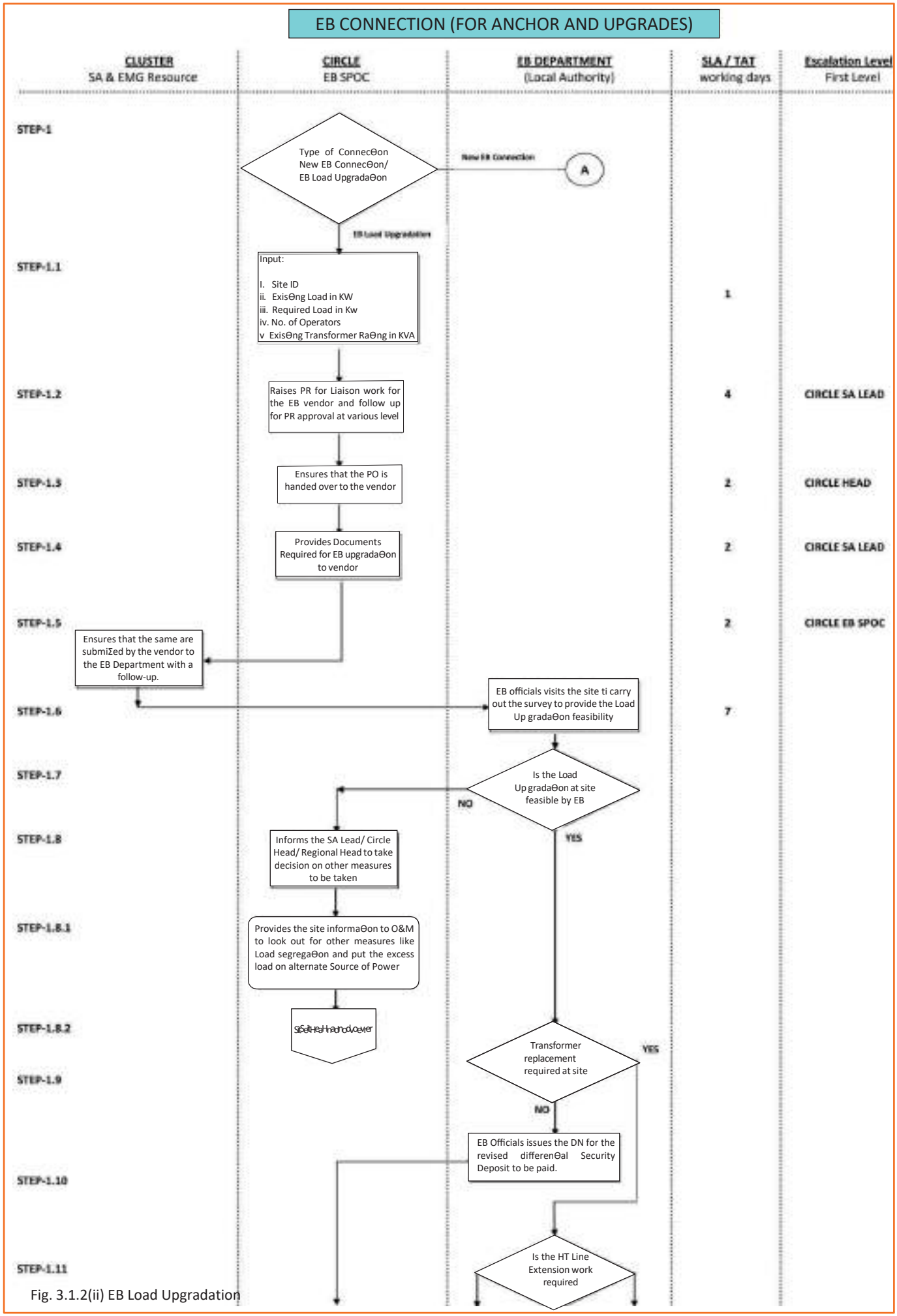


Fig. 3.1.2(ii) EB Load Upgradation

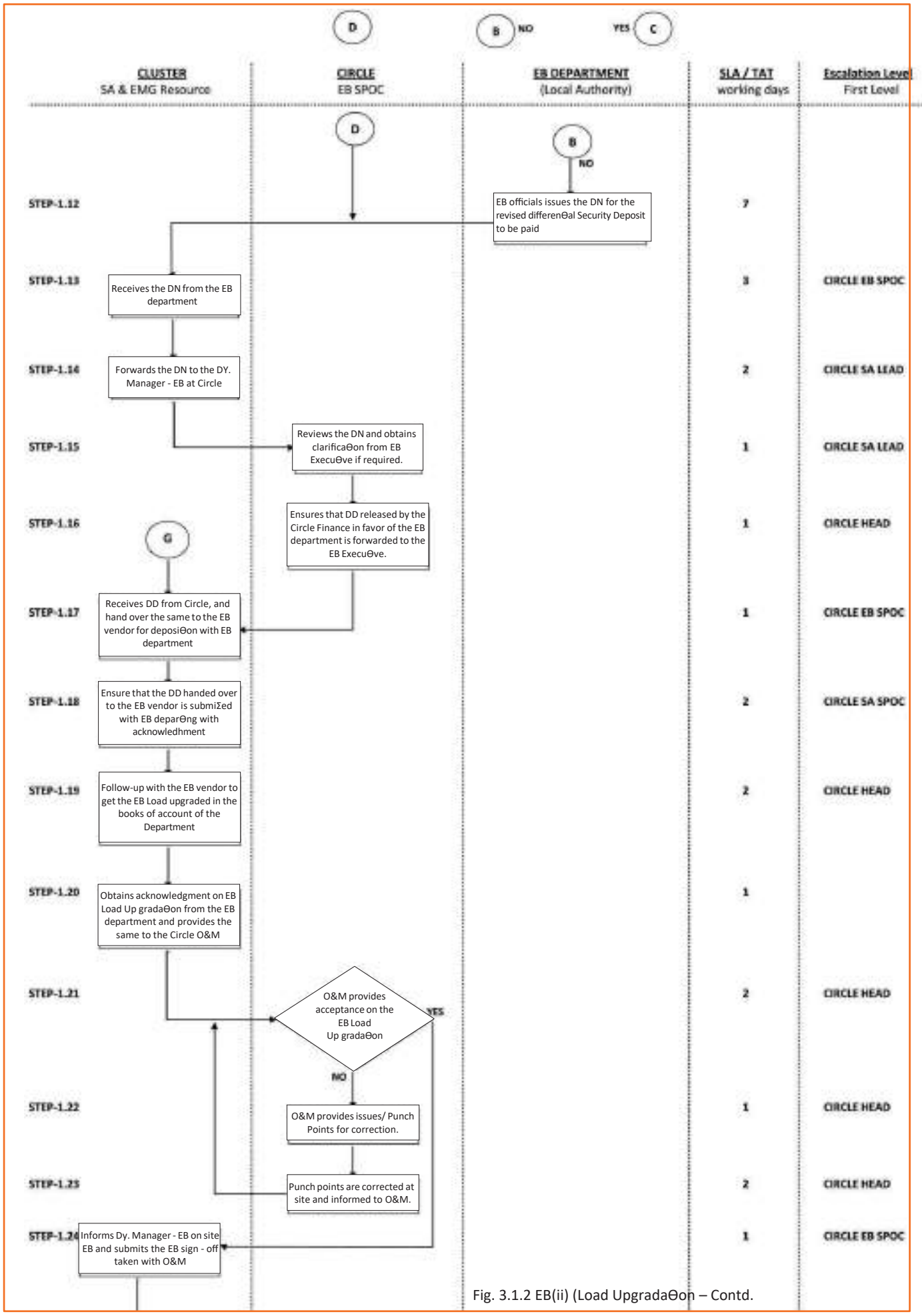


Fig. 3.1.2 EB(ii) (Load UpgradaΘon – Contd.

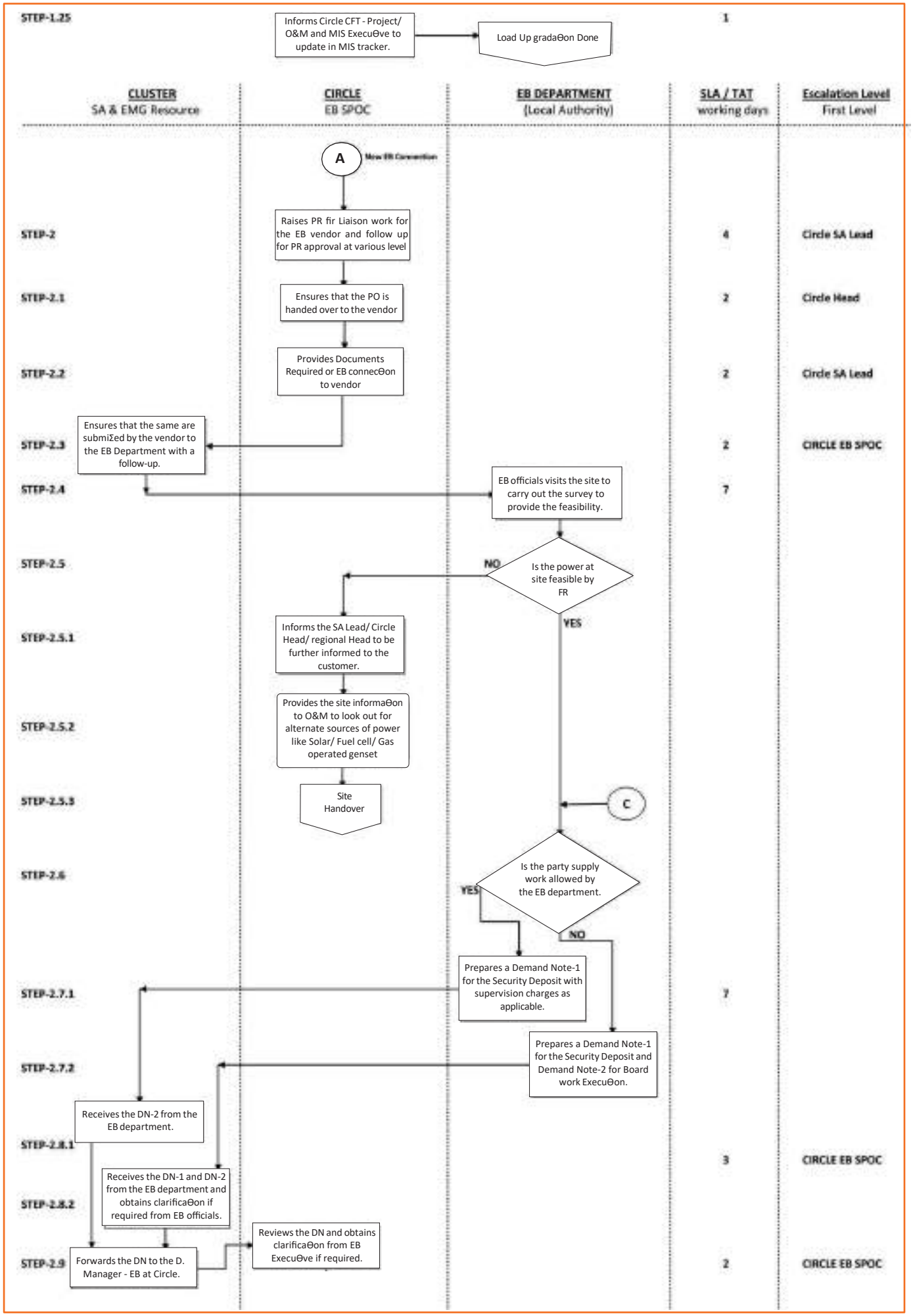


Fig. 3.1.2(ii) EB Load UpgradaΘon – Contd.

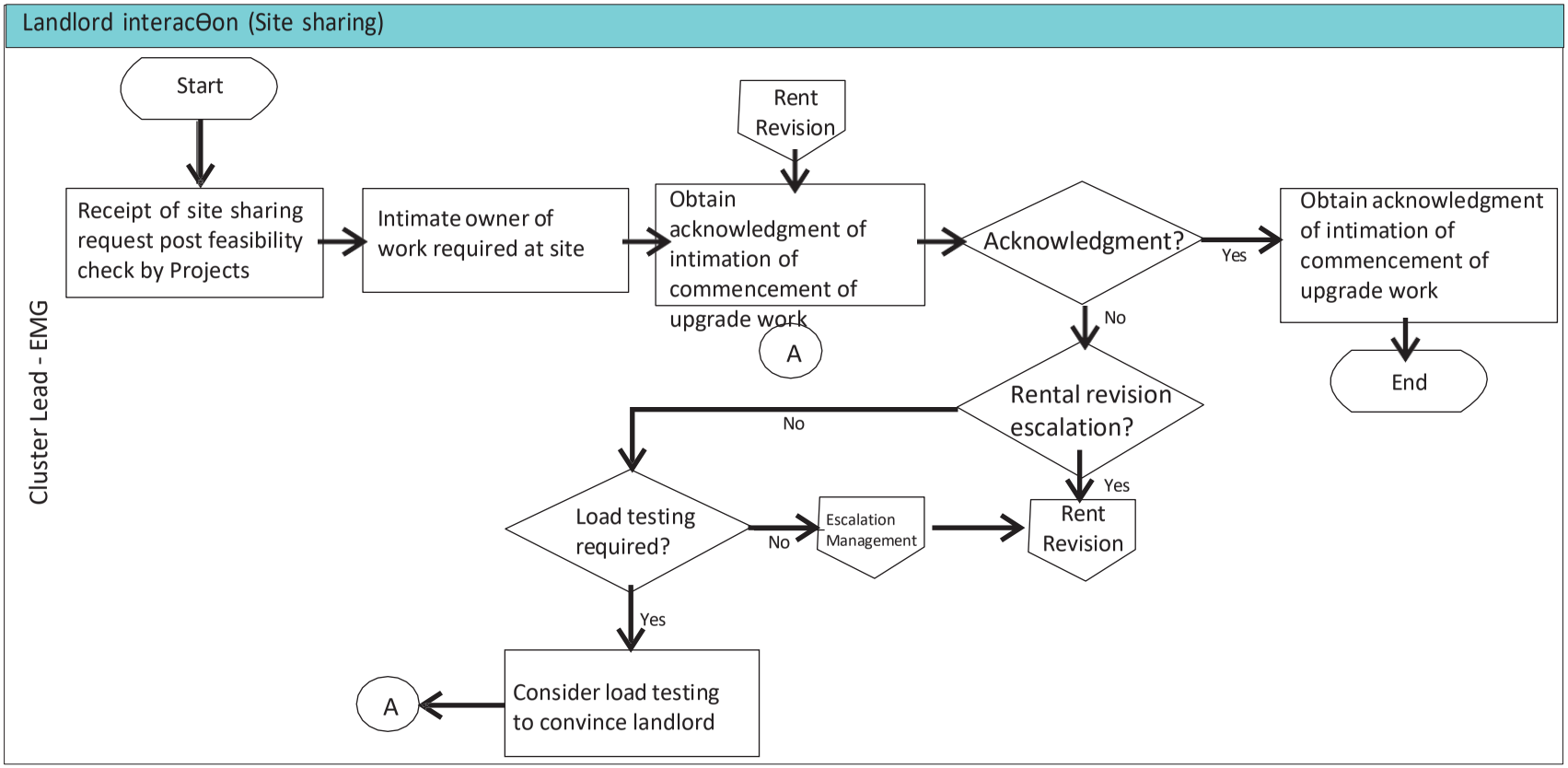
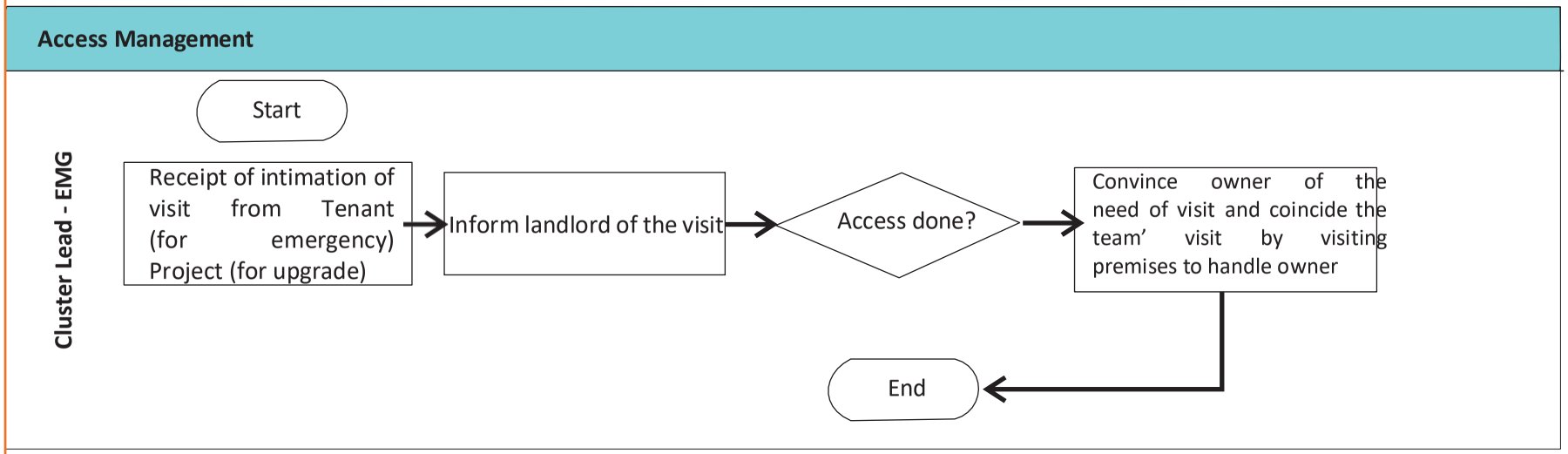


Fig. 3.1.2(iii) Landlord Interaction

S. No.	Process	Activity	Responsibility	SLA
1.	Landlord interaction (Site Sharing)	Co. coordinating with landlord	Cluster Lead/Vendor - EMG	Within 1 day of intimation
2.		Rent negotiation, load testing if required	Cluster Lead/Circle Lead - SA & EMG	Within 2 days of intimation



S. No.	Process	Activity	Responsibility	SLA
1.	E M G A c c e s s Management	Co-cordinaitng with landlord	Cluster Lead/Vendor - EMG	Immediately or prior to visit by team for commencement of work

Fig. 3.1.3(i) Site Access Management

Interaction with the Landlord: Most of the tower sites are rented sites where site owner controls the activities happening at site by controlling the access to the site. It is needed that in case of any shiftiing of material, downtime or visit of any official, employees to the site there should be no access issues. IN case there is a request for increase of site sharing, that also need to be discussed with the landlord. Contact details of the landlord should be recorded and kept in a way that any one at site should be able get these details immediately. It is also expected that the tower technician should maintain excellent relation with landlord. Monthly rental payment needs to be made to the landlord on regular basis, which has to be ensured by the person manning the tower site. Any request for increase in rental payment by Landlord also needs to be addressed properly

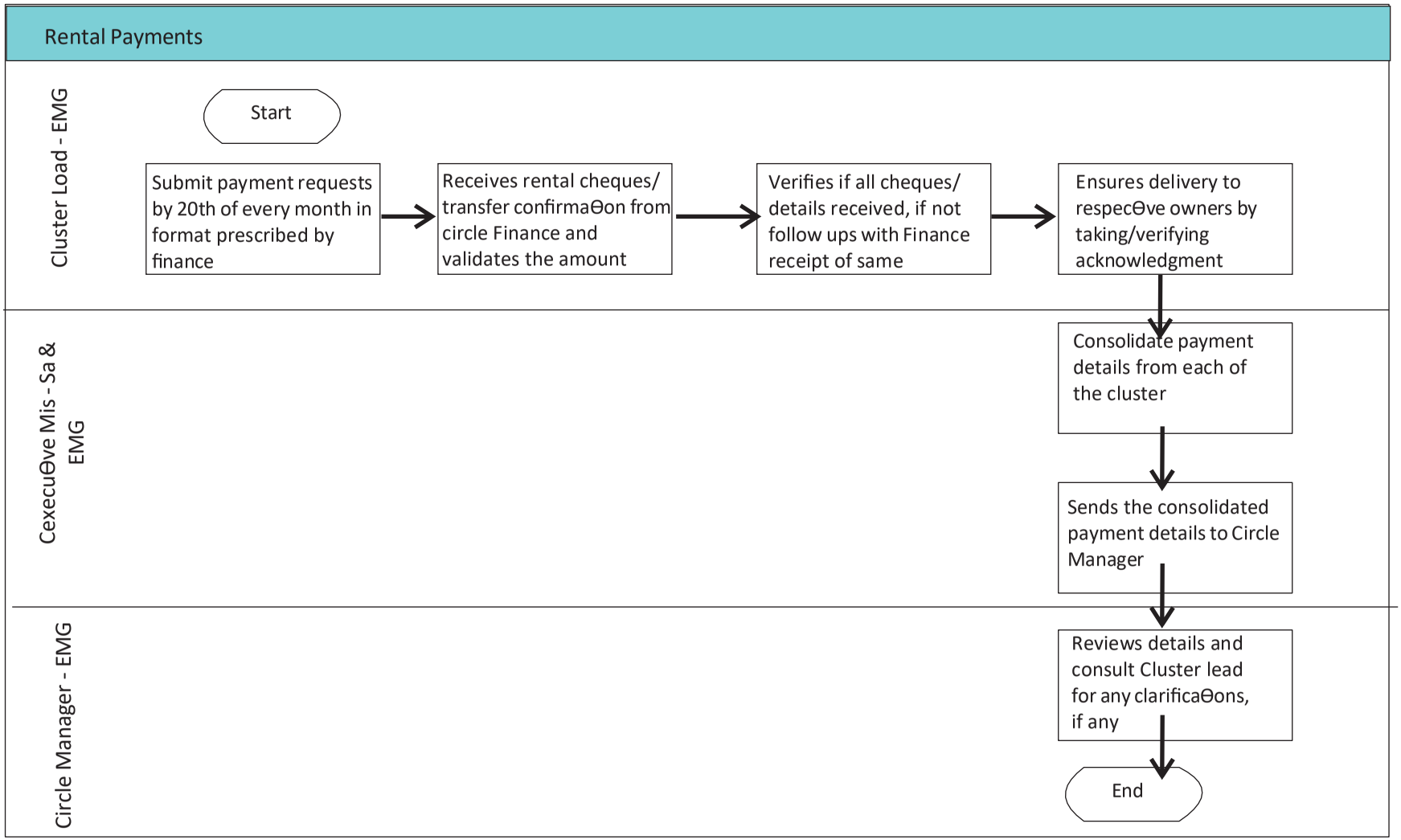


Fig. 3.1.3(ii) Rental Payment

S. No.	Process	Activity	Responsibility	SLA
1.	Rental Payments	Upload of rental details, in Finance prescribed format	Cluster Lead/Vendor - EMG	To be submitted by 20th of every month
2.		Rental cheques/ t ransfer confirmation from Circle Finance and validates the amount	Circle Finance	Within 4 days of receipt of details
3.		Distribution of cheques to respective owners	Cluster Lead/Vendor - EMG	By agreed date in the agreement

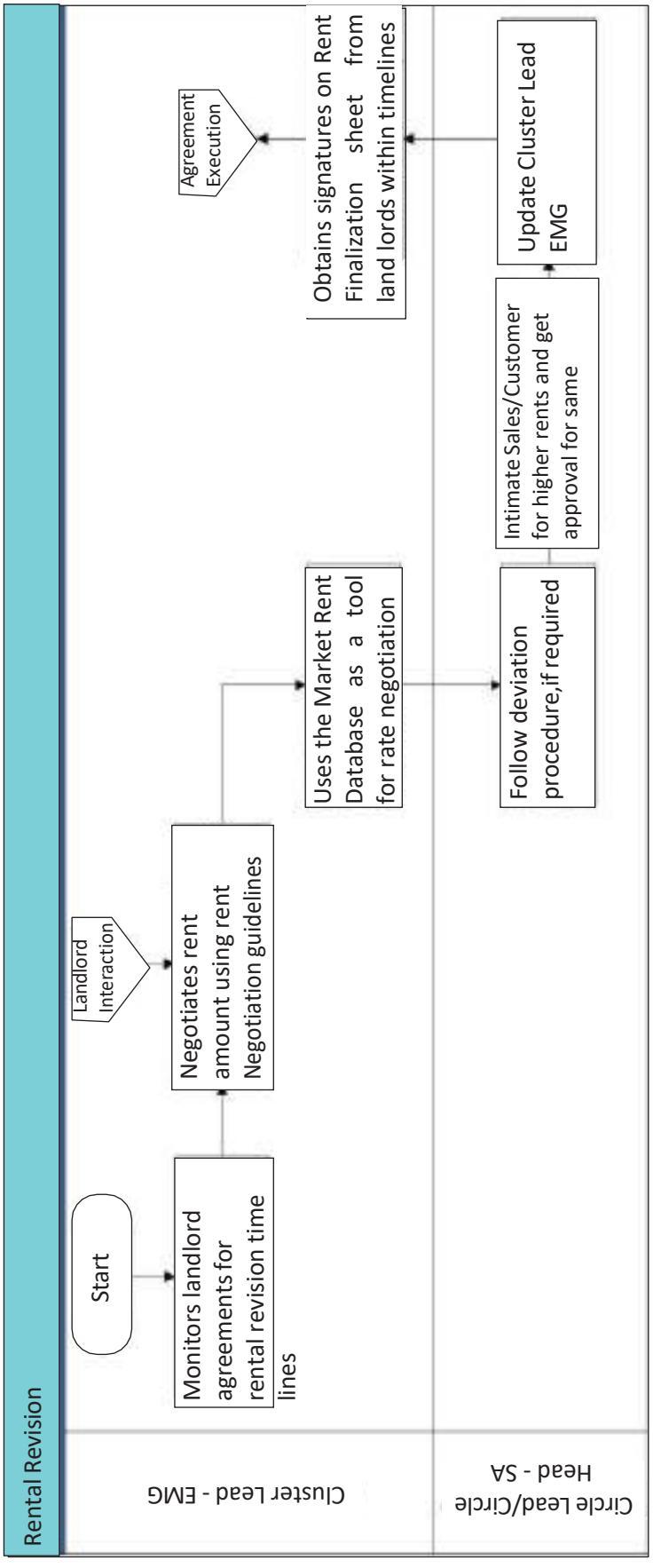


Fig. 3.1.3(iii) Rental Revision

S. No.	Process	Activity	Responsibility	SLA
1.	Rental revision	Negotiation of rent	Cluster Lead/Vendor - SA & EMG	Within 2 day of initiation of rental revision escalation

3.1.4 Statutory Approvals

Site Management activities also include interacΘon with other local Statutory authoriΘes. The Tower technician also need to interact with these teams to sort out any developments

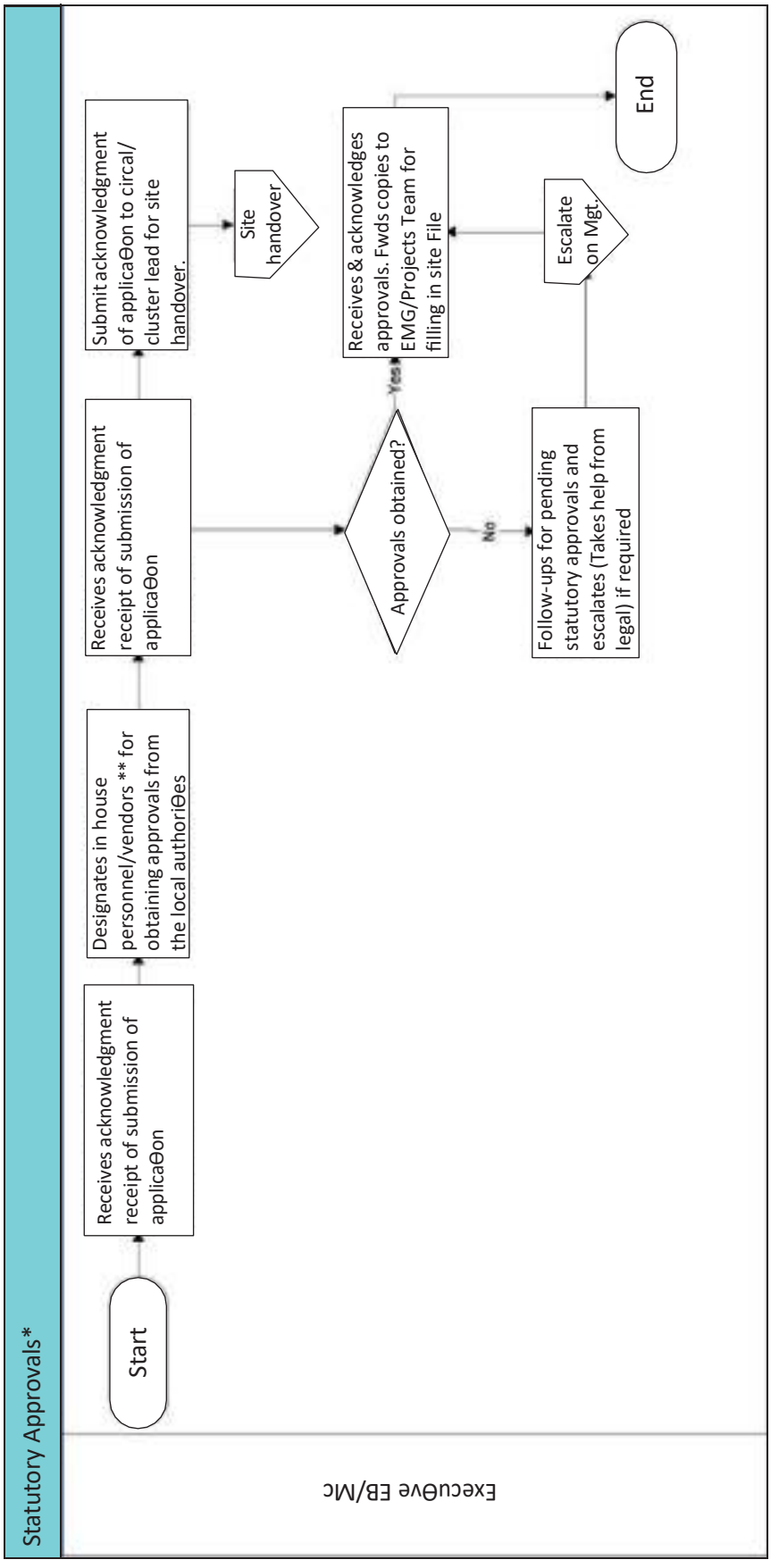


Fig. 3.1.4Statutory Approvals

S. No.	Process	Activity	Responsibility	SLA
1.	Statutory Approval	Allocation to vendor	Executive EB/MC	Within 1 day of intimation
2.		Submission of application	Executive EB/MC	Within 2 days of allocation to vendor

Unit 3.2 Waste Management at Site

Unit Objectives

At the end of this Unit, you will be able to:

1. Understand the concept of waste management.
2. Differentiate between types of waste generated at the site.
3. Identify actions you need to take to dispose off this waste.

3.2.1 Waste Management at Site

Lot of waste gets generated at any tower site which needs to be disposed off properly and timely to ensure efficient working of site and to ensure that the hazardous material is not accumulated at site. This waste material if not treated properly and timely can lead to an accidental situation like fire etc. Leading to loss of human capital and equipments. Table below shows what steps need to be taken regularly to dispose the waste material from the site (Refer to Fig. 3.2.1).

WASTE DISPOSAL MATRIX

S.No	Type of Waste	Source of GeneraΘon	Disposal Procedure	Responsibility
1.	Used Lube Oil	Diesel Generator	To be stored with closed lid in a container & to be taken back by the DG AMC Vendor	Project & O&M
2.	Paintbrush	Painting Activity	Taken back by Vendor	Project
3.	Paint Containers	Painting Activity	Taken back by Vendor	Project
4.	4 Electrical Wastes (Lights, Cut Cables, Old Equipments - Panel, AC)	Shelter & BTS	Sent to Ware House & Disposed Centrally	O & M
5.	Used Battery	Battery Bank	Sent to Ware House & Disposed Centrally to approved delear or manufacturer	O & M
6.	DG Filters	Diesel Generator	To be taken back by the DG AMC Vendor	Project & O & M
7.	Shelter related Debris	Shelter Erection	To be disposed eco-friendly manner while Site Cleaning activity before handover	Project

Fig. 3.2.1 Waste Disposal Matrix

WASTE DISPOSAL MATRIX				
S.No	Type of Waste	Source of Generation	Disposal Procedure	Responsibility
8.	Electronic waste or spare parts	Repair/maintenance of equipments	To be taken back by the AMC Vendor	Project & O& M

Notes

Unit 3.3: Operating Equipment at Site

Unit Objectives

At the end of this Unit, you will be able to:

1. Understand the procedure to start a DG Set.
2. Perform the steps to transfer the load on DG.
3. Perform the steps to stop a DG Set.
4. Operate the Fire Extinguisher at site.

3.3.1 Operating Equipment at Site

Diesel Generator is most frequently used equipment in a telecom tower site as electricity from Electricity Board is not consistent. Since the technician at the site will be using this everyday its important to understand the basic operational procedures for a DG Set.

3.3.2 DG Starting Procedure

Perform the following steps to start the DG set:

- Perform Daily checks as per daily check list.
- Ensure DG control panel MCB is in off position.
- Open canopy control panel side door and switch on ignition key to ON position.
- Turn the ignition key to start position and release the key once first firing noise of engine is heard. Ensure ignition switch is not held in start position for more than 3 seconds after engine has fired. Do not hold the ignition key in start position more than 10 seconds If DG does not start.
- If DG has not started in first attempt allow 30 seconds gap before attempting for next starting.
- Check any abnormal noise from DG.
- Check proper functioning of VAF meter (Volt / Ampere / Frequency).
- Check for indication on ESU Unit LED.
- Check for proper functioning of Lubricating oil pressure gauge.
- Check proper functioning of battery charging ammeter and ensure needle restores back to 0 position which ensures charging of battery.
- Check for proper functioning of Hot air cooling fan (Exhaust fan).
- Check for leakage oil / fuel / exhaust gases / water (applicable for water cooled engine).
- Check for indication lamp – DG supply incoming glowing.
- Check for functioning of Hour metre and record in Log book.
- Always keep ignition switch in on position while DG is in operation.
- Allow DG to warm up for 3 to 5 Minutes before transferring load on DG

3.3.3: DG Load transfer Procedure

AÕer DG is running at required speed, load is transferred to DG in the following way:

- Switch on the control panel MCB switch to ON position.
- Shift the manual change over switch to DG position.
- Check “LOAD ON” indicaϴon lamp glowing to confirm the DG power is transferred to Load.
- Check VAF Meter display and ensure DG is not overloaded.
- Always ensure DG is loaded to minimum 60 % of its rated capacity.
- Ensure imbalance of load between phases does not exceed 25 % - applicable for III Phase DG.
- Ensure proper closure of all DG doors.

3.3.4 DG Stopping Procedure

- Shift Manual Change over switch to EB position.
- Open canopy control panel side door and switch off the control panel MCB switch to off position.
- Run DG for minimum 3 to 5 minutes without load to allow the engine to cool down.
- Press the control panel Push button to stop the DG or switch of the ignition key to OFF position to stop the DG through Solenoid.
- Check for functioning of Hour meter and record in log book.
- Ensure ignition switch is kept in OFF position while DG is not in use.
- Ensure proper closure of all DG doors.

3.3.5 Fire Extinguisher using Procedure

Co2 (Carbon Dioxide) fire extinguishers are ideal for fires involving delicate electrical equipment and Class B liquid fires. They do not work by cooling the fire and therefore not recommended for controlling Class A fires involving solids. Co2 fire extinguishers discharge gas under pressure replacing the air with inert Carbon Dioxide gas which does not support combustion. Co2 fire extinguishers are color coded with a black label.

Co2 is a gas and can asphyxiate if inhaled. Care should be taken when using in a confined space.

How to use a Co2 fire extinguisher:

- Carbon dioxide extinguishers should NOT be used in small confined spaces as the gas will quickly replace the oxygen and may asphyxiate if inhaled.

- DO NOT HOLD THE HORN during discharge as it becomes extremely cold. Our Co2 extinguishers are fitted with a double skin insulated horn to prevent cold burns if handled making them easier and safer to use but caution should be exercised. Check the product specification for this feature.

- Direct the horn at the core of the fire and discharge working outward as the fire is dowsed.

Unit 3.4 Escalation Procedure for Fire Accident

Unit Objectives

At the end of this Unit, you will be able to:

1. Take Action which we need to do at the time of fire.
2. Follow the escalation procedures after a fire incidence.
3. Understand the Process of filling for insurance claim.

3.4.1 Escalation Procedure for Fire Accident

In case of a Fire accident there is a very specific procedure which is defined by all the telecom operators (Refer Fig 3.4..1(i)). This is to ensure that right people gets informed and correct actions are taken to resolve all the issues like informing a fire station, lodging a FIR ,filing an insurance claim etc post a fire accident.

S. No.	Process Flow	DescripΘon
1.	Fire reporting/visit to the affected site	The technical is informed of the fire by NOC. The technician will then share the details with the O&M Engineer. The O&M engineer will then call the fire Station in case of major fires, and then visit the site.
2.	Information to the fire station if required.	The O&M Engineer shall inform the O&M cluster manager. In case of active components be burnt, the customer will be burnt, the customer will be informed.
3.	Incident reporting and RCA	The O&M Engineer shall fill up the incident report and access the damage. They may also (If required) take photos/Pictures to show to higher authorities for further actions and resolution. The O&M head is responsible for the RCA with information to be shared with O&M hub head and BE hub head. This is to be escalated as per the matrix attached.
4.	FIR with the Police Station	O&M cluster manager/ Circle O&M head shall also call the Police station and lodge FIR, if required.
5.	Claim site reestablishment	For site reestablishment go to point no 6/ for claims go to point no. 2 Point no. 7
6.	Site re-establishment	Circle O&M head will initiate the process of re-establishment of the services aÕer discussion with the circle head and customer . The list of material and services required to re-establishment of this material will be done as per the NFA and the PR process. Finance to confirm that they have received all the documents required to claim for the insurance.

Fig. 3.4.1(i) Escalation Procedure for Fire Accident

S. No.	Process Flow	Description
7.	Assessment of the damage	The circle O&M head will prepare CIF (Claim notification form) with an estimated cost of items burnt and also attach copy of the FIR and send to the insurance company through circle finance head to process the claim for the damage.
8.	Insurance claims	If the damage is more then 2 lakhs then O&M/finance pays fees to the fire brigade department. This fees is for the process of assessment of the damage due to fire. This fire brigade report is to be submiΣed to police Station for the final FIR. 3 sets are prepared, one each for bank, fire department and 3rd for the O&M.
9.	Sureyor visit to the site	Insurance surveyor visits the site for claim assessment. O&M cluster manger to accompany the insurance surveyor for the site visit and ensure the completeion the formaliΘes in this regard.
10	Claims follow up and captalization/writing off of the material from the books.	O&M/Finance should ensure submission of documents for claim processing. Circle finance will follow up for the insurance claims. Material bought is to be capitalized and the materials lost is to be wriΣen off from the books.

Fig. 3.4.1(ii) Escalation Produre for Fire Accident

Practical

1. Check all the Alarms at a site and try to find reason for this fault, rectify the fault.

Unit 3.5 Fault Management System

Unit Objectives

At the end of this Unit, you will be able to:

1. Understand the Concept of Network Management and fault Management.
2. Describe the architecture of the fault management system.
3. IdenƟfy the components of a fault management system.
4. Understand how Alarms get routed to various interface.
5. Explain the back end system used in Fault management.

3.5.1 Fault Management - An Overview

In network management, fault management is the set of functions that detect, isolate, and correct malfunctions in a telecommunications network. This also compensate for the environmental changes, and include maintaining and examining error logs, accepting and acting on error detection notifictions, tracing and identifying faults, carrying out sequences of diagnostics tests, correcting faults, reporting error conditions, localizing and tracing faults by examining/ manipulating database information.

When a fault or event occurs, a network component will often send a notification to the network operator using a protocol such as SNMP. An alarm is a persistent indication of a fault that clears only when the triggering condition has been resolved. A current list of problems occurring on the network component is often kept in the form of an active alarm list, the Alarm MIB. A list of cleared faults is also maintained by most network management systems.

Fault management systems may use complex filtering systems to assign alarms to severity levels. These can range in severity from debug to emergency, as in the system log protocol. This takes on values of cleared, indeterminate, critical, major, minor or warning. It is considered good practice to send a notification not only when a problem has occurred, but also when it has been resolved. The latter notification would have a severity of clear.

A fault management console allows a network administrator or system operator to monitor events from multiple systems and perform actions based on this information. Ideally, a fault management system should be able to correctly identify events and automatically take Action, either launching a program or script to take corrective Action, or activating notification software that allows a human to take proper intervention (i.e. send e-mail or SMS text to a mobile phone). Some notification systems also have escalation rules that will notify a chain of individuals based on availability and severity of alarm.

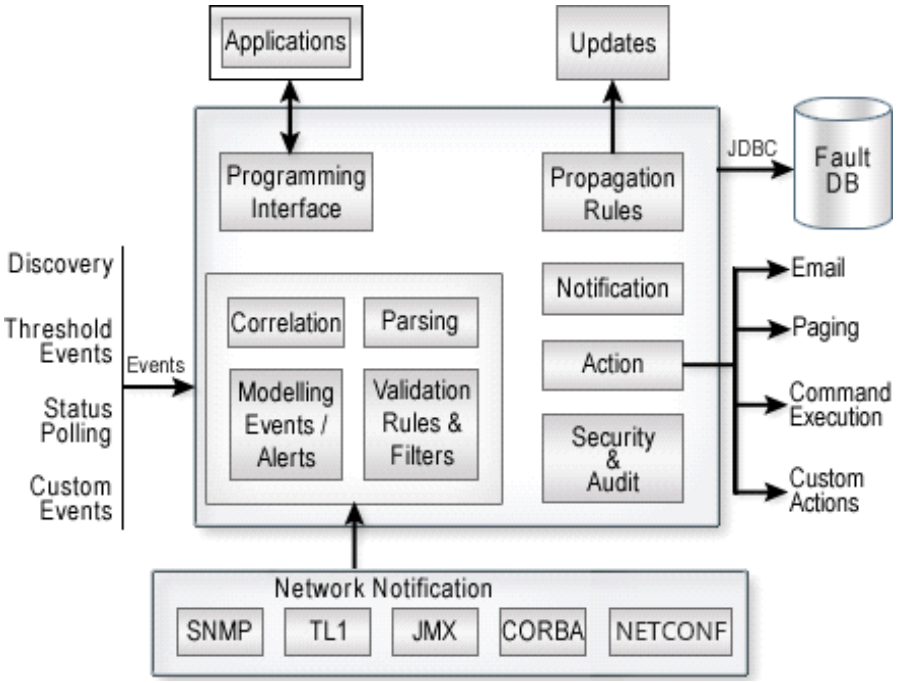
3.5.2 Need for Fault Management

No system is infallible. Ability to detect, recover and limit the impact of failures in a system is the most challenging job and is what every mission critical business should put in place. Understanding, monitoring and managing the individual elements of a system may not be a problem, but as the system increases in size and complexity, understanding the relationship between the various elements in the system, monitoring and managing their interrelationship and the problems that arises due to their interrelationship becomes tedious and challenging. Moreover, an army of personnel cannot be deployed to just administer the system. This is where a Fault Management system comes into play.

A comprehensive fault management system (FMS) enhances performance and availability. FMS correlates and manages notifications and presents critical information that meets the needs of managers. Notifications are modeled as objects that can be tracked and managed easily. FMS is a highly flexible and extensible framework in which domain specific filters and rules can be easily plugged in. It provides secure, scalable, flexible and reliable solution to manage mission-critical environments.

3.5.3 Fault Management Architecture

Notifications are raw data received from the network. These cryptic data needs to be converted to a format which could be understood by the console operators. Information such as whom to call, whom to page, procedures to fix the problem etc., on receipt of a notification, should be readily available to effectively crackdown the problem. The non-productive time spent on trying to find out what to do or where to start should be eliminated.



3.5.3 Fault Management Architecture

FMS addresses these issues effectively and more efficiently. It has a flexible architecture where filters and parsers can be plugged in easily (Refer to Fig 4.4.2). Filters help in validating the notifications received from the various managed network elements (NE) and also in applying domain specific rules. Rules can be structured to validate the incoming events based on time, thresholds, or count. For example, transient system failures occur as a normal part of network operation. Rules become quite handy in these circumstances and can be used to filter out transient network failures. This helps in reducing the thousands of events to ten or twenty actual problems that needs to be addressed. Parsers are simple but powerful mechanism that help in disseminating the raw data as fast as possible to the concerned parties in a meaningful manner.

FMS allows automated Action to be taken at various levels of the event flow, some of the actions supported out of box includes e-mail, paging, command execution, custom actions etc. Apart from the automated actions it has a powerful notification mechanism. External applications can register with FMS for notifications. Registered applications are notified during the various stages of event flow.

RDBMS is used as the persistence layer which facilitates achieving the high level goals of availability, scalability, performance, concurrence and atomicity of all the operations. All the persistent information is stored in the database and these information are used for generating reports and for auditing. An internal caching mechanism helps to speed up transactions.

The rich set of services offered by the fault management module are also exposed through a set of well- defined and easy to use APIs, using which scalable, secure and reliable applications can be developed with ease.

3.5.4 Network Notifications and Event Flow

In FMS, Event is the basic Unit of management information that is complete in itself and relates to an occurrence like discovery of an element, status update of an element or failure in an element. Events form a repository of information for all the occurrences in the system. Alarm results from correlation of events and represents failure or fault in a network element that may need immediate attention.

These Event and Alert objects define the basic attributes and actions needed for effecive fault management (Refer to Fig 3.5.4). Users can also model their own objects by extending the basic units to plug-in their domain specific properties. It is also possible to add additional attributes to these basic units or their derivatives at runtime.

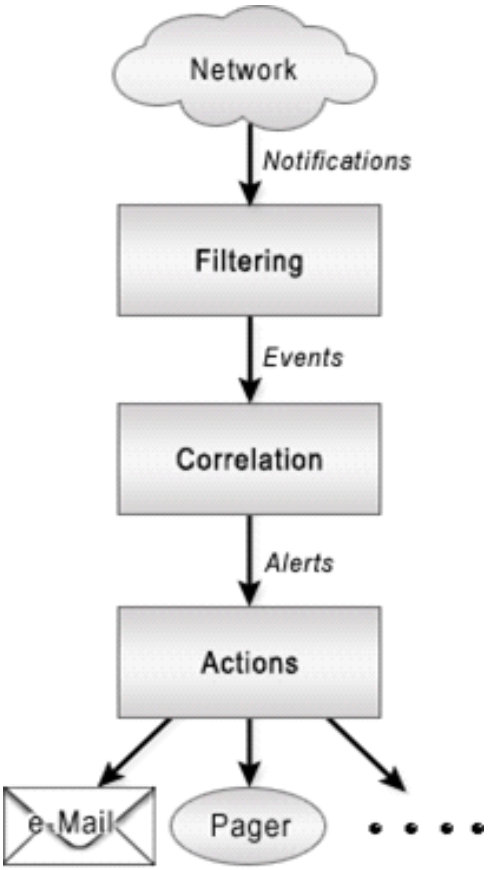


Fig. 3.5.4 Event Flow in a FMS

3.5.5 Fault Management Internals

The fault management system is a collection of few processes like alarm handling, alarm filtering, alarm correlation, alarm forwarding, alarm generation and thresholding, log management and alarm reporting. The process flow for these activities is collect, process, generate information.

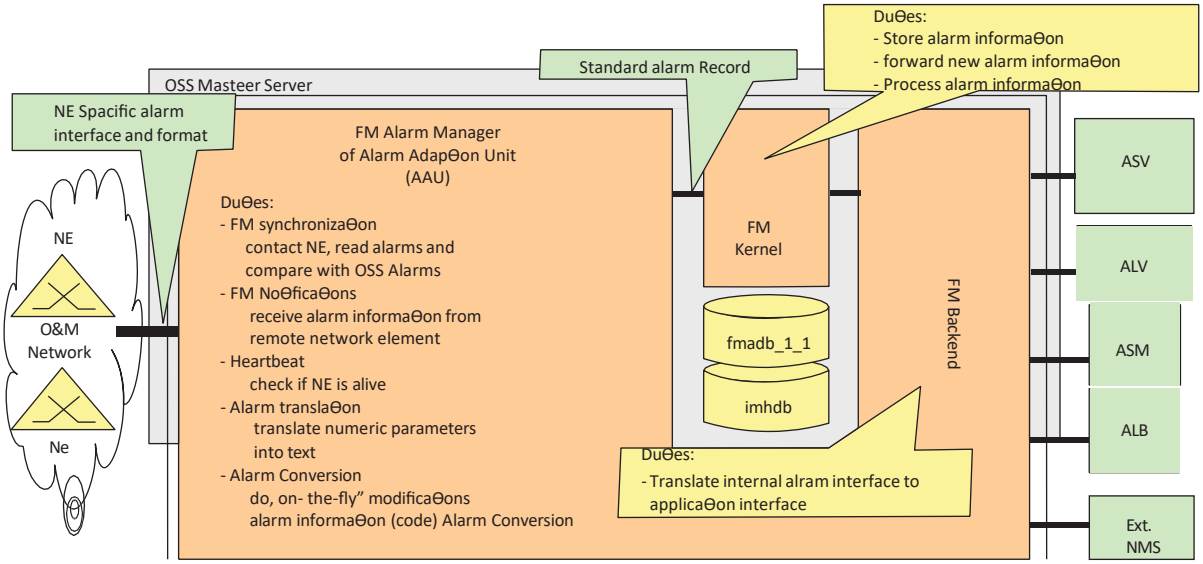


Fig. 3.5.5(i) Fault Management Alarm System

The Fault management system consists of (Refer to Fig. 3.5.5) :

- Fault Management Alarm System
- FM kernel
- FM Back end
- Network Element interface

FM Alarm System does the following functions like Fault Management Synchronisation, FM Notifications, heartbeat management and Alarm conversion. The FM Alarm system passes the inputs to FM kernel where this kernel stores, forwards and process alarms. Once these Alarms are processed, they go into FM Back end which translates internal alarms to application specific Alarms which can be acted upon by the user or NOC manager.

Alarm Acknowledgment – Process Flows happens in the following way

• Usual Alarm Life cycle is

– Alarm -> Acknowledge -> Cease -> gone

1. The alarm gets into FM.
2. The alarm gets acknowledged by an operator.
3. The alarm is fixed on the NE; a cease message gets into FM.
4. The alarm is removed from FM alarm list, but is logged in the databases.

Alarms shown on the Fault management system can be routed to any device as per the policy of the company. They could be send on email, SMS, printer, beep system etc. From there these alarms are picked by the technicians to do the fault recΘficaΘon.

Alarm Record parameters included in the mail body

☐ Alarm Record ID
☐ Event Time
☐ Event Type
☐ Object of Performance
☐ Backup Object of Reference
☐ Backup Object
☐ Backup Status
☐ Trend Indication
☐ Perceived Severity
☐ Probable Course
☐ Specific Problem
☑ Problem Text Problem
☐ Data Proposed Repair
☐ Action Previous Record
☐ ID Previous Severity
☐

AWE PARAMETERS
☐ Alarm Class
☐ Alarm Category
☐ Alarm Number
☐ Attendance Indications
☐

INTERNAL PARAMETERS
☐ Record Type
☐ Logging Time
☐ Object Type
☐

USER PARAMETERS
☐ TH OS Control InformaΘon

FMK PARAMETERS
☐ FMK Processing Type
☐ FMK Generated
☐

Valid E-Mail address and Subject for all matching alarms

Mail: eddrent
Mail Subject Feild: ATR-

Fig. 3.5.5(ii) Alarm Text Routing – E-MAIL Destination Window

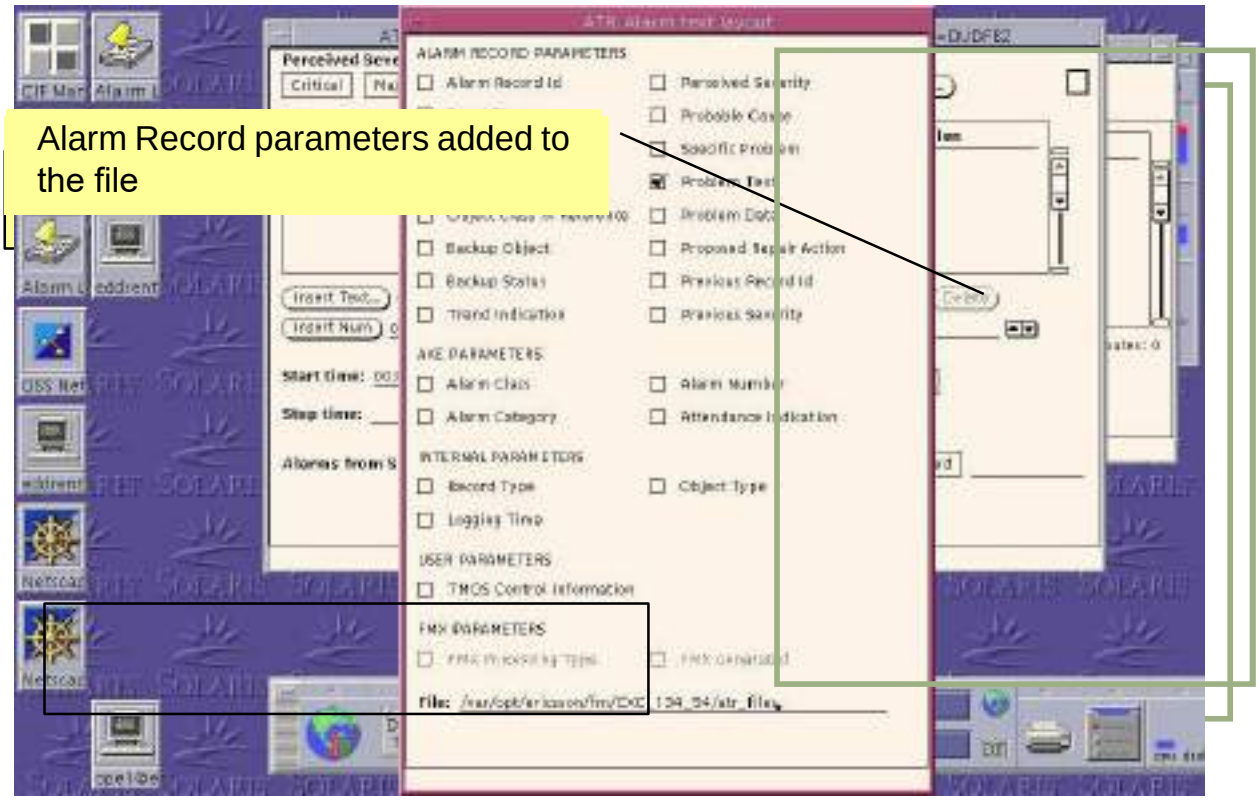


Fig. 3.5.5(iii) Alarm Text Routing – File Destination Window

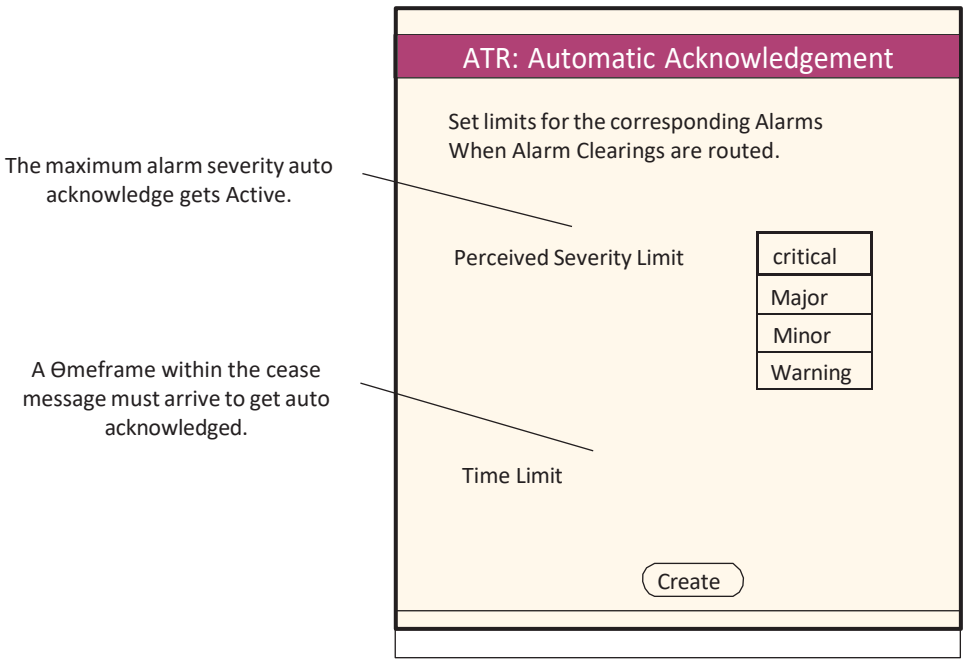


Fig. 3.5.5(Iv)Alarm Text Routing – Auto Acknowledge Window

3.5.6 FM Backend

Fault Management Back End stores the alarm informaθon, forwards new alarm informaθon and processes the alarm informaθon. For doing this it supports various Alarm user interfaces, alarm presentaθon interfaces, Alarm Programmer interfaces and various NMS interfaces. Few of them are given below to give a basic overview.

1. Alarm user interfaces as shown in fig. 3.5.6:
   - Alarm List Viewer GUI (ALV)
   - Alarm Status Matrix GUI (ASM)
   - Alarm Log Browser (ALB)
   - Alarm Status Viewer (ASV)

2. Geographical Map alarm presentation are shown in the following form:
   - CLI: alnip, allist, alcom, alack, alrout, allog

3. Alarm programmer's & NMS interfaces are represented in the following way:
   - CLI (Command Line Interface): fmlist, fmack, fmrout
   - CIRP Agent – CORBA Alarm & Notification IRP R99
   - BNSI Agent - Basic Network Surveillance Interface Agent

Fig. 3.5.6 Different Alarm Interfaces

3.5.7 Understanding Alarms

Alarms when generated are displayed on the site and are also send to the Fault Management system (Refer to Fig 3.5.7(i)), where they gets stored and Network Engineer is directed to take the required actions. Some of the fault codes which are defined for various faults are given in Fig 3.5.7(ii). These alarms are also tested by the Network Engineer as a routine activity as part of regular check mechanism.

Alarm Name	Alarm Meaning	Category
battery Discharge	battery Discharged	critical
Fire & Smoke	Fire Alarm	critical
Rectifier Fail	Rectifier fail	critical
Power Plant Minor	Rectifier fail	critical
Power Plant Major	Power Plant Major alarm	critical
DG Fail to Run	DG Auto Start failed	critical
Low Lub fuel pressure	Low Lube Oil Pressure	critical
High Room temperature	High Room Temperature	critical
DG Temperature High	DG High Head / Water temperature	Major
Rectifier Input Fail / EB Supply Failure	AC Input to PP fail	Minor
AC1 Fail	Aircon 1 Failure	Major
AC2 Fail	Aircon 2 Failure	Major
Door Open	Shelter Door Open	Major
DG ON Load	DG Running EB not available	Major
DG Low Fuel Level	Low Fuel Level	Minor
Mains Fail	EB Power Fail	Minor
DG Fail to Stop	DG running even EB available	Major
	SMS on BD and fire incidents	

Fig. 3.5.7(i) Severity Level of Various Faults

Alarm Testing				
		(To be done by Engg. once in month along with tech)		
			Cluster	
S.NO.	Fault Code	Alarms	Status at time of maintenance	Action
1.	AL1	Site on battery	Available at DDF/not available a DDF	Rectify if not available at DDF
2.	AL2	Site on DG	Available at DDF/not available a DDF	Rectify if not available at DDF
3.	AL3	Intruder/Door open alarm	Available at DDF/not available a DDF	Rectify if not available at DDF
4.	AL4	Aircon Faluty	Available at DDF/not available a DDF	Rectify if not available at DDF
5.	AL5	DG fail to start	Available at DDF/not available a DDF	Rectify if not available at DDF
6.	AL6	Fire/smoke alarm	Available at DDF/not available a DDF	Rectify if not available at DDF
7.	AL7	Low fuel level	Available at DDF/not available a DDF	Rectify if not available at DDF
8.	AL8	Rectifier module fail	Available at DDF/not available a DDF	Rectify if not available at DDF
9.	AL9	DG fail to stop	Available at DDF/not available a DDF	Rectify if not available at DDF
10.	AL10	High Temperature	Available at DDF/not available a DDF	Rectify if not available at DDF
11.	AL11	Confirmation from OMCR	Available at DDF/not available a DDF	Rectify if not available at DDF

Fig. 3.5.7(ii) Presentation of Various Alarms

Excercise

1. What is the minimum level of percentage of HSD in a diesel tank of a DG?

2. For access related issues a tower technician will contact whom?

3. Who will collect the used Lube oil from a tower site?

4. What is the function of a fault management Alarm System?

5. What is the full form of ALV and ASM. And where they are used?

Notes

Notes

Skill India
कौशल भारत-कुशल भारत

सत्यमेव जयते
GOVERNMENT OF INDIA
MINISTRY OF SKILL DEVELOPMENT
& ENTREPRENEURSHIP

N·S·D·C
National
Skill Development
Corporation
Transforming the skill landscape

4. Plan Work Effectively, Optimise Resources and Implement Safety Practices

Telecom Sector Skill Council

TEL/N9101

Key Learning Outcomes

By the end of this module, the participants will be able to:

1. Explain about the work place health and safety
2. Differentiate various health hazards
3. Demonstrate various first aid techniques
4. Importance of safety at workplace
5. Understand Basic hygiene Practices and hand washing techniques
6. Explain the need for social distancing
7. Understand the reporting of hazards at workplace
8. Explain e-waste and process of disposing them
9. Explain Greening of jobs

UNIT 4.1: Workplace Health & Safety

Unit Objectives

By the end of this unit, the participants will be able to:

1. Understand about workplace health and safety
2. Explain tips to design a safe workplace
3. Explain precautions to be taken at a workplace

4.1.1 Safety: Tips to Design a Safe Workplace

Every organization is obligated to ensure that the workplace follows the highest possible safety protocol. When setting up a business some tips to remember:

- Use ergonomically designed furniture and equipment to avoid stooping and twisting
- Provide mechanical aids to avoid lifting or carrying heavy objects
- Have protective equipment on hand for hazardous jobs
- Ensure presence of emergency exits and they are easily accessible
- Set down health codes and ensure they are implemented
- Follow the practice of regular safety inspections in and around the workplace
- Get expert advice on workplace safety and follow it
- Get regular inspection of electrical wiring and also the electrical switches and gadgets
- Install fire extinguishers and fire alarms.

4.1.2 Non-Negotiable Employee Safety Habits

Every employee is obligated to follow all safety protocols put in place by the organization.

All employees must make it a habit to:

- Immediately report unsafe conditions to the supervisor
- Recognize and report safety hazards that could lead to slips, trips and falls
- Report all injuries and accidents to the supervisor
- Wear the correct protective equipment when required
- Learn how to correctly use equipment provided for safety purposes
- Be aware of and avoid actions that could endanger other people
- Always be alert
- Educate the employees about the first/emergency exits on the floor, and also where the fire extinguishers are kept.

Tips

- Be aware of what emergency number to call at the time of a workplace emergency
- Practice evacuation drills regularly to avoid chaotic evacuations

UNIT 4.2: Different types of Health Hazards

Unit Objectives

By the end of this unit, the participants will be able to:

1. Understand the health hazards
2. Demonstrate First Aid Techniques

4.2.1 First Aid

Illness, injuries, and pain are part of human life. This can happen anyway. Every individual is prone to illness and injuries at any time and anywhere.

In case of any of these, some kind of immediate medical attention or treatment is needed to reduce the discomfort, pain, and deterioration of the condition. The medical attention that is given at the first instance before seeking professional medical help is called "First Aid". First aid is the immediate and temporary treatment given to the victim of an accident or sudden illness while awaiting the arrival of "Medical Aid". First Aid means providing the initial treatment and life support for people with an injury or illness. However, First Aid has its limitations and does not take the place of professional medical treatment. Proper early assistance given by First Aider helps in saving the life of a patient.

Illness and injuries can happen anywhere, be at home, the workplace, or in the market place. Whatever safety measures we adopt, we are all prone to illness sometime or the other.

Some common injuries and their rescue techniques:

4.2.2 First Aid Techniques

- Direct pressure must be applied to the cut or wound with a clean cloth, tissue, or piece of gauze, until bleeding stops.
- If blood soaks through the material, it is highly recommended not to remove it.
- More cloth or gauze must be put on top of it, and pressure must be continued.
- If the wound is on the arm or leg, the limb must be raised above the heart to help slow the bleeding.
- Hands must be washed again after giving first aid and before cleaning and dressing the wound.
- A tourniquet must not be applied unless the bleeding is severe and not stopped with direct pressure.

Click/Scan this QR code to view the video on first aid at work

Fig. 4.2.1: clean cut or wound

Clean cut or wound

- The wound must be cleaned with soap and lukewarm water.
- To prevent irritation and burning sensation, the soap solution must be rinsed out of the wound.
- Hydrogen peroxide or iodine must not be used to clean or treat the wound since they are corrosive and can damage live tissues.

Fig. 4.2.2: Apply hydrogen peroxide or iodine

Protect the wound

- Antiseptic cream or solution must be applied to the wound to reduce the risk of infection.
- Then the wound must be gently covered with a sterile bandage.
- Till the wound heals, the bandage must be changed (dressed) daily to keep the wound clean and dry.

Fig. 4.2.3: Protect the wound

Call the Emergency Helpline if:

- The bleeding is severe and deep
- You suspect Internal Bleeding
- Abdominal or Chest wound exists
- Bleeding continues even after 10 minutes of firm and steady pressure

For Burns:

- Immediately put the burnt area under cold water for a minimum of 10 minutes
- If the burned area is covered, take clean scissors, cut and remove the fabric covering the area
- In case clothing is stuck to the burned area, leave it as it is
- Before sterile dressing application, remove jewellery (if any)
- It is better to leave the burned area open
- Do not apply any medication or ointment
- Breaking a blister – it is an absolute no-no!

Fig. 4.2.4: Put Burnt Area under Water

For Broken Bones and Fractures

- **Protruding bone must be left alone**
  - If a bone has broken through the skin, it must not be pushed back into place.
  - The area must be covered with a clean bandage and immediate medical attention must be sought.
- **Bleeding must be stopped**
  - Steady and direct pressure must be applied with a clean piece of cloth for 15 minutes and the wound must be elevated.
  - If a blood soaks through, one must apply another cloth over the first and seek immediate medical attention.
- **Swelling must be controlled**
  - The RICE (Rest, Ice, Compression and Elevation) therapy must be applied to control and reduce swelling.
  - Rest the injured part by having the person stay off of it.
  - Ice must be applied on the area with the help of an ice pack or by wrapping the ice in a clean cloth. Ice must not be directly placed against the skin.

For Heart Attack/Stroke

- Think FAST. Face: is there weakness on one side of the face? Arms: can they raise both arms? Speech: is their speech easily understood? Time: to call Emergency helpline
- Immediately call medical/ambulance helpline or get someone else to do it

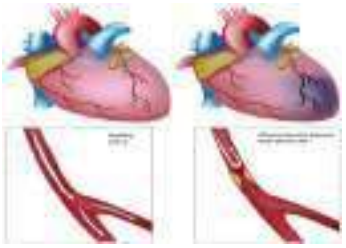


Fig 4.2.5: Anatomy of Heart Attack

For Head Injury

- Ask the victim to rest and apply a cold compress to the injury (e.g. ice bag)
- If the victim becomes drowsy or vomits, call Medical helpline or get someone else to do it

Steps of using breathing apparatus:

Check the parts of the breathing apparatus thoroughly.

Check the bypass knob (red). Close it if you see it open. After this, press the reset button (area above bypass nob – black)

Inspect the facemask to see that it is undamaged.

Lift the cylinder ensuring that on the top the cylinder valve should be present.

The back plate of the cylinder should face the wearer.

Wear the breathing apparatus on the shoulder like a bag pack and by the neck strap, hang the facemask.

After wearing the breathing apparatus tighten shoulder straps and fasten the waist belt

The cylinder valve should be opened slowly to inspect the pressure gauge.

	
Make sure that 80% of the cylinder is full.	Wear the mask slowly by resting your chin in the resting cusp and pull the head strap slowly over your head. Pull the head straps for a snug but comfortable fit.
	
Breath in and normally to see if you can breathe normally or not.	Now insert a finger sidewise of the facemask for easy outward airflow.
	
Slowly close the cylinder valve without leaving the knob. Be steady for 10 minutes and hold your breath or extremely slow to listen to any wheezing sound. Also, check the pressure gauge for any dip in the pressure.	Normally Breathe to vent system Listen for a whistle alarm while observing the pressure gauge at 55 bar (+/-5 bar)

Table: 4.2.1: Steps of using breathing apparatus

Briefing and Guidance for Fire Fighters

There are basically three methods with the help of which people can be rescued from a building engulfed in a blazing fire. To ensure on-site reception, here are two of the important steps that we will discuss now. These come under the best safe lifting and carrying practices.

Conventional Technique: This is a good method if there is an open area close by. The first rescuers will make the victim sit reach under their armpits and finally, grab their wrist. The other rescuer will cross the ankle (victim), pull up that person's legs on his shoulder. Finally, on the count of 3, both will lift the person up and move out.

Fig. 4.2.6: Fast Strap

Fast Strap: In case the victim is completely incapable of moving out of the fire zone. The rescuers should follow this method. One of the rescuers will place their knee between victim's shoulder and head. Pin the loop of webbing to the ground with the help of the knee. This acts as an anchor. With the non-dominant hand hold the other end of the webbing and make a loop. With steady hands, pull the victim's hand in from the loop, tie it securely and finally clip the webbing loops.

Fig. 4.2.7: Fast Strap

Essentials for Smooth Evacuation: The following are essential to have a smooth evacuation during an outbreak:

- Clear passageways to all escape routes
- Signage indicating escape routes should be clearly marked
- Enough exits and routes should be present to allow a large number of people to be evacuated quickly
- Emergency doors that open easily
- Emergency lighting where needed
- Training for all employees to know and use the escape routes
- A safe meeting point or assembly area for staff
- Instructions on not using the Elevator during a fire

Special Evacuation Requirements For Specially Abled Persons

- **The Visually Impaired**
  - Announce the type of emergency
  - Offer your arm for help
- **With Impaired Hearing**
  - Turn lights on/off to gain the person's attention, or indicate directions with gestures, or write a note with evacuation directions
- **People with Prosthetic Limbs, Crutches, Canes, Walkers**
  - Evacuate these individuals as injured persons.
  - Assist and accompany to evacuation site if possible.
  - Use a sturdy chair, or a wheeled one, to move the person to an enclosed stairwell
  - Notify emergency crew of their location

4.2.3 Importance of Fire Safety Drills

Fire drills are indispensable in any workplace or public building for rehearsing what to do in the event of a fire. They are also a lawful obligation under the Fire Safety Order of 2005 and all workers in a company must partake. Here's how to get the most out of your fire practice.

Why have fire drills?

There are numerous reasons why fire drills are vital; first of all, fire drills are a chance to practice evacuation techniques to make sure all staff are acquainted with them. The staff will vacate the building quickly and therefore in a real life situation panic will be decreased, as everyone will know what they need to do. Fire drills are also beneficial for testing escape methods to assess their efficiency.

During fire drills, checks can also be carried out on alarm systems to make certain they are working properly and that emergency exits are passable. Overall fire drills help increase safety, so that you will be best equipped if a real fire does happen.

How often?

Ideally there should be two fire drills a year, although this may vary according to the workplace and after checking the firm's risk assessment. If there are people who work in shifts, suitable preparations should be made to ensure all staff partake in at least one fire drill per year and to educate them as to how to handle the situation.

Should you inform staff beforehand?

There are arguments for and against making people conscious of fire drills before they take place. Some people contend that not notifying staff gives an element of surprise, so that people take drills more sincerely. However, this can also have the reverse effect in a real fire, as on overhearing the alarm people may reason that it's only a drill.

The benefit of notifying all staff of fire drills in advance is that initially, they will not panic, which circumvents potential injuries that could be instigated in a rush to exit a building. Furthermore, if the alarm sounds, lacking a prior warning, there will be no uncertainty as to if it is a drill or not and people will act correctly. In public places such as shopping centres, it is prudent to make members of the public alert when a drill is about to happen.

Fig. 4.2.3: Fire exit signage

UNIT 4.3: Importance of Safe Working Practices

Unit Objectives

By the end of this unit, the participants will be able to:

1. Explain Basic Hygiene Practices
2. Understand the importance of Social Distancing
3. Demonstrate the safe working practices

4.3.1 Basic Hygiene Practices

We are living in an environment with millions of germs and viruses. And our body can be a breeding space for these microbial organisms. They grow and multiply and cause many diseases which sometimes can prove to be fatal for the human beings. These disease-causing mi-crobial organisms kill over 17 million people every year. Some simple hacks and little changes of basic personal hygiene habits can bring amazing changes to all of us. We can prevent contracting these diseases if we follow these hygiene practices every day.

Personal Hygiene

Personal hygiene is all about managing your body hy-giene, essentially caring for your well-being incorporat-ing some physical hygiene habits. Also, there are mental health benefits as well, as they affect each other im-mensely.

What are good personal hygiene habits?

Good personal hygiene includes but not limited to-

- Take regular shower
- Maintain oral hygiene
- Wash your hands frequently
- Wash your genitals
- Keep your clothes and surrounding dry and clean

These habits should be practiced on a regular basis, at home, at work, basically where you are!

That's the whole idea of preventing your body system collapse over a tiny mi-crobe!

Personal Hygiene Practices at Home

Your home should be the most comfortable and conven-ient for you to keep up your personal hygiene level to a standard, yet, we find ourselves procrastinating over hygiene issues when we are at home. Even though some of these tasks barely take a minute.

1. **Take Regular shower**

   Do not wait up to feel the dried sweat in your body to feel the urge to take shower, make it a routine, you have the choice to either take them before you head to work or after the long day or even before you head to sleep, whichever one suits your routine. Make sure to rinse your body thoroughly, especially the genitals and underarms as they produce more sweat and are more prone to fungal activities.

2. Wash your hands frequently

We use our hands to do our most physical acts, from picking up the keys, browsing through our phones, cooking or eating to attending our pets. While we agree and accept the importance of washing hands before eating and after visiting the toilet, it is also important to wash our hands with soap or sanitizer every now and then. The pandemic covid-19 which crippled the life all over the world has taught us an important lesson that sanitizing our hands regularly is the only way we can avoid transmission of the disease. Use alcohol based sanitizer to wash hands well to prevent the spread of communicable diseases.

Fig. 4.3.1: 7 steps for Handwashing

Click/Scan this QP code to view the hand washing techniques

3. Maintain oral hygiene practices

It is very important to take care of the teeth and gum, to prevent tooth decay and bad odour. Just brushing them twice a day is not enough, but using fluoride toothpaste and brushing properly is very essential. And wash it well with water to remove any food particles that is stuck in the gap in between the teeth. It is advised to wash the teeth everyday twice to maintain healthy teeth and gum.

4. Nails and hairs hygiene

The cleanliness of nails and hair is also very important. They store dirt and grease. And even the microbes could be in there stuck and spreading. If the nail is not clean they can cause severe food poisoning, as we use our hands to eat food. Trim the nails once in a fortnight and wash hair at least twice a week with a shampoo to keep them healthy

5. Nose and ears hygiene

Wherever we are most likely to breathe in some pollutants, and most of the particles are bound to be stuck in the nasal hair. So, rinse the nose and ear with warm water once you return from outside.

6. Wear fresh and clean clothes

Changing into neat and clean clothes will prevent many infectious diseases. It will also give the mental effect immediately and it will boost the mind. Wash clothes with a good detergent every day and dry it in the sun. This will ward off any microbes attached to the clothes. If possible, Dettol can be used while rinsing which is an anti-disinfectant.

7. **Food hygiene**

   You can get severely sick from food-borne diseases, as most of your foods are raw, purchased from outside, they risk being cross-contaminated with harmful microbes. Food hygiene is basical-ly the idea of better storage, handling, and preparation of food to prevent contamination and to prevent food poisoning.

4.3.2 Importance of Social Distancing

Preventing communicable diseases:

All these above practices will help us to prevent communicable diseases. These diseases are highly infectious and contagious and spread through air, urine, feaces, saliva, skin (through touch) and using same towels and utensils.

Social Distancing and isolation, Self-Quarantine:

Ever since the spread of the pandemic covid-19, several health organisations have been insisting on following social distancing and isolation. Communicable diseases mainly spread through coming close to the infected individual and through physical touch. If a person is infected with diseases like normal flu or cold and spread it to others, the symptoms and may remain with the infected person for a day or two. The virus may be destroyed by taking an antibiotic. But in severe cases like corona virus the infection is severe and can prove fatal to the affected people. To prevent the spread of the virus, the entire world adopted lockdown, social distancing and compulsory face mask. And the infected person has to be in self isolation and quarantine till the time the symptoms are over. This was the advisory from the World Health Organisation, and the entire world followed it to prevent the rapid spread of the virus. The same can be applicable to all types of communicable diseases that are spread mainly through air and touch.

As communities reopen and people are more often in public after the pandemic, the term “physical distanc-ing” (instead of social distancing) is being used to rein-force the need to stay at least 6 feet from others, as well as wearing face masks. Historically, social distanc-ing was also used interchangeably to indicate physical distancing which is defined below. However, social dis-tancing is a strategy distinct from the physical distanc-ing behavior.

What is self-quarantine?

Self quarantine was imposed on people who have been exposed to the new covid-19 and who are at risk for getting infected with the virus were recommended to practice self-quarantine. Health experts advised the self-quarantine for 14 days or two weeks. Two weeks provides enough time for them to know whether or not they will become ill and be contagious to other people.

Self-quarantine was also recommended for people who have recently returned from traveling to a part of the country or the world where COVID-19 was spreading rapidly, or if a person has knowingly been exposed to an infected person.

Self-quarantine involves:

- Using standard hygiene and washing hands frequently
- Not sharing things like towels and utensils
- Staying at home
- Not having visitors
- Staying at least 6 feet away from other people in your household

Once your quarantine period has ended, if the symptoms are not there, then the person may return to normal routine as per doctor's advice.

What is isolation?

Anybody who is infected with a contagious disease needs to practice isolation in order to prevent the spread of the germs to their near and dear ones. This became very popular and was strictly adhered to during the covid-19 pandemic. People who were confirmed to have COVID-19, isolation was mandatory. Isolation is a health care term that means keeping people who are in-fected with a contagious illness away from those who are not infected. Isolation can take place at home or at a hospital or care facility. Special personal protective equipment will be used to care for these patients in health care settings. They are attended by well trained nurses and specialised doctors. And these people have to be in the PPE kits all through their presence in the hospital.

Complete PPE Kit

Fig. 4.3.2: Complete PPE Kit

Disposing off the PPE Kits

The PPE kits are worn by health workers and doctors who are attending to patients with highly infectious diseases and who are kept is isolation in order to arrest the spread. They have to wear it every time they go near the patient and have to remove it once their duty is over. Most of the PPE components are used for single use, however the face mask and goggles can be reused provided they are sanitised properly. The PPE kits have to be disposed off safely as they might have contaminants stuck to them and they may infect the healthy person if they are not discarded properly. The health workers may be all the more vulnerable to contact the disease.

4.3.3 Safe Workplace Practices

Every company has the provision of first aid box. As you have already read about the types of injuries that technicians can receive in their field of work, it is imperative for the companies to have appropriate first aid accessories.

The basic first aid supplies and accessories that a first aid box should have are:

Supplies and Accessories in the First Aid Box

Splint

Elastic wraps

Latex gloves

Adhesive tape

Tweezers

Blanket

Scissors

Wound cleaning agent

Triangular bandages

Gauze roller bandage

Adhesive bandages

Gauze pads

Antiseptic cleansing wipes

Burn cream or gel

Eyewash liquid

CPR Kit

Chemical hazards are caused by toxic materials, which are poisonous. And being poisonous in nature, they can either be fatal or cause serious damages in case the preventive actions are not taken on time. Now, the exposure to chemicals can be in 3 forms.

They can be:

- Inhaled (entering the body through nose)
- Directly in contact with skin
- Ingested (consumed)

The symptoms, in this case, will be:

- Seizures
- Partial or complete loss of responsiveness
- Burning sensation
- Stomach Cramping with bouts of excruciating pain
- Nausea
- Vomiting (and in times with blood-stains)

Now, where there are problem, their solutions come side by side. In such situations, the person giving first aid requires to be calm and take certain preventative actions.

Some of the essential actions are:

- Using insulated equipment
- Wearing protective clothing, goggles, masks, shoes and gloves
- Ensuring the place has enough ample ventilation

Remedial action

- The foremost thing that one should do is to provide immediate first aid. However, it is to be remembered that the victim should not be given any kind of fluid (water, milk) until doctors from Poison control unit gives a green signal.
- Aside from this, there are a few things a person can perform to the victim of toxic material exposure.
- Remove the victim from the toxic zone or vicinity
- Call for an ambulance

- Remove contaminated clothing
- Splash water in the eyes
- If ingested, do not try to make the victim puke (vomit)
- Wash their mouth with water

Fig. 4.3.3: CPR

- In case the victim's breathing has stopped, give CPR (Cardiopulmonary resuscitation)
- In case of burning due to toxic material, apply burn gel or water gel on that area.
- Avoid any cream based or oil based lotion or ointment
- Even though giving first aid is the right thing to do in the first place, it is also important to report the incident to their supervisor.

Click/Scan this QR code to view the video on CPR Techniques

Exercise

1. Burnt area should be kept under _____ for a minimum of 10 minutes
2. _____exits should be easily accessible in case of fire.
3. _____or _____must be applied to the wound to reduce the risk of infection
4. The RICE which is_____,_____,_____ and _____therapy must be applied to control and reduce swelling.
5. CPR is _____.

UNIT 4.4: Reporting Safety Hazards

Unit Objectives

By the end of this unit, the participants will be able to:

1. Discuss the process of reporting in case of emergency (safety hazards)
2. Understand methods of reporting hazards

4.4.1 Methods of Reporting Safety Hazards

Every organization, from every industry, has a standard reporting protocol, comprising the details of people in the reporting hierarchy as well as the guidelines to be followed to report emergencies. However, the structure of this reporting hierarchy varies between organizations, but the basic purpose behind the reporting procedure remains same.

The general highlights of the Organizational Reporting Protocol, commonly known as the 6Cs, are:

- Communicate First
  - The first source of information during emergency is the preferred source.
  - Crises situations are time-bound and hence it is important to communicate promptly.
- Communicate Rightly
  - Distortion of information due to panic must be avoided.
  - Proper, accurate information must be provided to concerned authorities and this can save lives.
- Communicate Credibly
  - Integrity and truthfulness must never be forgotten during emergencies.
- Communicate empathetically
  - One must wear the shoes of the victims while communicating emergencies.
- Communicate to instigate appropriate action
  - Communicating to the right authorities help in taking the necessary action.
- Communicate to promote respect
  - Communicating with the victims with respect help in earning their trust and thus eases the disaster management process.

Hazards and potential risks / threats can be identified and then reported to supervisors or other authorized persons in the following ways:

While identifying and reporting a hazard / potential threat / potential risk, one must describe the following:

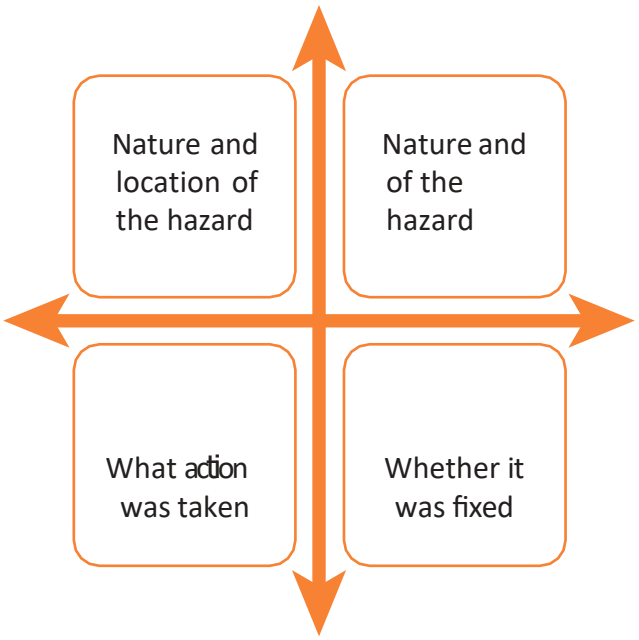


Fig. 4.4.1: Describing hazard matrix

Part A: To be completed by the Worker Details Required:

- Name of Worker
- Designation
- Date of filling up the form
- Time of incident / accident
- Supervisor / Manager Name
- Work Location / Address
- Description of the hazard / what happened (Includes area, task, equipment, tools and people involved)
- Possible solutions to prevent recurrence (Suggestions)

Part B: To be completed by the Supervisor / Manager Details Required:

- Results of Investigation (Comment on if the hazard is severe enough to cause an injury and mention the causes of the incident / accident)

Part C: To be completed by the Supervisor / Manager Details Required:

- Actions taken / Measures adopted (Identify and devise actions to prevent further injury, illness and casualty)

Action	Responsibility	Completion Date

Any job role and any occupation in this world have some hazards, in varying severity, associated with it. These are called Occupational Hazards. Occupational Hazard can be defined as "a risk accepted as a consequence of a particular occupation". According to the Collins English Dictionary, it is defined as "something unpleasant that one may suffer or experience as a result of doing his or her job". Occupational Hazards are caused by the following:

Hazard Report Form	
Name:	Date:
Location:	
Tool/Equipment:	
Description of the hazard:	
Suggested correction action:	
Signature:	
Supervisor's remarks:	
Corrective Action taken:	
Signature of Supervisor:	Date:

Fig 4.4.2: Sample form of reporting hazards

UNIT 4.5: Waste Management

Unit Objectives

By the end of this unit, the participants will be able to:

1. Understand what is e-waste
2. Understand the concept of waste management
3. Explain the process of recycling of e-waste

4.5.1 Introduction to E-Waste

Electrical and electronic products are all around us. We can't imagine a world without these gadgets. Our life is indispensable without electricity and electronic devices. Growth in the IT and communication sectors has increased the usage of electronic equipment immensely. Frequent change on the technological features of electronic products is forcing consumers to discard their old electronic products very quickly, which, in turn, adds to e-waste to the solid waste pool. What this translates to is mountainous masses of electrical and electronic waste which has a high potential to pollute the environment. This growing menace of e-waste calls for a greater focus on recycling e-waste and better e-waste management.

E-waste means electrical and electronic equipment, whole or in part discarded as waste by the consumer or bulk consumer as well as rejects from manufacturing, refurbishment, and repair processes. E-waste usually is made up of usable and non-usable material. Some of the waste if left unattended will be destructive to the environment. E-waste is made up of hazardous substances like lead, mercury, toxic material, and gases.

There are many companies these days who are engaged in the collection, handling, and disposal of this e-waste in a safer and more secure place to protect the environment.

4.5.2 What is E-Waste?

The amount of e-wastes comprising computers and computer parts, electronic devices, mobile phones, entertainment electronics, refrigerators, microwaves, TV, fridges, and industrial electronics that are obsolete or that have become unserviceable is growing. All these electronic devices contain plastics, ceramics, glass, and metals such as copper, lead, beryllium, cadmium, and mercury and all these metals are harmful to humans, animals, and the earth. Improper disposal only leads to poisoning the Earth and water and therefore all life forms. Our effort is meant to preserve the environment and prevent pollution by proper handling of e-waste. While it will take a lot of effort to educate people to dispose of such wastes in the right way, we are doing our part by providing a channel to collect e-wastes and dispose off them in a sustainably safe manner. We convert waste to usable resources.

The electronic industry is not only the world's largest industry but also a fast-growing manufacturing industry. It has been instrumental in the socio-economic and technological growth of the developing society of India.

At the same time, it poses a major threat in the form of e-waste or electronics waste which is causing harmful effects on the whole nation. e-waste is creating a new challenge to the already suffering Solid waste management, which is already a critical task in India.

4.5.3 Electronic Goods/gadgets are Classified Under Three Major Heads

White goods: Household appliances,

Brown goods: TVs, camcorders, cameras etc.,

Grey goods: Computers, printers, fax machines, scanners etc.

The complete process is carried out as per the government guidelines.

4.5.4 E-waste Management Process

- Collection of e-waste from all the electronic stores, manufacturing companies, etc.
- Transport of e-waste to the disposal units
- Segregation of e-waste at the disposal unit
- Manual dismantling of e-waste to segregate components into various types such as metal, plastics and ceramics
- Convert into raw material (recycle and reuse)
- Supply recovered raw material to processors and electrical/electronic industries
- Dispatch hazardous e-waste for safe disposal

Waste management is carried out to ensure that all types of waste and garbage are collected, transported, and disposed of properly. It also includes recycling waste so that it can be used again.

Fig. 4.5.4: E-waste Management Process

Click/Scan this QR code to view the video on waste management

4.5.5 Recyclable and Non-Recyclable Waste

Recyclable waste is renewable or can be reused. This means that the waste product is converted into new products or raw material, like paper, corrugated cardboard (OCC), glass, plastics containers and bags, hard plastic, metal, wood products, e-waste, textile, etc

Recycling not only conserves important areas in our landfills but also assists decrease greenhouse gas emissions.

Contrary to this, Non-recyclable waste cannot be recycled and cause a major threat to the environment.

The following items cannot be recycled:

Shredded paper, aerosol cans, paper coffee cups, milk and juice cans, used baby diapers, and bottle caps.

Recycling is one of the best ways to have a favorable influence on the world where we live.

Recycling will greatly help us to save both the environment and us from pollution. If we take immediate action, we can control this, as the quantity of waste we are accumulating is increasing all the time.

4.5.6 Colour Codes of Waste Collecting Bins

Waste collecting bins colour code

India's urban population of 429 million citizens produce a whopping 62 million tonnes of garbage every year. Out of this, 5.6 million tonnes is the plastic waste, 0.17 million tonnes is the biomedical waste, 7.90 million tonnes is hazardous waste and 15 lakh tonnes is e-waste.

According to an estimate, 40% of municipal waste in the city is 'wet' waste, which can easily be composted and used as manure. Nearly 30% of the municipal waste comprises of plastic and metal, which can be sent to an authorized dealer for recycling, and about 20% of it is e-waste, from which precious metals can be taken apart and recycled. However, out of the total municipal waste collected, 94% is dumped on land and only 5% is composted. To gather the garbage two color bin system was suggested. Green bin for wet waste and blue for dry waste. However, there is a drawback in that system. People do through the sanitary napkins and children's diaper along with wet waste causing the contamination of things. Hence the government has come up with three colored garbage collection bins.

1. **Green Bin**

   The green coloured bin is used to dump biodegradable waste. This bin could be used to dispose off wet/organic material including cooked food/leftover food, vegetable/ fruit peels, egg shell, rotten eggs, chicken/fish bones, tea bags/coffee grinds, coconut shells and garden waste including fallen leaves/twigs or the puja flowers/garlands will all go into the green bin

2. **Blue bin**

   The blue coloured bin is used for segregating dry or recyclable left over. This category includes waste like plastic covers, bottles, boxes, cups, toffee wrappers, soap or chocolate wrapper and paper waste including magazines, newspapers, tetra packs, cardboard cartons, pizza boxes or paper cups/plates will have to be thrown into the white bin. Metallic items like tins/cans foil paper and containers and even the dry waste including cosmetics, hair, rubber/ thermocol (polystyrene), old mops/dusters/sponges.

4.5.6 Tricoloured bins

3. **Black bin**

   Black bin, make up for the third category, which is used for domestic hazardous waste like sanitary napkins, diapers, blades, bandages, CFL, tube light, printer cartridges, broken thermometer, batteries, button cells, expired medicine etc.

4.5.7 Waste Disposal Methods

- Incineration: Combusting waste in a controlled manner to minimize incombustible matter like waste gas and ash.
- Waste Compaction: Waste materials are compacted in blocks and are further sent away for recycling.
- Landfill: Waste that can't be recycled or reused can be thinly spread out in the low-lying areas of the city.
- Composting: Decay of organic material over time by microorganisms.
- Biogas Generation: With the help of fungi, bacteria, and microbes, biodegradable waste is converted to biogas in bio-degradation plants.
- Vermicomposting: Transforming the organic waste into nutrient-rich manure by degradation through worms.

4.5.8 Sources of Waste

1. **Construction waste –** waste coming from construction or demolition of buildings.
2. **Commercial waste-** waste from commercial enterprises
3. **Household waste-** garbage from households is either organic or inorganic
4. **Medical or clinical waste -** wastes from the medical facilities- like used needles and syringes, surgical wastes, blood, wound dressing
5. **Agricultural waste-** Waste generated by agricultural activities that include empty pesticide containers, old silage packages, obsolete medicines, used tires, extra milk, cocoa pods, wheat husks, chemical fertilizers, etc.
6. **Industrial waste-** The waste from manufacturing and processing industries like cement plants, chemical plants, textile, and power plants
7. **Electronic waste-** The defective, non-working electronic appliances are referred to as electronic waste. These are also called e-waste. Some e-waste (such as televisions) contains lead, mercury, and cadmium, which are harmful to humans and the environment
8. **Mining waste-** chemical gases emitted in mine blasting pollutes the environment. And the mining activity greatly alters the environment and nature.
9. **Chemical waste-** waste from the chemical substance is called chemical waste.
10. **Radioactive waste-** radioactive waste includes nuclear reactors, extraction of radioactive materials, and atomic explosions.

4.5.9 Source of Pollution

All these above-mentioned waste also adds to environmental pollution.

The contaminants that cause detrimental change to the environment are called pollution. It is one of the most serious problems faced by humanity and other life forms on our planet. The earth's physical and biological components have been affected to such an extent that normal environmental processes could not be carried out properly.

4.5.10 Types of Pollution

Types of Pollution	Detail/Pollutants involved
Air pollution	• Solid particles and gases mixed in the air cause air pollution • Pollutants: emissions from the car, factories emitting chemical dust, and pollen
Water pollution	• Water gets polluted when toxic substances enter water bodies such as lakes, rivers, oceans, and so on. They get dissolved in it and cause it unfit for consumption. • Pollutants that contaminate the water are discharges of untreated sewage, and chemical contaminants, release of waste and contaminants into surface
Soil pollution	• It is the presence of toxic chemicals (pollutants or contaminants) in soil, in high enough concentrations to pose a risk to human health and/or the ecosystem • Sources of soil pollution include metals, inorganic ions, and salts (e.g. phosphates, carbonates, sulfates, nitrates),
Noise pollution	• Noise pollution happens when the sound coming from planes, industry or other sources reaches harmful levels • Underwater noise pollution coming from ships has been shown to upset whales' navigation systems and kill other species that depend on the natural underwater world
Light pollution	• Light pollution is the excess amount of light in the night sky. • Light pollution, also called photo pollution, is almost always found in urban areas. • Light pollution can disrupt ecosystems by confusing the distinction between night and day.

UNIT 4.6: Organizations' Focus on the Greening of jobs

Unit Objectives

By the end of this unit, the participants will be able to:

1. Understand the concept of ESG
2. Explain the different factors of ESG

4.6.1 What is ESG?

The ESG is the short form of environmental, social, and governance. ESG guidelines are used to evaluate businesses on how well they control emissions, governance, human rights, and other factors of their business.

Several companies audit these companies for ESG compliance. They will let the companies know how well the ESG policies are implemented in their company hat let companies know how well their ESG policy is working.

Every business enterprise is deeply intertwined with Environmental, Social, and Governance (ESG) issues. ESG has been looked at seriously by the corporate, government establishments and stakeholders.

ESG is important as it creates high value, drives long-term returns, and global stakeholders are paying attention to the topic.

ESG is said to have created high value, and focuses on long-term returns, and stakeholders are focusing more on this concept.

4.6.2 Factors of ESG

Several factors are used to determine how well a business is doing in maintaining its ESG policies. For creating the ESG Policy, thorough knowledge of these factors are critical.

The factors are divided into three categories; environmental, social, and governance. Knowing about these factors come a long way in designing the effective ESG policy.

Environmental

Environmental factors relate to a business's impact on the environment. Examples include:

- Usage of renewable energy
- Effective waste management
- Policies for protecting and preserving the environment

Social

Social factors relate to the people of the organization. How they are treated in the organization is what it focuses on. The major entities are the stakeholders, employees, and customers. Examples include:

- diversity and inclusion
- proper work conditions and labor standards
- relationships with the community

Governance

Governance factors relate to the company policies for effectively running it. They include:

- tax strategies
- structure of the company
- relationship with stakeholders
- payments to the employees and CEO

Every factor is important and matters a lot to the overall rating of the company in ESG compliance. Ignoring one aspect in favor of another can affect the rating and in turn the reputation of the company.

The companies make a clear communication about these policies to all the employees, and to the public, they should mention what their various activities are that will protect the environment, people, and the governing factors.

Exercise

1. ESG stand for _____, _____, _____.
2. Governance factors include _____, _____, _____, _____.
3. The three causes of air pollution _____, _____ and _____.
4. Mining waste includes_____.
5. Landfill is a _____.
6. _____,_____ and _____ coloured bins are used for disposing the waste.
7. The plastics cans are trashed in _____coloured bin.
8. _____,_____and _____ are considered as e-Waste
9. _____ part of e-waste is recycled and used again
10. E-waste is made up of hazardous substances like _____,_____,_____ and _____

Notes

Skill India
कौशल भारत-कुशल भारत

सत्यमेव जयते
GOVERNMENT OF INDIA
MINISTRY OF SKILL DEVELOPMENT
& ENTREPRENEURSHIP

N·S·D·C
National
Skill Development
Corporation
Transforming the skill landscape

5. Communication and Interpersonal Skills

Telecom Sector Skill Council

Unit 5.1 - Interaction with Supervisor, Peers, Customers and Differently abled persons
Unit 5.2 – Explain the importance of developing sensitivity towards Differently abled people

Key Learning Outcomes

By the end of this module, the participants will be able to:

1. Understand what is communication and the importance of communication in the workplace
2. Understand effective communication and communicate effectively for success
3. Discuss types of communication -verbal and non-verbal
4. Communicate at workplace
5. Communicate effectively with superiors
6. Communicate effectively with colleagues and customers using different modes viz face-to face, telephonic and email communication
7. Understand the hurdles for effective communication
8. Conduct professionally at work place
9. Respect differences in gender and ability
10. Communicate effectively with person with disabilities
11. Respect for disabled people

Unit 5.1: Interaction with Supervisor, Peers, Customers and Differently abled persons

Unit Objectives

By the end of this unit, the participants will be able to:

1. Understand the importance of communication
2. Understand types of communication

5.1.1 Why is Communication Important?

- Communication Skills are more important than ever, for all fields of endeavor.
- Whatever the role a person is holding in the organization, having a firm grasp of effective communication will undoubtedly be a key role in the individual's as well as the organization's success
- Oftentimes, people with excellent technical skills don't get promoted to higher roles because of their inability to communicate effectively
- Hence one fundamental skill everybody should be proficient along with the technical skill is Communication Skills
- Effective communication help us to build rapport with the customer both internal and external and help us resolve issues and conflicts easily and quickly.

5.1.2 What is Communication?

- Communication is the process of sending and receiving information among people.
- It is imparting or exchanging of information by speaking, writing, or using some other medium
- The purpose of communication is to convey your thoughts and opinions to others.
- Communication is said to be successful only when both the sender and the receiver perceive it in the same way.
- In your personal and professional life, you would be communicating with the following people-
  - Colleagues
  - Customers
  - Friends
  - Parents
  - Relatives

5.1.3 Effective Communication

Effective communication is the process of delivering messages to a target audience in a way that guarantees satisfactory reception and understanding. If the communication is effective, both the sender and the receiver will share the same information at the end of the process. Effective communication is about more than just exchanging information. It's about understanding the emotion and intentions behind the information

5.1.4 Effective Communication for Success

Effective Communication is critical to a business's success. From top to bottom, among colleagues, from subordinates to superiors, and from the organization to the outside, several messages are delivered daily. All the people must communicate these messages properly. Content, language, remarks, tone of voice, and non-verbal communication are elements that affect the effectiveness of messages

Clear and effective communication will

- Increase customer satisfaction
- Bring more business to the company
- Increase productivity among team members

5.1.5 Types of Communication

Communication has been divided into two types:-

- Verbal Communication
- Non-Verbal Communication

Verbal communication takes place when people exchange words with each other, either spoken or written. It includes the choice and use of words and language to convey a message. Examples of verbal communication are face-to-face conversation, telephonic conversation, and a speech or presentation.

Speech

Face to face communication

Phone conversation

Voice chat over internet

Newspapers, e-mails, etc.

Speech has certain characteristics which will affect the message that is being spoken:

- Volume – loud speech may sound bossy, very quiet speech cannot be heard.
- Tone – use warm tones without sounding over-friendly. Cool tones are very unwelcoming.
- Pace – fast speech is not easy to follow. Speak at a reasonable pace so that the other person has a chance to understand.

Click/Scan this QR code to view the video on types of communication

Correct body language also plays an important role in effective communication. For example, a warm smile accompanying 'Have a nice day' or looking directly at the person who is being spoken to give a positive image of the organisation.

Non –Verbal Communication

Non-verbal communication includes the overall body language of a person. There are two kinds of non-verbal communication:

1. **Signs and symbols:** for example pictures, or notices, or signboards, or even photographs, sketches and paintings. Here are some examples of different signs and symbols:

2. **Gestures and expressions:** hand signs, facial expressions, body postures or body language that can help to convey a message. You can learn to communicate better with others if you learn to recognise some of these.

   Facial expressions - A smile or a frown

   Gestures - movements of hands and body to help explain or emphasize the verbal message

   Body posture - how we stand or sit. Maintain a good posture. When you are talking to a colleague or guest, remember to stand up straight, look professional and be positive. Do not slouch, lean against something or fidget with equipment or your hands.

   Orientation - whether we face the other person or turn away

   Eye contact - whether we look at the other person and for how long

   Proximity - the distance we are from a person

   Head nods - for encouragement, indication of agreement or disagreement

   Appearance - dress and grooming

   Non-verbal aspects of speech - tone and pitch of voice

These non-verbal clues are important as they can be used to improve the quality of communication. They can be used to reinforce any verbal communication; for example, leaning forward and looking at the person you are speaking to and smiling naturally. Your expressions, posture and appearance must be appropriate and should tell the guest that you are professional, competent and willing to help.

5.1.6 Communication at Workplace

In every situation, while interacting with people, we make use of both verbal and Non-Verbal Communication. It is the key to the success of any organization. Be it communication with customers, supervisors, or peers. In today's scenario having technical skills alone is not enough to get the work done, but communication skill is also equally important. Completing the task must require the support of the whole team, and without proper communication, it cannot happen. Effective Communication helps managers to perform their jobs and responsibilities and it serves as a foundation for planning.

5.1.7 Communication with Supervisors

Effective and open communication within a team will build a common purpose among team members that will allow them to reach their goals. Team leaders know that group communication enhances organizational efficiency. The team members should always follow the communication guidelines. Some of the points to remember while interacting with supervisors:

1. Be aware of the communication guidelines of the organization.
2. Understand and interpret clearly, the work requirements from the supervisor.
3. Keep the supervisor informed about the progress of the task assigned.
4. Participate in all the discussions which call for decision-making, and provide facts and figures
5. Give/ accept suggestions during the discussions.
6. Accept the feedback positively and work towards rectifying errors if any. Make sure the same mistakes are not repeated.

5.1.8 Communication with Colleagues & Customers

- The main responsibility is to handle customers' concerns
- Interaction with colleagues/peers is also equally essential and it enhances productivity in the workplace.
- Be polite in speaking to your peers at the office.
- Value other people's time as much as you value your own.
- Before you begin discussing something, ask your co-worker if it is the right time to talk, and give a true picture of how much time you expect to take. Always start the conversation
- Communication with colleagues/customers can be through face-to-face, telephonic, or email.
- Keeping a few points in mind while communicating will make the interaction pleasant and fruitful.

Click/Scan this QR code to view the video on Communication with colleagues and customers

5.1.9 Face-to-face Communication

This is an important medium of oral communication, wherein two or more persons talk to each other and see each other physically. This form of communication is direct or straight. Things to remember while you are communicating face to face

1. Adjust the tone of voice, don't be too loud
2. Make eye contact
3. Use appropriate language
4. Maintain adequate distance
5. Acknowledge, nod during interaction
6. Use appropriate non-verbal gestures to communicate with persons with disabilities

Benefits of face-to-face communication

- Instant feedback
- Information conveyed clearly
- Build rapport

5.1.10 Telephonic Communication

Another widely adopted mode of communication is through the telephone. This is the person-to-person conversation where nobody sees others but hears each other and interacts instantly. Nowadays mobile phones are becoming more popular along with landlines as a mechanical media of oral communication.

The following suggestions are recommended to follow while making telephone calls-

1. Make the call at the appropriate time
2. Provide details about your identity like name, company, department, etc.
3. Discuss the purpose of the call
4. Think about the tone of your voice
5. Listen carefully
6. Speak clearly
7. If you don't understand something, ask
8. Use please, thank you, sorry wherever necessary
9. Follow the organization's policies and procedures while interacting on the telephone.

Click/Scan this QR code to view the video on Effective Telephonic Communication

5.1.11 Email Communication

Email or Electronic mail is a method of exchanging messages using electronic media. The official or business communication between colleagues or inter-department communication usually happens through email. The advantage of email is you can send communication to many people at the same time.

Points to remember in email communication

1. Be clear and concise
2. Keep the content short and to the point

3. Avoid using jargon and short forms
4. Re-read the message, before sending it for grammar and spelling mistakes
5. The subject line should describe the main mail content
6. Use readable font size (don't keep it too small)
7. Add signature at the bottom of the mail body
8. Check the attachments for viruses before sending

5.1.12 Importance of timely completion of tasks

Time is a major factor that evaluates the success or failure of a project. Even when the whole team has done a wonderful job and produced high-quality results, with half the cost allotted to the project, everything will be a waste if it was not delivered on time. Any deviation from the timeline will call for a penalty and sometimes may result in losing the project and eventually the customer. so adhering to the timeline is important when it comes to any organization who are into products and services.

Benefits of adhering to timelines:

1. Increased and improved customer satisfaction
2. Increased productivity and efficiency of the individual
3. Team feels motivated
4. Sense of adhering to the SLA's and Standard Operating Procedures
5. Shows the commitment toward the work and the organization
6. Good word of mouth from the customers

5.1.13 Standard Operating Procedure

A Standard Operating Procedure (SOP) is a standardized process that outlines a set of detailed instructions to help workers perform complex tasks properly and safely. The main objective of standard operating procedures is to develop an effective quality system and comply with industry- specific regulations and standards. Failure to follow SOPs can cause significant errors in operations and services.

For a mobile repairing center, the SOP defines the different process of operations, namely handling customer, repairs, sales and interaction among the staff within the repair center.

SOP also clearly defines the responsibility of each and every designated person in the organisation and what is expected from them. It further defines what the various levels of engineers will handle with respect to the handsets coming for repair.

The escalation matrix specifies how the different levels escalate the issue to the next level and adhere to the timelines for repair and communication to the customer.

SOP is created keeping in mind the customer satisfaction as a main motive.

Each and every person in the organisation is expected to read the SOP thoroughly and work accordingly. Because every customer when they go for purchasing a product, one of the main things they see is the post-sales Support. If they find the brands deliver good service support then they don't mind even spending few extra moneys.

5.1.14 Escalation Matrix

Escalation matrix is made up of several levels of contact based on the specific problem at hand. This is being followed by all who are working on that product and have to adhere to the service guidelines. And the problem has to be closed at a minimum turnaround time, and for any reason the repair is taking time proper reason has to be mentioned and notified to all the people concerned including the customer.

5.1.15 Escalation Mechanism

Customer service is a very important aspect of a typical service industry. Giving committed service to customers every time and on time is very crucial for the success of the brand. In recent times, customers do research on how the after-sales support of a product is, and based on that rating they will decide which brand to buy. If the customer service is not good, they will not go for that product even though the product is very good. Hence customer service is a second important aspect of a product and services organization.

For electrical home appliances, the customer logs a complaint and the service engineer is sent to the site for looking into the problem and repairing.

For electronic devices like mobile phones and tablets, the customer is expected to take the product to their service center to get it checked and repaired.

The resolution time matters a lot, as mobile phones have become an indispensable device for people. Their business cannot function without that. Hence too much downtime is also not good. Once at the service center, the technicians at L1 level look for the problem and try to resolve it. If it's beyond their area of resolution the same is escalated to the next level. Every organization has Standard Operating Procedures clearly state the workflow for the repair of the smart phones. Every individual working there must be aware of the same and adhere to the deadline for faster service and enriched customer satisfaction.

5.1.16 Escalation through CRM

Customer Relationship Management is a software, through which most of these companies who are into customer service, manage their customers. The customer details are entered in the system and also the services which are logged against a particular customer. This is the automated system, which takes a particular action after a period of time. For example, if a service request is assigned to an engineer for rectifying a problem of a client, and if the engineer does not update the status of the service in the system within a specified period of time, the problem is automatically escalated to the next level for resolution. Then the new engineer who is responsible for resolving pick it and try to find a solution. This system helps to maintain a track of a particular problem and the current status which will help the organization in effectively managing the customer queries. The complete escalation route is mentioned in the SOP and the same is implemented through the CRM software. This eases the manual escalation procedure which is time consuming and slow.

5.1.17 Escalation Issues at Work

Whether an issue arises among team members or with customers, sometimes the severity of the circumstance requires an escalation to management. Understanding how to approach an escalation can help you better find a solution when conflicts arise. We explore what it means to escalate an issue in the workplace and provide tips for how to do so successfully.

What does it mean to escalate an issue at work?

Escalating an issue in the workplace is the process of bypassing those involved by contacting upper/ senior management. It involves raising awareness of the context to the right people in order to resolve a chal-lenging situation. Typically, escalation occurs when there is an issue that the current staff working on the problem can't resolve and requires assistance from those with more authority and resources

When should you escalate an issue at work?

Deciding when to escalate an issue depends on the amount of risk it can bring to the company. Because escalating an issue can lead to difficult meetings and cause disruptions in work, you should reserve them for issues that truly require escalation. You can often avoid escalating an issue by solving the problem with the individual first.

However, some issues require support from those with higher authority. Consider escalating an issue at work when:

- You have already tried other strategies but that did not work.
- Resolving may incur additional cost to the company or the customer, while rectifying the
- problem.
- Because of the non-availability of certain parts the repair work is taking longer than usual.
- The engineer broke another part while repairing a part. So escalation is required to get the approval to replace the broken part by the company.

5.1.18 Hurdles for Effective Communication

Following are factors contribute to communication not being effective.

Stress and out-of-control emotion. When you are stressed or emotionally disturbed, you're more likely to misread other people and send confusing non-verbal signals. Calm down before continuing the conversation.

Lack of focus. You can't communicate effectively when you're multitasking. If you're checking your phone, planning what you're going to say next, or daydreaming, you're almost certain to miss nonverbal cues in the conversation. To communicate effectively, you need to avoid distractions and stay focused.

Inconsistent body language. Nonverbal communication should support what is being said, not contradict it. If you say one thing, but your body language says something else, your listener will likely feel that you're being dishonest. For example, you can't say "yes" while shaking your head no.

Negative body language. If you disagree with or dislike what's being said, you might use negative body language to ignore the other person's message, such as crossing your arms, avoiding eye contact, or tapping your feet. You don't have to agree with, or even like what's being said, but to communicate effectively and not put the other person on the defensive, it's important to avoid sending negative signals.

5.1.19 Professional Conduct

There are six basic rules to be followed for professional conduct:

- **Be on time:** Being late impedes a company's operations and demonstrates a lack of consideration of the time concerns of others. If you are constantly late for work, meetings, or are always late with your reports and other tasks; it demonstrates to others that you are probably not executive material because you disregard the value of time.
- **Be discreet:** Keep company secrets such as new product designs, sales figures or any other confidences to yourself.
- **Be courteous, pleasant, and positive:** No matter how demanding your clients, customers, co-workers or employees might be; always remain upbeat and positive. Projecting a positive company image has the same effect.
- **Be concerned with others, not just yourself:** Finding out a customer or client's point of view naturally helps you get ahead in any industry. Concern for others should include your superiors, co-workers and subordinates as well.
- **Dress appropriately:** Dress to be comfortable in your environment. Dressing poorly or too casually does not convey a good image, neither does overdressing, which breeds suspicion and mistrust, and will be seen as inappropriate.
- **Use proper written and spoken language:** People who can express themselves clearly are at an advantage. This goes beyond using good grammar, proper spelling, and appropriate diction in all your communications; you should also speak and write to the point.

5.1.20 Respect Gender Differences

In any business, be it a small company to a big corporate, the workforce is a mix of both genders. The ratio of men vs. women varies from 70:30 or 60:40. Studies show that business teams with an equal gender mix perform significantly better than male-dominated teams when it comes to both sales and profits. No two women or men are alike and yet at the same time there are some work-related traits that are gender specific. Both men and women approach their work in a different way and deal with many hurdles that come their way. Since they all share the same workspace, every organization has devised a policy as to how they treat the opposite gender at the workplace and what are the implications of any abuses

Some of the points to remember while interacting with female colleagues

1. Treat them with respect
2. Support them in case they approach you
3. Value their opinion and suggestions
4. Involve and include the opposite gender in all the discussions

Unit 5.2: Explain the importance of developing sensitivity towards disabled persons

Unit Objectives

At the end of the unit, you will be able to

- Respect differences in gender and ability
- Communicate effectively with person with disabilities
- Respect people with disability at work

5.2.1 Communication with disabled person

A **disability** is any condition that makes it more difficult for a person to do certain tasks or interact with the people around them (socially or materially). These conditions, or defects, may be cognitive, developmental, intellectual, mental, physical, sensory, or a combination of multiple conditions. Defects may be present from birth or can be acquired during a person's lifetime. Often, disabled people are excluded from full participation in any activity." But things are changing, every organization has allotted some percentage of employees from this section of the society. They are also allowed to exhibit their skills in a few jobs which they can perform without putting their life at risk

General tips for communication with disabled people

Keep these points in mind while interacting with people with a hearing problem

1. Speak to them as you would speak to anyone else in a soft and low tone.
2. Respect the person first, not their disability. For example, use the term ‘a person with disability’ rather than ‘a disabled person’.
3. Do not use phrases such as ‘suffers from’ and ‘crippled’ rather the phrase should be ‘people who use a wheelchair’ rather than ‘wheelchair bound.
4. Don’t drag or push a person’s wheelchair, and don’t move their crutches or walking stick without their permission. It has to be in their personal space.
5. When talking to a person who is in a wheelchair, try to sit in such a way you could reach their eye level. This would not strain them much, to lift their head and talk.

5.2.2 Communicating with People with a Hearing Impairment

Keep these points in mind while interacting with people with a hearing problem

1. Draw the person's attention before you speak. Give a gentle tap on their shoulder, a wave of some other visual signal to the person's attention
2. Stand in front of the person and maintain eye contact
3. Don't cover the mouth while talking. They can figure out what is being said by just looking at the lip movement
4. Speak at a normal pace don't speak fast or slow
5. Choose the words wisely
6. Use short sentence
7. Be gentle while speaking don't raise the tone

5.2.3 Respect People with Disability

Learn the proper way to act and speak around someone with a disability.

1. Do not use offensive or derogatory words like 'handicapped', 'crippled', and retarded etc.
2. Don't criticize or blame them. Don't shout at them or use abusive language
3. Talk slowly with a low tone. Pause while talking
4. Avoid excessive whispering, joking and laughing unnecessarily
5. Assuming things about them or their situation.
6. Don't make jokes about their condition or be sarcastic
7. Don't look down upon them because of their disability
8. Appreciate them for their efforts and work, and motivate them to perform better

5.2.4 Safety at Workplace for People with Disability

Disabilities of all types affect employees and can pose various mental or physical challenges. In many situations, a disability may impact the amount of time it takes for an employee to complete a task or get from one part of a facility to another. Some disabilities may be known while others remain unknown to an employer.

Health and safety legislation should not prevent disabled people from finding or staying in employment so it should not be used as an excuse to justify discrimination against them.

Disabled people and those with health conditions, including mental health conditions, should be given the opportunity to both get into and stay in work.

Responsibilities of an employer towards disabled people

The employer is responsible for the health, safety and welfare of all of their employees, whether they have a disability or not.

Disability is not always obvious so one might not realise a worker is disabled or they might choose not to tell you, particularly if their disability has no impact on their ability to do their job.

Workers do not have to tell anybody unless they have a disability that could foreseeably affect the safety of themselves or anyone else connected to their work. If they do not reveal and there are no obvious indicators of any disability, then the organization are not under any obligation to make workplace adjustments.

Periodically, consult with the employees (whether directly or through their representatives) on issues relating to health and safety. These discussions reflect good safety practice because employees have day-to-day understanding of the job, so they are likely to have good ideas on keeping themselves and others safe.

6.2.5 Workplace Adaptations for People with Disability

Few changes in the workplace to make it a safe place for the disable people will go a long way in the employee satisfaction for an organisation.

Workplace Adaptations

Workplace should be easily accessible for these people with special needs. One major compliance concern deals with accessibility. For example, if workplaces have been adjusted or created more accessible entrances and exits to their facilities, allowing more independence for persons in wheelchairs, would be a great idea. Other subtle changes may include the width of bathroom stalls, hand rails inside the stalls and long ramps instead of stairs. The path of travel that employees take should never be obstructed; there should be no barriers to prevent someone from getting to safety in an emergency.

Workstations easily can be adapted to follow this universal design. Many companies now use slide- out keyboard trays and monitors on swinging arms to allow employees to adjust to their needs.

Desks can accommodate wheelchairs in place of regular chairs, and general work spaces can be lowered to allow easier access. The main goal is to remove all barriers and allow everyone to concentrate more on completing their tasks.

The biggest challenge with universal design is accommodating the multitude of challenges that different disabilities present. Not all disabilities are the same, and not all will present the same challenges for employees. Some employees may have issues with their right hand while others have issues with their left. For some, it may involve not being able to stand or sit. Some may need low lighting, while others need bright lighting. Designing a facility to accommodate all is always going to be a challenge.

Complying with government guidelines can be more difficult in regards to employees with disabilities. This difficulty lies with ensuring that employees are aware of all hazards in the workplace. Multiple disabilities will create multiple reasons that may keep employees from recognizing hazards. Employees with impaired vision, for example, must have other means of identifying hazards. This may be remedied with audible alarms or touch-activated devices that warn employees not to go in an area. Other employees may have difficulties reading and may benefit from shapes or colors to further identify hazardous areas. For workers who lack hearing ability, employers can utilize signs to demonstrate hazards or use flashing strobes to identify when employees need to evacuate an area and head to safety.

Every organization has to make few adaptations in order to make it a better place to work even for people with disabilities. It should provide an environment where they feel they are safe and can carry out their work rather than worrying about their safety.

Exercise

1. What are the three points you will focus on when you talk to people face to face?

   _____

   _____

   _____

Fill in the blanks

1. Before sending the mail it's important to check the _____and of the content.
2. When you interact through phone, provide your identity details like , _____and ___
3. Add your _____at the bottom of your mail.
4. The Customer Care Executive is mainly responsible for handling _____.

Notes

Annexure

Chapter No	Unit No	Topic Name	Page No	QR Code
1	1.4	Components of a Cellular Network	24	Click the QR code to view the video on how a telecom tower works
2	1.5	Types of Telecom Towers	24	Click the QR code to view the video on types of telecom tower
3	2.1	Telecom tower and its components	30	Click the QR code to view the video on Telecom tower and its components
4	2.11	General Maintenance activities	151	Click the QR code to view the video

Annexure(contd.)

Chapter No	Unit No	Topic Name	Page No	QR Code
5	4.3	Importance of safe working practices (First Aid Techniques)	210	Click/Scan this QR code to view the video for First Aid at work place
6	4.3	Importance of safe working practices	218	Click/Scan this QR code to view the video on Hand Washing techniques
7	4.3	Importance of safe working practices	223	Click/Scan this QR code to view the video on CPR Techniques
8	4.5	Waste Management	229	Click/Scan this QR code to view the video on Waste Management
9	5.1	Types of Communication	239	Click/Scan this QR code to view the video on Types of Communication
10	5.1	Types of Communication	241	Click/Scan this QR code to view the video communication with Customer and colleagues
11	5.1	Types of Communication	242	Click/Scan this QR code to view the video on Effective Telephone Communication

Chapter No	Topic Name	QR Code
12	Employability Skill	Click/Scan the QR code to access e-Book on Employability Skills

Skill India
कौशल भारत - कुशल भारत

सत्यमेव जयते
GOVERNMENT OF INDIA
MINISTRY OF SKILL DEVELOPMENT
& ENTREPRENEURSHIP

N·S·D·C
National
Skill Development
Corporation
Transforming the skill landscape

Click/Scan this QR code to access e-Book

Telecom Sector Skill Council

Address: 2nd Floor, Plot No:- 105, Sector 44 Rd,
Sector 44, Kanahi,
Haryana, 122003
Email: tssc@tsscindia.com
Web: www.tsscindia.com
Phone: +91-124 4148029
CIN No.:

Price: `

978-1-111-22222-45-7