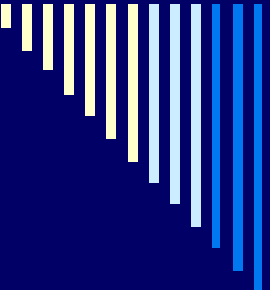


BASICS OF ELECTRICAL ENGINEERING AND MAINTENANCE PRACTICES

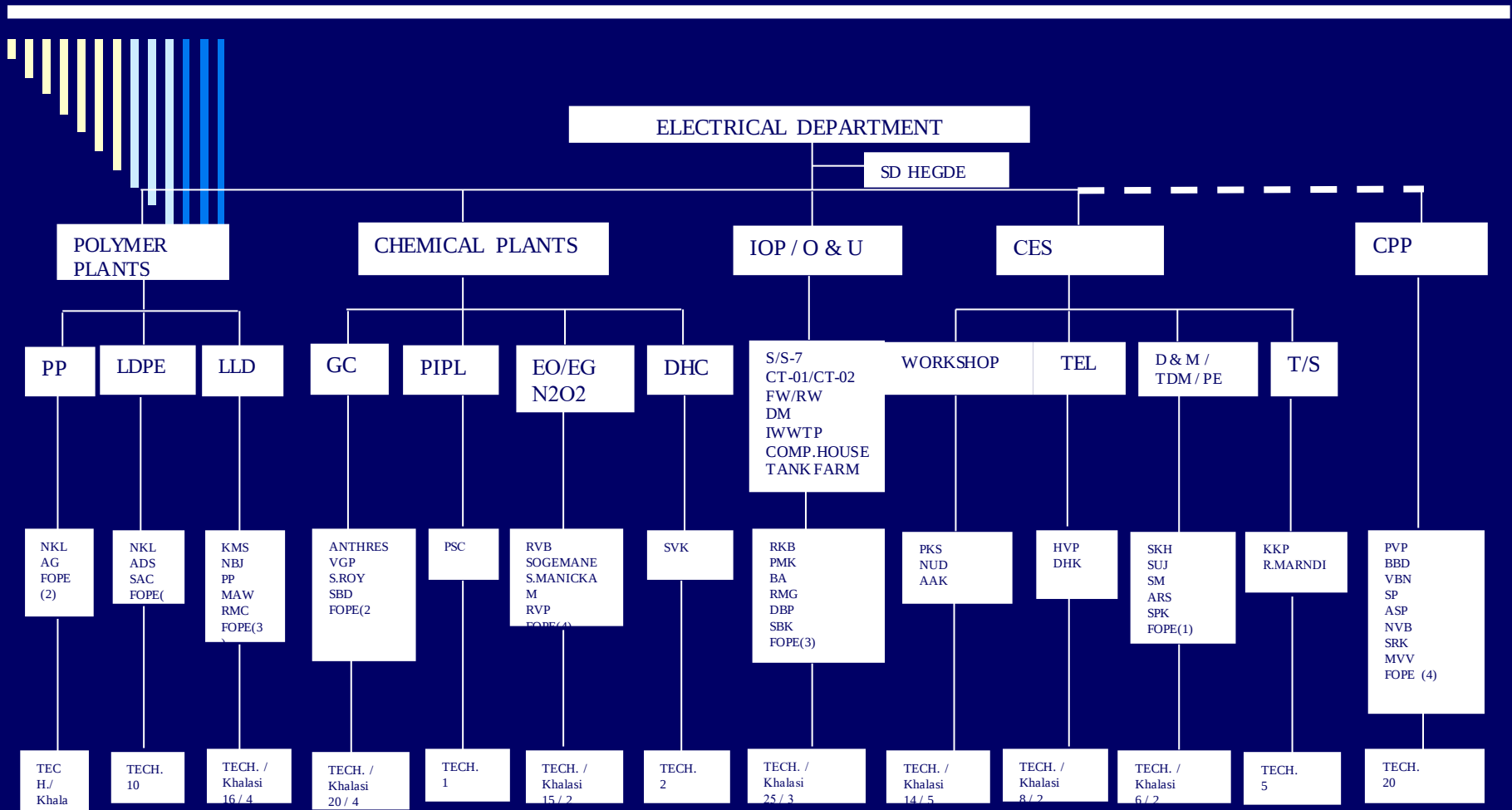


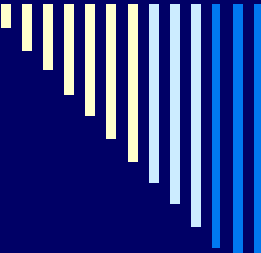
**BY
*R. BHARGAVA / A. R. SHENDYE***



CONTENTS

- ☐ DEPARTMENTAL SETUP / ORGANOGRAM
- ☐ ROLES, RESPONSIBILITY AND AREAS OF EACH SECTION
- ☐ POWER SYSTEM OF MGCC
- ☐ CES-E/ WORK SHOP FACILITIES
- ☐ ACT AND STATUTORY APPLICABLE
- ☐ EQUIPMENT AND THEIR SELECTION IN CLASSIFIED AREA
- ☐ TYPES OF MAINTENANCE, SCHEDULING/PLANNING
- ☐ TASK ANALYSIS, RISK MITIGATION AND ACHIEVEMENTS
- ☐ INTERFACE WITH OTHER DISCIPLINE
- ☐ ILLUMINATION
- ☐ ELECTRICAL SAFETY AND AUDITS



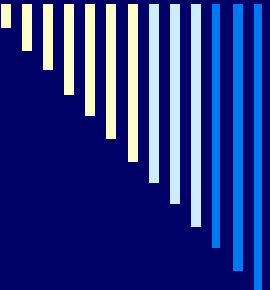


MANPOWER ELECTRICAL *as on 01.02.2007*

HOD : S D Hegde VP(E)

PLANT	L2	L3	L4	FOPE	TECH
PP	1	1		2	11
LDPE		1	1	3	10
LLDPE		4	1	3	16
GC		3	1	2	20
GC PIPL			1		1
EOEG/ N202/ DHC	1	3	1	4	17
CPP	2	3	3	4	20
IOP	2	2	2	3	25
CES + T/S	4	5	3	1	33
TOTAL	10	22	13	22	153

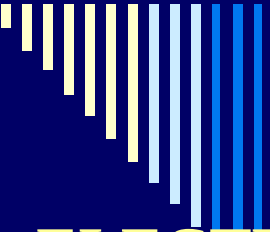
01 GM and 01 Tech.is working with CMG group.



RESPONSIBILITIES (PLANT)

PLANT MAINTENANCE DEPT :

- ☐ **PREVENTIVE AND PREDICTIVE MAINTENANCE PLANNING**
- ☐ **MAINTENANCE BUDGETING**
- ☐ **MAINTENANCE OF SUBSTATION AND FIELD EQUIPMENTS**
 - o **CABLES, TRANSFORMERS, MOTORS,**
 - o **HT / LT SWITCHBOARDS**
 - o **DG SET, BATTERY BANK**
 - o **PLANT LIGHTING, SERVICE BUILDING LIGHTING**
- ☐ **MATERIALS MANAGEMENT**
- ☐ **SUPPORT SERVICES**



RESPONSIBILITIES (CES)

ELECTRICAL REPAIR SHOP

- **REPAIR AND OVERHAUL OF MOTORS, TRANSFORMERS,**
- **CABLE FAULT LOCATION**
- **RELAY TESTING AND ELECTRONIC CARD REPAIRS.**
- **AIR CONDITIONING [CAC ,WAC, SAC],**
- **REFRIGERATORS, WATER COOLERS**
- **NON-PLANT BUILDING & STREET LIGHTING**
- **CALIBRATION OF INSTRUMENTS**

TROUBLESHOOTING AND DESIGN MODIFICATION

- **TROUBLESHOOTING OF SPECIAL SYSTEMS LIKE VSD,**
- **MAINTENANCE OF UPS AND BATTERY CHARGERS.**
- **DESIGN & MODIFICATIONS SUPPORT FOR FCO /
RELIABILITY.**



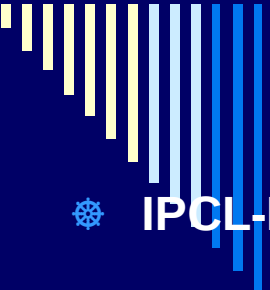
RESPONSIBILITIES (CES)

PLANNING AND COORDINATION

- **CO-ORDINATION WITH VENDORS FOR MAJOR SHUTDOWN**
- **STATUTORY REPORTS / MIS COMPLIANCE**
- **CO-ORDINATION WITH STATUTORY AUTHORITIES LIKE ELECTRICAL INSPECTOR, MSEB, LIFT INSPECTOR, ELECTRICITY DUTY INSPECTOR**

COMMUNICATION

- **TELEPHONIC EXCHANGES FOR PLANT/TOWNSHIP**
- **MODIFICATION IN TELEPHONE NETWORK**
- **WIRELESS AND WALKIE-TALKIE SETS**
- **NEUMANN COMMUNICATION**
- **FIRE ALARM SYSTEMS**
- **PIPELINE COMMUNICATION**



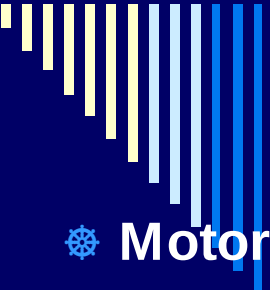
ELECTRICAL POWER SYSTEM

- ❁ **IPCL-MGCC receives electrical power from MSEB at 220 kV (2 circuits).**
- ❁ **This 220 kV is step down to 11 kV, which is then synchronized at our captive power plant (CPP) generation at 11 kV.**
- ❁ **CPP is having 03 gas turbines of 20 MW each, Frame size 5 (AEG-KENIS, Germany make) and one steam turbine of 25 MW (AEG-KENIS) with a total generation capacity of 64 mw.**
- ❁ **Load flow control and monitoring is done through Electrical Control System (ECS) located at CPP. ECS system takes care of mainly:**
 - **Active / Reactive power control**
 - **Load shedding in case of Generator / prime mover failure**
 - **Auto changeover at HT/LT boards**
 - **Online monitoring and data logging**



ELECTRICAL POWER SYSTEM

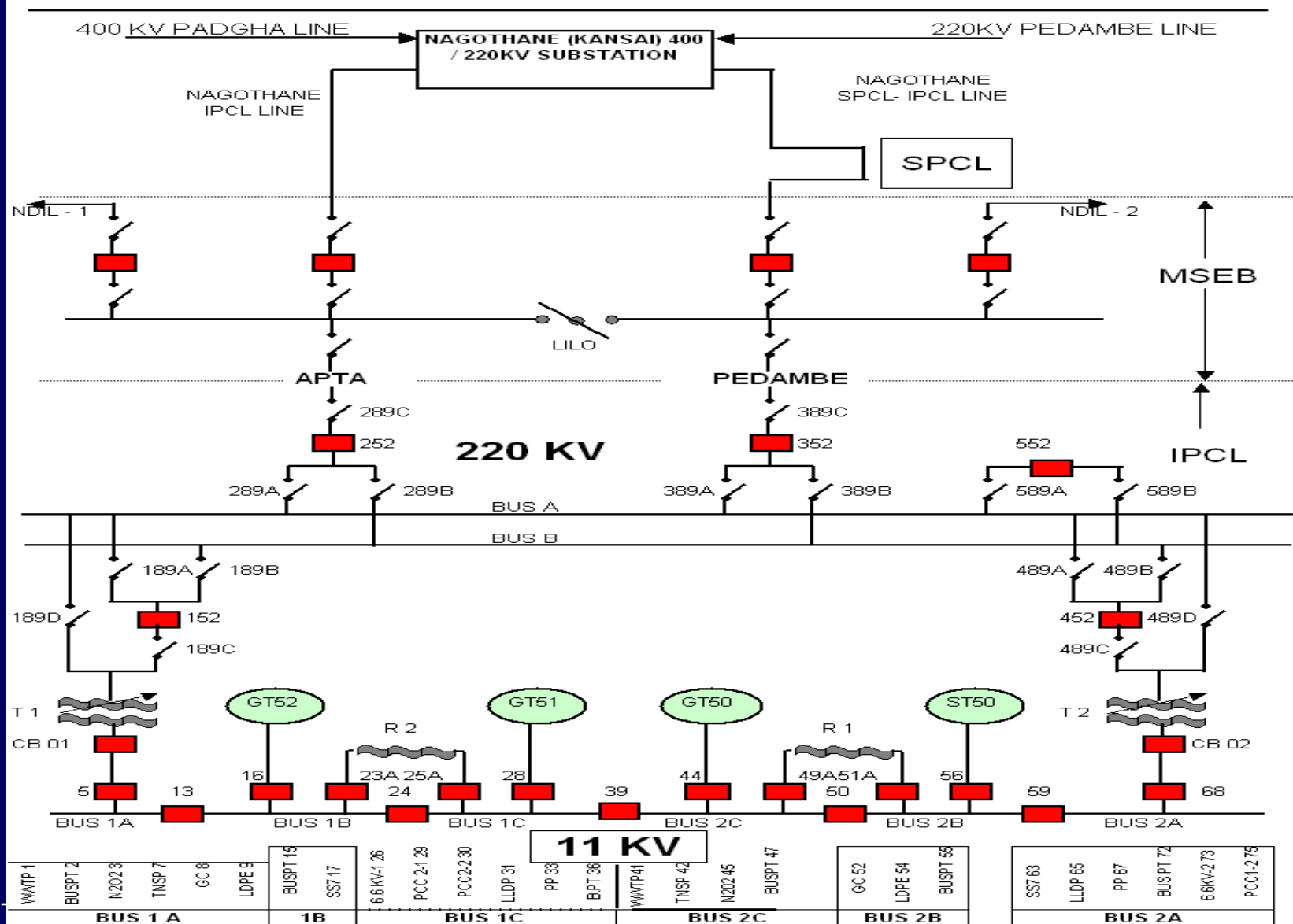
- ❁ There are 14 nos. of Electrical Substations (Including T/S) having 11 kV, 6.6 kV, 415 v, 3Ø, 50 Hz supply system feeding to various loads.
- ❁ These substations are supplied with redundant 11 kV supply as Incomer-1 and Incomer-2 from CPP.
- ❁ There is manual transfer scheme provided in switchboard for transferring the load from one bus to other without affecting connected load.



ELECTRICAL POWER SYSTEM

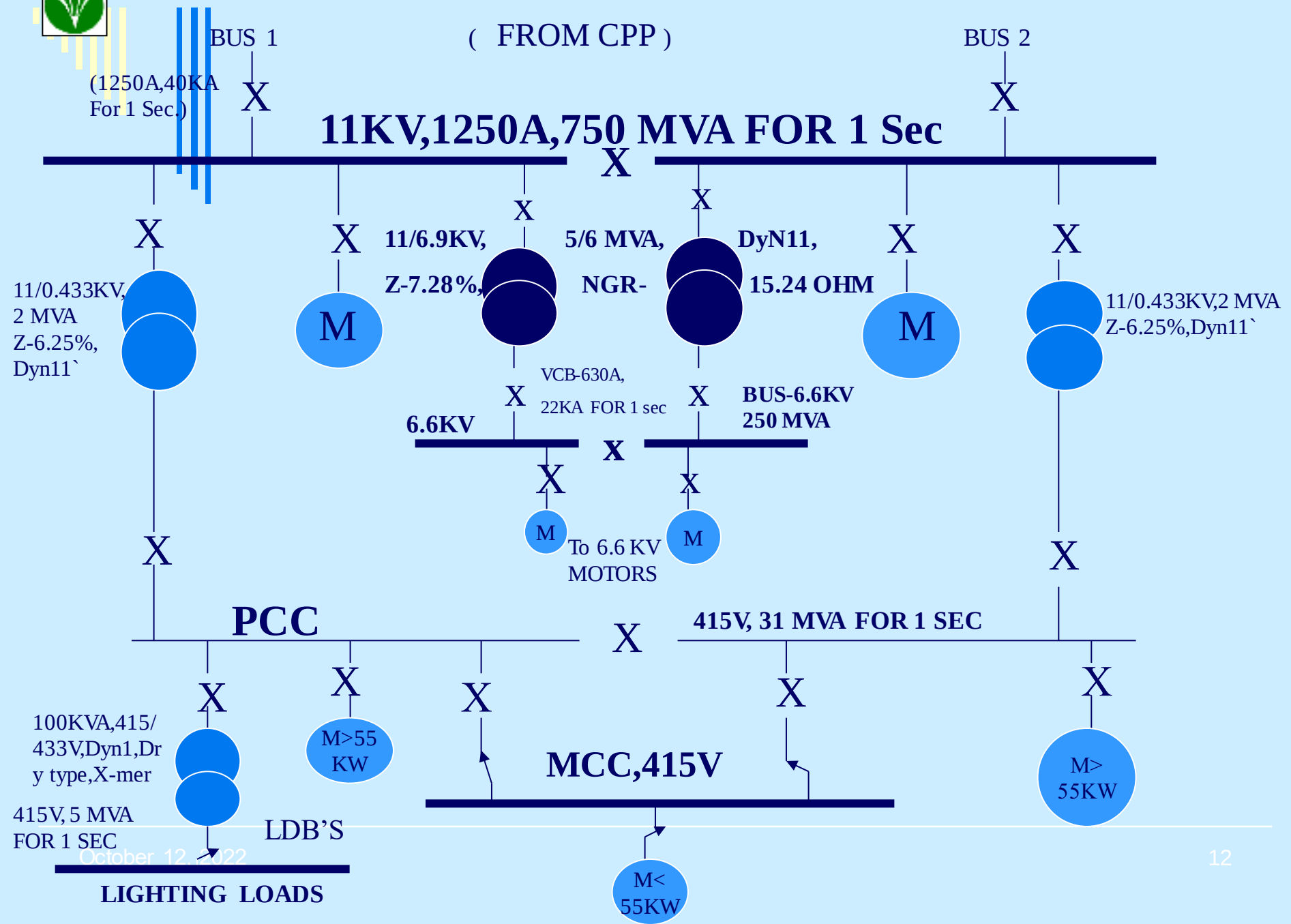
- ❁ **Motors above 160 kW are fed through either 6.6 kV or 11 kV switchboard.**
- ❁ **Motors more than 55 kW and up to 160 kW are fed from 415V PCC.**
- ❁ **Motors up to 55 kW are fed from 415 V MCC.**
- ❁ **DG sets are provided at:**
 - **CPP of 867 kVA for black-start purposes**
 - **GC of 500 kVA for emergency supply like id fan etc.**
 - **LDPE of 250 kVA for refrigeration at catalyst storage bunkers.**

IPCL-NAGOTHANE POWER SYSTEM SINGLE LINE DIAGRAM





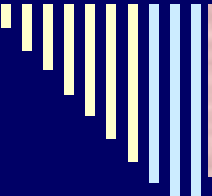
TYPICAL SINGLE LINE DIAGRAM (GC PLANT)



FACILITIES AVAILABLE AT CES(E)

- 1 PHASE POWER ANALYSER
- AC / DC EARTH FAULT LOCATOR
- CABLE FAULT LOCATOR
- PORTABLE BATTERY CHARGER
- INFRARED THERMOGRAPHY CAMERA
- RELAY TESTING KIT
- ELECTRONIC MOTOR CHECKER
- PRIMARY INJECTION KIT
- VACUUM TESTER
- CONTACT RESISTANCE TESTER
- CT / PT TESTING KIT
- MOTOR TEST BENCH
- OIL FILTRATION UNIT
- BDV TEST KIT





THE STATUTORY ACTS WHICH REGULATE THE USAGE OF ELECTRICITY IN INDIA

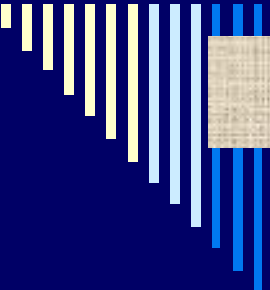
- 1. THE INDIAN ELECTRICITY ACT 2003**
- 2. THE FACTORIES ACT 1948**
- 3. THE MINES ACT**
- 4. THE LIFTS ACT**
- 5. THE BOMBAY ELECTRICITY DUTY ACT 1958**
- 6. THE INDIAN ELECTRICITY RULES 1956**

- ABOVE ACTS CONTAINS IMPORTANT CLAUSES GOVERNING THE INSTALLATION AND USE OF ELECTRICAL APPARATUS.**
- IT IS A DUTY OF EVERY ONE TO STUDY THEM CAREFULLY AND COMPLY WITH THEM.**

**REMEMBER :
IGNORANCE OF LAW IS NO EXCUSE**

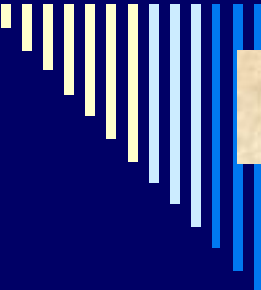
STATUTOY COMPLIANCE

Sr. No.	Statutory maintenance required	Frequency
1	Insulation resistance tests for Panels	(Megger tests twice/Year)
2	Transformer Oil testing for Dielectric (BDV), PPM, acidity	Yearly
3	DGA (for transformer above 5 MVA)	Twice/Year
4	Testing / Calibration of measuring instruments	Yearly
5	Earthpit testing	Yearly
6	Battery maintenance	
	Records to be maintained	
7	L.A./Surge Counter readings register	
8	Failure and interruption record	
9	History sheet of equipments / maintenance	
10	Register of Generating Set (Generation Figures)	CPP / GC / LDPE
11	Battery maintenance	
12	HT / LT load addition / alteration / removal	
13	Details of Training (Fire / Safety / First Aid / Ambu bag etc)	



MAJOR ELECTRICAL EQUIPMENTS

TOTAL NOS. OF HT MOTORS	80 NOS.
TOTAL NOS.OF LT MOTORS	1800 NOS APPROX.
TRANSFORMERS	79 NOS(FROM 0.5 TO 33.3 MVA)
VARIABLE SPEED DRIVES	60 NOS
UPS SYSTEMS (110V AC)	16 NOS (FROM 10 KVA TO 100 KVA)
RECTIFIERS (BATTERY CHARGERS)	25 NOS

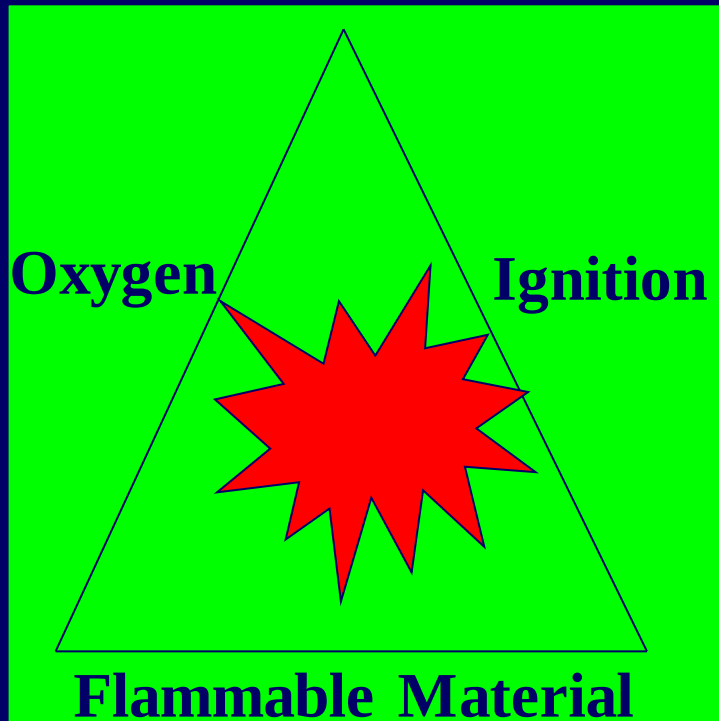


CONTROL SUPPLY ARRANGEMENT

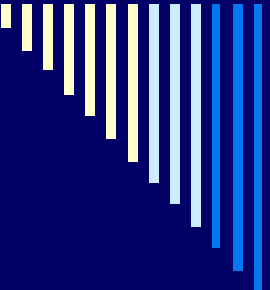
PLC & DCS SYSTEMS	110 VAC (UPS)
FIELD INSTRUMENTS	110 VDC (RECTIFIERS WITH BATTERY BACK UP)
CONTROL SUPPLY FOR ELECT. PANELS	220 VDC (RECTIFIERS WITH BATTERY BACK UP)
SUPPLY FOR COMMUNICATION EQUIPMENTS	24 VDC – FIRE ALARM 48 VDC – EPABX 60 VDC – NEUMANN (ALL WITH RECTIFIERS AND BATTERY BACK UP)

EQUIPMENT SELECTION IN HAZARDOUS AREA

BASIS FOR AREA CLASSIFICATION AND EQUIPMENT SELECTION

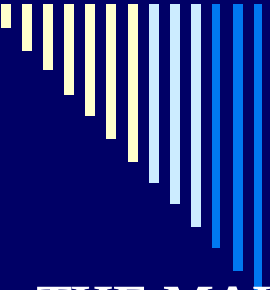


- 1) **ZONE** : BASED ON THE OCCURANCE OF HAZARDOUS MATERIAL
- 2) **GAS GROUP** : TYPE OF GAS PRESENT. IT DETERMINES THE CONSTRUCTION OF ENCLOSURE.
- 3) **TEMPERATURE CLASS** : IT IS BASED ON ALLOWABLE SURFACE TEMPERTURE OF ENCLOSURE



SRA & JOB CONTRACTS

- ✓ **LT MOTOR REWINDING**
- ✓ **STREET LIGHT MAINTENANCE**
- ✓ **SRA FOR MISC. ELECTRICAL JOBS**
- ✓ **O&M OF CENTRAL A/C**
- ✓ **HT/LT BREAKER MAINTENANCE**
- ✓ **TELEPHONE NETWORK MAINTENANCE**
- ✓ **AMC FOR TELEPHONE EXCHANGE**
- ✓ **AMC FOR ENPL UPS SYSTEMS**
- ✓ **AMC FOR OTIS/OLYMPUS ELEVATORS**
- ✓ **SRA FOR HT CABLE TERMINATIONS/JOINTING**
- ✓ **SRA OF CABLE TUNNEL MAINTENANCE**
- ✓ **SRA FOR ELECTRONIC CARDS REPAIRS**



MAINTENANCE DEFINITION

- **THE MAINTENANCE IS ALL TECHNICAL AND ASSOCIATED ADMINISTRATIVE ACTIONS INTENDED TO RETAIN AN ITEM IN, OR RESTORE IT TO, A STATE IN WHICH IT CAN PERFORM ITS REQUIRED FUNCTION (STATED CONDITION).
(BS 3811:1984)**
- **THE ENGINEERING DECISIONS AND ASSOCIATED ACTIONS NECESSARY AND SUFFICIENT FOR THE OPTIMIZATION OF SPECIFIED CAPABILITIES**
- **[CAPABILITY IS THE ABILITY TO PERFORM A SPECIFIC ACTION WITHIN A RANGE OF PERFORMANCE LEVEL.]**

(MESA-MAINTENANCE. ENGINEERING. SOCIETY OF AUSTRALIA)



WHAT IS TO BE MAINTAINED?

The list of Electrical equipments, location wise which needs to be maintained.

A. SUB-STATION ELECTRICAL EQUIPMENTS

1. *HT/LT (PCC/MCC) PANELS*
2. *TRANSFORMERS (POWER/DISTRIBUTION/LIGHTING)*
3. *LIGHTING/SERVICE BOARDS*
4. *UPS AND BATTERY CHARGERS*
5. *BATTERY BANKS*
6. *CONTROL PANELS FOR SPECIFIC EQUIPMENTS*
7. *PROCESS INTERLOCKS*
8. *ANNUNCIATION PANEL*
9. *ECS PANELS*
10. *EMERGENCY DG SETS*
11. *JUNCTION BOXES IN FIELDS*



WHAT IS TO BE MAINTAINED?

B. A/C PLANT AND PRESSURIZATION

C. EMERGENCY DG SET

D. FIELD ELECTRICAL EQUIPMENTS-

- 1. MOTORS AND LOCAL CONTROL STATIONS, MOVs**
- 2. EOT CRANE**
- 3. SPECIFIC EQUIPMENTS**
- 4. POWER / LIGHTING PANELS**
- 5. LIGHTING FIXTURES**
- 6. PANELS FOR HYDROJETTING / WELDING M/C CONNECTION**
- 7. SINGLE PHASE POWER POINTS**
- 8. HAND LAMP CONNECTIONS**
- 9. FIRE ALARM MCP**
- 10. JUNCTION BOXES FOR FIRE ALARM/NEUMANN COMMUNICATION**



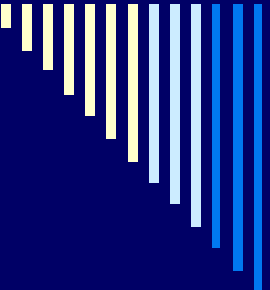
WHAT IS TO BE MAINTAINED?

E. ELECTRICAL EQUIPMENTS IN CONTROL ROOM

1. *PANEL FOR FIRE ALARM*
2. *PANEL FOR NEUMANN EXCHANGE*
3. *CONTROL PANELS FOR SPECIFIC EQUIPMENTS*
4. *POWER CABLE END TERMINATION IN INST. PANELS*
5. *CONTROL CABLE END TERMINATION*
6. *LIGHTING FIXTURE INCLUDING EMERGENCY LIGHTING*
7. *LIGHTING/POWER PANELS/POINTS*

F. CABLING

1. *POWER CABLES*
2. *CONTROL CABLES*
3. *END TERMINATIONS*
4. *STRAIGHT THROUGH JOINTS*



MAINTENANCE-WHY?

- **TO IMPROVE / ENHANCE**
 - **PERFORMANCE**
 - **LIFE OF EQUIPMENT**
 - **RELIABILITY**
- **TO SAVE TIME AND MONEY**
- **TO REDUCE / ELIMINATE BREAKDOWN**



SOURCES OF DEFECTS

FAILURE Collateral damage. (bearing seizure, damaged shaft)

WORKMANSHIP What they do; not what they could do. Not just skill and motivation... the system as well. (being so reactive and time-pressed so as to fail to align the pump before bringing it to line.)

DESIGN Design not fitting current use, could be poor initial design.

MATERIALS Defects in mfg, storage, handling and sourcing

OPERATIONS Normal wear & tear, operational practices

TYPES OF MAINTENANCE

PREVENTIVE MAINTENANCE

CONSISTS OF PERFORMING REGULAR MAINTENANCE ON A TIME SCHEDULE. IT IS AN EXPENSIVE ALTERNATIVE THAT SIMPLY MASKS AND DELAYS THE ROOT CAUSES OF FAILURE.

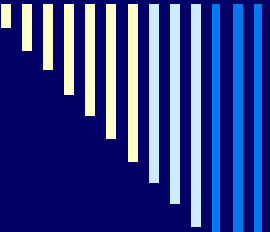
PREDICTIVE MAINTENANCE

CONSISTS OF APPLYING EARLY WARNING TECHNIQUES TO DETECT SMALL AMOUNT OF DAMAGE BEFORE THEY LEAD TO CATASTROPHIC FAILURE. EXPENSIVE REPAIRS REMAIN IMMINENT.

PROACTIVE MAINTENANCE

FOCUSES ON IDENTIFYING THE ROOT CAUSE OF FAILURE AFFECTING THE SYSTEM. PROPERLY APPLIED, IT COMMISSIONS CORRECTIVE ACTION TO ELIMINATE THEIRS BEFORE DAMAGE HAS OCCURRED.

WHILE PREDICTIVE AND PREVENTIVE MAINTENANCE ARE EFFECTIVE TO A CERTAIN DEGREE, BUT DO NOT FOCUS ON DETECTING THE ROOT CAUSE OF FAILURE. AND TRUE EXPENDITURE CONTROL, THEREFORE PROACTIVE APPROACH IS REQUIRED.



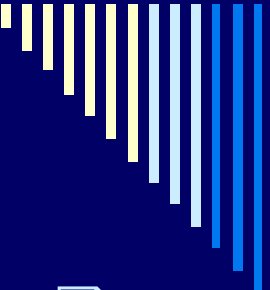
TYPES OF MAINTENANCE

BREAKDOWN MAINTENANCE

BASED ON A “RUN TO FAILURE” PHILOSOPHY. OFTEN RESULTS IN MAINTENANCE EXPENDITURES EXCEEDING ANNUAL PROFIT.

RELIABILITY CENTERED MAINTENANCE (RCM)

FIX THE PROCESS, NOT JUST THE PROBLEM. TO GET OTHER DEPARTMENTS TO ADJUST, TO WORK OUT NEW, MORE PRODUCTIVE ARRANGEMENT THAT SOMETIME CROSS TRADITIONAL BOUNDARIES OR SHIFT TERRITORIES OR RESPONSIBILITIES AND GET DIFFERENT DEPARTMENTS OR FUNCTIONAL GROUPS TO EVEN ACCEPT EACH OTHERS IDEA.



PREVENTIVE MAINTENANCE

SCHEDULED/PLANNED

- ☐ RELAY TESTING
- ☐ EARTHING BONDING TESTING
- ☐ MOTOR PREVENTIVE MAINTENANCE
- ☐ UPS / BATTERY CHARGER MAINTENANCE ETC.

CHANCE BASED MAINTENANCE

SINGLE LINE EQUIPMENT AND CRITICAL EQUIPMENT WHICH NORMALLY CAN NOT BE RELEASED FOR MAINTENANCE.



PREVENTIVE MAINTENANCE

CHANCE BASED MAINTENANCE

RELAY TESTING (SINGLE LINE EQUIPMENTS)

EARTHING / BONDING CHECKING

PANEL MAINTENANCE

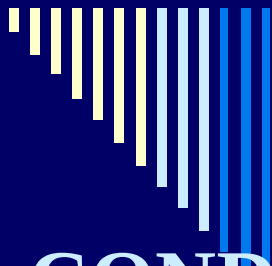
TRANSFORMER OVERHAULING

**OVERHAULING / PM OF CRITICAL MOTORS AND SINGLE
LINE EQUIPMENT**

BATTERY BANK MAINTENANCE

UPS AND BATTERY CHARGER MAINTENANCE

MAINTENANCE OF COMMUNICATION SYSTEM ETC.



PREDICTIVE MAINTENANCE

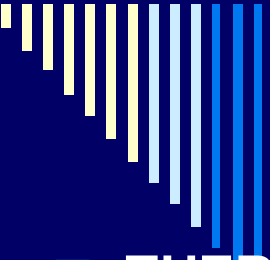
CONDITION MONITORING

THE CONTINUOUS OR PERIODIC MEASUREMENT AND INTERPRETATION OF DATA TO INDICATE THE CONDITION OF AN ITEM TO DETERMINE THE NEED FOR MAINTENANCE.

(BS 3811 : 1984)

THE PREVENTIVE MAINTENANCE INITIATED AS A RESULT OF KNOWLEDGE OF THE CONDITION OF AN ITEM FROM ROUTINE OR CONTINUOUS MONITORING.

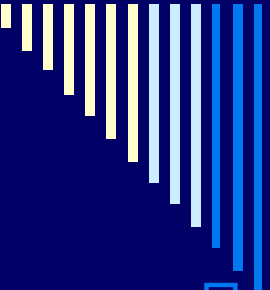
(BS 3811 : 1984)



CONDITIONING MONITORING

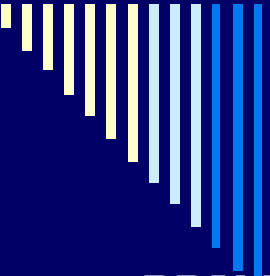
- ❑ THERMOGRAPHY OF ALL HT/LT CRITICAL PANELS, EQUIPMENTS ONCE EVERY 4 MONTHS.
- ❑ TEMPERATURE MONITORING BY THERMOHUNTER ON REGULAR BASIS.
- ❑ MOTOR CURRENT SIGNATURE ANALYSIS OF ALL CRITICAL HT/LT MOTORS EVERY SIX MONTHS.
- ❑ VIBRATION MONITORING OF ALL ROTATING EQUIPMENTS (MONTHLY/BIMONTHLY)
- ❑ TRANSFORMER OIL TESTING BDV ONCE IN A YEAR AND (CHEMICAL/DGA) ONCE IN TWO YEARS.

Contd...



CONDITIONING MONITORING

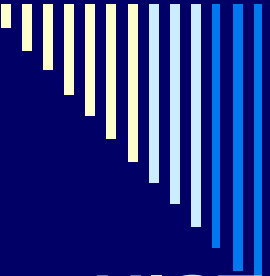
- **CONTACT RESISTANCE AND TIMING MEASUREMENT OF HT BREAKERS BASED ON CHANCE MAINTENANCE.**
- **PHYSICAL CHECKING OF ALL HT/LT CABLE JOINTS IN TUNNEL/OVERHEAD TRAYS ON REGULAR BASIS.**
- **IR VALUE OF TRANSFORMERS, MOTORS BASED ON CHANCE MAINTENANCE.**
- **TAN DELTA TESTING**
- **CT/PT TESTING**



PREDICTIVE MAINTENANCE

DIAGNOSTIC TESTING

-  **BDV, DGA/ CHEMICAL TESTS ON TRANSFORMER OIL**
-  **MILLIVOLT DROP TESTS ON BREAKERS/ CONTACTORS CONTACT**
-  **VACUUM TEST ON VACUUM BOTTLE OF VCB**
-  **TAN-DELTA & CAPACITANCE TEST FOR MOTORS, TRANSFORMERS, CABLES.**
-  **MCSA TEST ON RUNNING MOTORS**
-  **PARTIAL DISCHARGE TEST, RATIO, POLARITY AND KNEE POINT VOLTAGE TESTS ON CT& PT .**
-  **CONTACT RESISTANCE TESTS FOR THE JOINTS/TERMINATIONS.**
-  **THERMOGRAPHIC SURVEY FOR HT/LT PANELS**

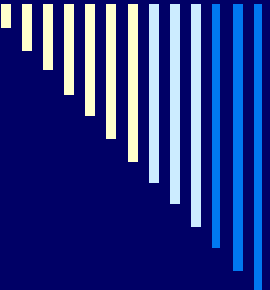


PREDICTIVE MAINTENANCE

HISTORY/TREND MONITORING

BASED ON THE HISTORY AND TREND DECISION IS TAKEN TO CARRY OUT MAINTENANCE ACTIVITY

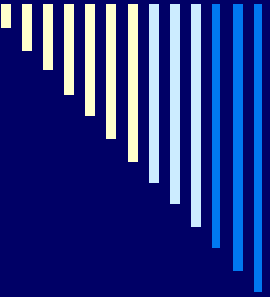
MTBF- MEAN TIME BETWEEN FAILURE IS ONE OF THE CRITERIA TO DECIDE MAINTENANCE ACTIVITY.



PROACTIVE MAINTENANCE

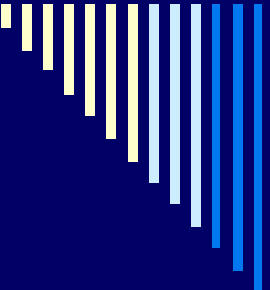
IMPROVES EQUIPMENT RELIABILITY

- ☐ INCREASES MEAN TIME BETWEEN FAILURE.
- ☐ IDENTIFIES IMPROPER OPERATING CONDITIONS.
- ☐ DEVELOPS MORE EFFECTIVE EQUIPMENT SPECIFICATIONS.
- ☐ ALLOWS FOR ROOT CAUSE FAILURE ANALYSIS.
- ☐ AUTOMATICALLY PROVIDES PREDICTIVE MAINTENANCE CAPABILITIES.



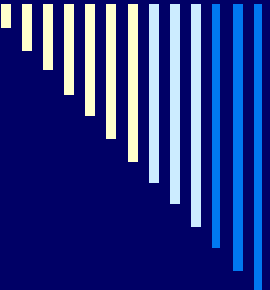
PROACTIVE MAINTENANCE

- ❖ FCO - DESIGN AND MODIFICATIONS JOBS
- ❖ FIR – FAR SYSTEM
- ❖ RELIABILITY IMPROVEMENT PLANS



RELIABILITY CENTERED MAINTENANCE

- ❑ FORM A CROSS-FUNCTIONAL TEAM TO SOLVE THE PROBLEM.
- ❑ WIDEN YOUR VIEWS TO UNDERSTAND THE CAUSE OF PROBLEM.
- ❑ USE BRAINSTORMING SESSION AND 5-WHY PRINCIPLES TO ARRIVE AT ROOT CAUSE.
- ❑ USE P-D-C-A CYCLE TO SOLVE THE PROBLEM.



TASK ANALYSIS AND RISK MITIGATION

- IT AIMS AT REDUCING / ELIMINATING RISKS CAUSING PRODUCTION LOSS BY WAY OF JOINT STUDY OF THE TASK BEING UNDERTAKEN.
- PROVIDES ALTERNATIVE / STANDBY TO OVERCOME RISK / REDUCE PRODUCTION LOSS

Contd..

TASK ANALYSIS AND RISK MITIGATION

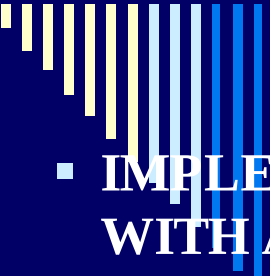
UPS Control supply provision to OTI of Transformer T1 and Installation of New calibrated WTI

Step No.	Activity	Impact	Precautions	Remarks	Time duration
1	CPP - Elect to take ELO on Transformer T1. For which ELO on breaker 152, CPP 11 KV breaker 5, Isolator 189 C is required.	1)Supply from transformer T1 will not be available and Incomer 1 will not be available. 2)With only T2 available, import requirement (during exigency) will be met by T2	1)ELO procedure to be followed for lockout on T1. 2) ELO activity under direct supervision of CPP Elect shift engineer.	1)Supply to CPP 11 KV Incomer 2 (Panel 68) will be available from transformer T2 and no activity is planned on this transformer T2. 2) Max import thru T2 possible is 25 MVA, which is higher than import requirement in case of 1 generator tripping and also the CD with MSEDCL. Hence NC can run with T2	45 Min
2	Connection of UPS supply cable to MCB of Transformer T1 at DB located in s/yard celler.	Under control	Ensuring MCB is switched OFF.	To be supervised by BA.	30 Min
3	Removal of WTI and installation of new calibrated WTI.	Under control	Under control	To be supervised by BA.	4 Hrs

TASK ANALYSIS AND RISK MITIGATION

UPS Control supply provision to OTI of Transformer T1 and Installation of New calibrated WTI

Step No.	Activity	Impact	Precautions	Remarks	Time duration
4	Connection of UPS supply cable at Elmex in OTI / WTI marshaling box and extension of UPS control supply to OTI & WTI controllers.	Under control	Under control	To be supervised by BA.	30 Min
5	Switching ON of UPS supply MCB to Transformer T1 and observing the temperature readings on controllers.	Under control	Under control	To be supervised by BA.	1 Hrs
6	Lifting of ELO and charging of Transformer T1.	Under control	Under control		45 Min
7	1) Total shutdown time required on transformer T1 is 8 Hrs. 2) During all the above activity Transformer T2 will be available to CPP.			Information Refer remarks in step 1	
				Total time required	8 Hrs

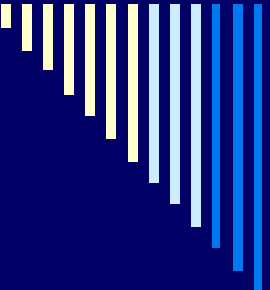


ACHIEVEMENTS

- **IMPLEMENTATION OF LOCKOUT-TAG OUT (LOTO) SYSTEM WITH ALL NECESSARY MODIFICATIONS IN HT/LT PANEL.**
- **MODIFICATION IN ALL HT PANELS FOR THERMOGRAPHIC SURVEY**
- **REPLACED PLANT AND TOWNSHIP EXCHANGES WITH NEW AVAYA EXCHANGE TO IMPROVE COMMUNICATIONS.**
- **SEGREGATION OF BATTERY BANKS IN ALL UPS SYSTEMS**
- **NEW NEUMANN PP PLANT PUBLIC ADDRESS SYSTEM COMMISSIONED**
- **AMR SYSTEM IN TOWNSHIP INSTALLED.**

FORWARD PATH

- **UPGRADATION OF ECS**
- **REPLACEMENT OF OLD TLL UPS AT N2O2, OSBL, PIPELINE**

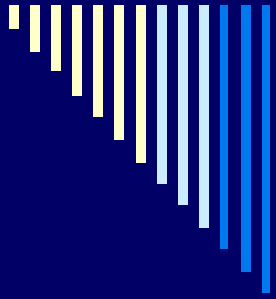


INTERFACING WITH OTHER DISCIPLINES

- INTERFACE WITH OPERATION
- INTERFACE WITH MECHANICAL
- INTERFACE WITH INSTRUMENTS

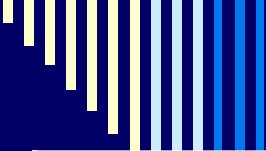
CASE :

PUMP MOTOR TRIPPING ON OVERLOAD
PUMP MOTOR NOT STARTING



ILLUMINATION

- 1) **SAFE AREA LIGHTING**
- 2) **LIGHTING IN CLASSIFIED AREA (IS 2206)**

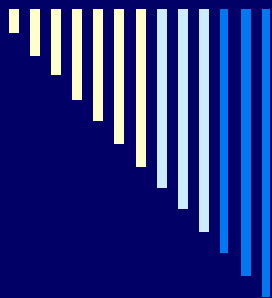


ILLUMINATION REQUIREMENT

SR. NO.	TYPE OF AREA	LUX LEVEL
1	OUTDOOR AREAS, YARDS, ROADS, PARKING AREAS	20
2	CONTROL PANELS	150
3	TRANSFORMER BAY, BATTERY ROOM, BLOWERS, SWITCHYARDS	100
4	STAIR CASE, STORE ROOMS, CORRIDOR GENERAL LIGHTING	100
5	CABLE CELLAR / BASEMENTS, CORRIDORS AND LIFT CARS	70
6	CONFERENCE ROOMS, GENERAL AND EXECUTIVE OFFICES	300
7	ENTRANCE HALL AND RECEPTION AREAS	150
8	GARAGE IN TOWNSHIP	70
9	CONVEYERS	50
10	ROUGH WORK AREAS, FOR E.G. FRAME ASSEMBLY, ASSEMBLY OF HEAVY MACHINES	150

ILLUMINATION REQUIREMENT

SR. NO.	TYPE OF AREA	LUX LEVEL
11	REACTOR AREAS, BOILERS, GALLERIES ETC.	150
12	BOILER HOUSE AND TURBINE HOUSE	100
13	BOILER PLATFORMS	50
14	BURNER PLATFORMS	110
15	OIL STORAGE TANKS, PLATFORMS, BOILER & TURBINE DECKS	50
16	CHEMICAL AND GENERAL LABORATORY	300
17	SHEET METAL WORKS SUCH AS PRESSING, PUNCHING, SHEARING, STAMPING, SPINNING, FOLDING	200
18	CONDENSERS, DE-AERATOR FLOOR, EVAPORATOR FLOOR, HEATER FLOOR	55
19	CONTROL ROOMS :	200 TO 300
20.	VERTICAL CONTROL PANELS	200 TO 300
21.	CONTROL DESKS	300



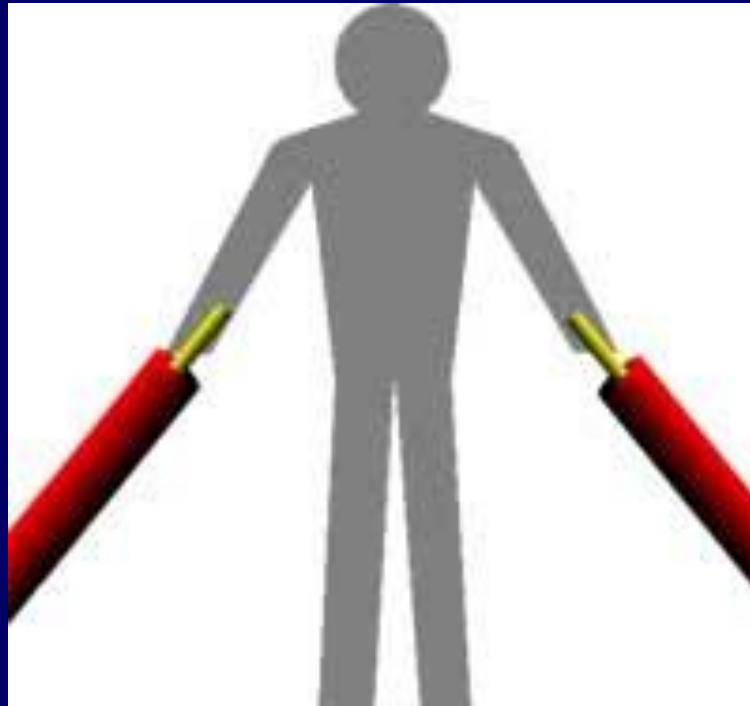
ELECTRICAL SAFETY

HOW SHOCK OCCURS

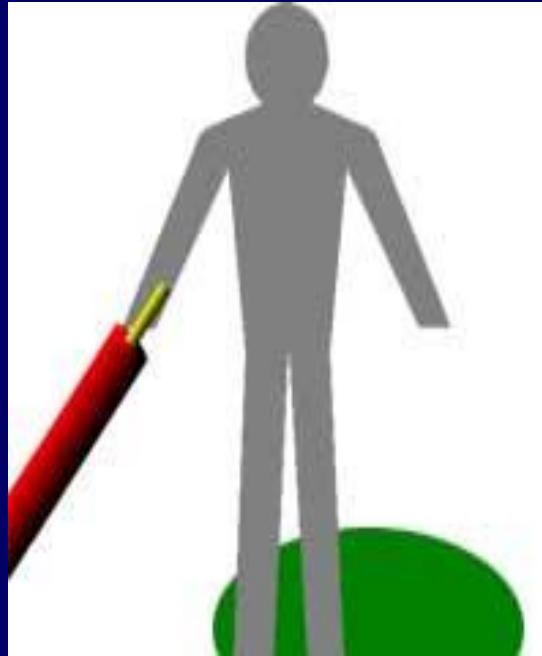
ELECTRICITY TRAVELS WHEN THERE IS A CLOSED CIRCUIT & ITS NORMAL ROUTE IS THROUGH A CONDUCTOR.

ELECTRIC SHOCK OCCURS IN THREE WAY.

WHEN PERSON COMES IN CONTACT WITH BOTH LIVE WIRES

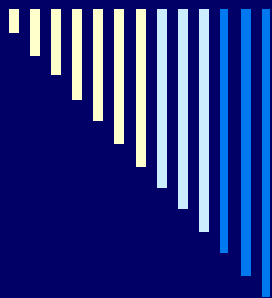


WHEN PERSON COMES IN CONTACT WITH ONE LIVE WIRE AND HE IS STANDING ON GROUND



WHEN PERSON USING TOOLS OR MACHINE WHICH IS HAVING FAULTY INSULATION AND STANDING ON GROUND

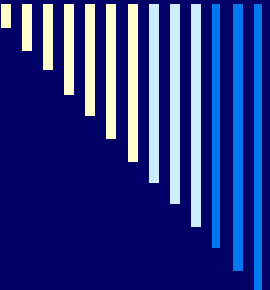




SEVERITY OF SHOCK

**OTHER INJURIES ARE INDIRECT OR
SECONDARY NATURE SUCH AS**

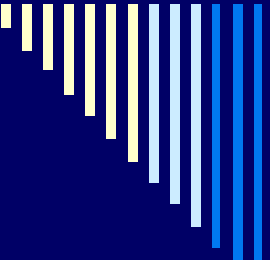
- **INVOLUNTARY MUSCLE REACTION FROM ELECTRICAL SHOCK CAN CAUSE BONE FRACTURE OR EVEN DEATH DUE TO FALLING FROM HEIGHT.**
- **WHEN SHORT CIRCUIT OCCURS THERE ARE CHANCES OF FIRE OR EXPLOSION WHICH MAY LEAD SEVERE DAMAGE OR FATALITY.**



EFFECT OF CURRENT ON HUMAN BODY

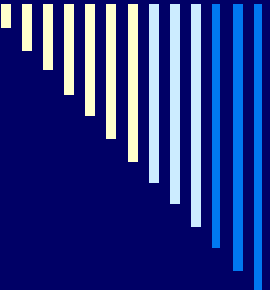
50 HZ AC PASSING THROUGH BODY FOR 1 SECOND, THROUGH THE ROUTE LEFT HAND TO BOTH FEET TO EARTH.

CURRENT	EFFECT
UPTO 1 MA	NO SENSATION
1 MA TO 8 MA	SENSATION – BUT NOT PAINFUL
8 MA TO 15 MA	PAINFUL SHOCK
15 MA TO 20 MA	MUSCULAR CONTROL LOST
20 MA TO 50 MA	SEVERE MUSCULAR CONTRACTION
50 MA TO 200 MA	VENTRICULAR FIBRILLATION POSSIBLE DEATH
ABOVE 200 MA	SEVERE BURNS SEVERE VENTRICULAR FIBRILLATION HEART ARREST



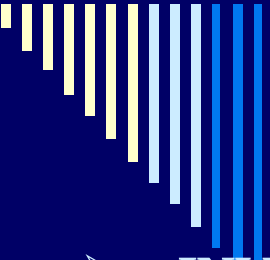
PREVENTING ELECTRICAL HAZARD

- ☐ **INSULATION**
- ☐ **GROUNDING / EARTHING**
- ☐ **CIRCUIT PROTECTION DEVICES**
- ☐ **ELCB**
- ☐ **USE OF STANDARD ELECTRICAL APPLIANCES.**
- ☐ **PROPER AND REGULAR MAINTENANCE.**
- ☐ **USE OF ELECTRICAL EQUIPMENT WITH ADEQUATE RATING AND AREA CLASSIFIED.**
- ☐ **GUARDING**
- ☐ **SAFE WORK PRACTICES**
- ☐ **TRAINING**



ELECTRICAL AUDIT SYSTEM

- **SYSTEM ESTABLISHED IN YEAR 2005**
- **13 TYPES OF AUDITS ACROSS 14 AREAS/SUBSTATION**
- **VARIOUS FREQUENCIES FOR THE AUDITS VIZ. MONTHLY, QUARTERLY, HALF YEARLY, YEARLY**
- **SELF AUDITS, CROSS AUDITS AND AUDIT BY NOMINATED COMMITTEE**
- **WIDE PARTICIPATION AT VARIOUS LEVELS IN AUDITORS ROLE**



ELECTRICAL AUDIT SYSTEM

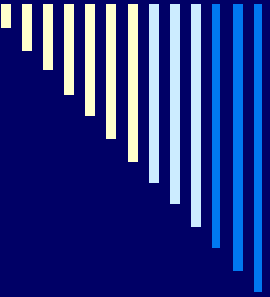
- **INVOLVED 14 AUDITORS FOR SELF AUDITS, 12 AUDITORS FOR THE CROSS AUDITS AND 04 AUDITORS FOR COMMITTEE AUDIT**
- **COMPLETED TOTAL 557 AUDITS IN 2005 COMPLETED FIRST REVIEW OF THE SYSTEM IN YEAR 2006 .**
- **FINE TUNING OF THE AUDIT SYSTEM WAS DONE .**
- **NUMBER OF AUDITS REDUCED TO 379 WITHOUT COMPRISING THE QUALITY .**
- **THE CHECKLISTS WERE REVIEWED TO INCREASE THE EFFECTIVENESS OF THE AUDIT SYSTEM.**

AUDIT PLAN FOR YEAR 2007

SR NO	AUDIT CODE	DISCRIPTION	FREQUENCY	TYPE	RESPONSIBILITY
1	EA-01	SYSTEM COMPLIANCE AUDIT	QUARTRLY	CROSS	
2	EA-03	FACILITIES (SPECIAL - EQPT. / MACHINES / INSTRUMENTS / TOOLS)	QUARTERLY	CROSS	
3	EA-04	ELECT INSTALLATION AUDIT	YEARLY	COMMITTEE	NOMINATED BY HOD(E)
4	EA-05	PREMANSOON AUDIT	YEARLY	CROSS	REFER MATRIX
5	EA-06	VERMIN PROOFING AUDIT	YEARLY	CROSS	REFER MATRIX
6	EA-07	CONTRACTORs SITE FACILITY AUDIT	QUARTERLY	SELF	
7	EA-08	ELECTRICAL CONTRACTORS AUDIT	YEARLY	SELF	HOS CES(e)
8	EA-09	SAFETY DISTRICT AUDIT	QUARTRLY	DIST OWNER	SDH(TELECOM)
9	EA-10	AIR CONDITIONING & PRESURISATION EQPT PERFORMANCE AUDIT	MONTHLY	SELF	HOS(ers)
10	EA-11	AIR CONDITIONING & PRESURISATION SYSTEM PERFORMANCE AUDIT	HALF YRLY	SELF	HOS(ers)
11	EA-12	SUBSTATION HOUSEKEEPING AUDIT	HALF YRLY	COMMITTEE	NOMINATED BY HOD(E)
12	EA-13	GREASE STORAGE & GREASE GUN AUDIT	QUARTRLY	SELF	HOS(PLANTS)
13	EA-14	MINI-TOWNSHIP ELECT/CIVIL INSTALLTIONS AUDIT	QUARTRLY	SELF	HOS(T/S)

BSC SELF SAFETY CHECKLIST SCHEDULES

File No.	Checklist	Frequency
1	Master list of checklist format	
2	Internal Audit compliance	Monthly
3	Hazardous Area Equipment Checking	Yearly
4	First Aid Box	Fortnightly
5	Tool Box Talk	Weekly
6	Inspection of guards	Quarterly
7	Illumination Level	Yearly
8	Inspection Of Cylinders	Quarterly
9	Portable Ladder	Quarterly
10	Facility Audit	Quarterly
11	Electrically Operated Lifting Tools	Quarterly
12	Manually Operated Lifting Tools	Half yearly
13	Rubber Mat, Rubber Hand Gloves	Quarterly
14	MCP Testing	Quarterly
15	Inspection of Forklift	Monthly
16	Portable Elect. Equipment	Half yearly
17	ELCB	Half yearly
18	Equipment Earthing	Half yearly
18	Conveying lines earthing/bonding checking	Quartley
19	Earth Pit/Grid testing	Yearly
20	Hand Tools	Quarterly
21	Battery Bank Maintenance	Monthly
22	Battery Room Checking	Monthly
30	Verminproofing checking	Quarterly
	Safety belts/lifeline belts	Quarterly
	Physical inspection of building	Half yearly
53	Monitoring of Lighting load	Half yearly(plant)
53	Monitoring of Lighting load	Quarterly(non-plan
54	Monitoting of running hours of critical motors	Half yearly
	ACB trolley checking	Yearly
	VCB trolley checking	Yearly



THANK YOU