INSPECTION AND SAFE PRACTICES
DURING ELECTRICAL INSTALLATIONS

OISD - RECOMMENDED PRACTICE - 147
First Edition, October, 1993
Amended Edition- October 2002

Oil Industry Safety Directorate
Government of India
Ministry of Petroleum & Natural Gas
8th Floor, OIDB Bhavan, Plot No. 2, Sector – 73, Noida – 201301 (U.P.)
Website: www.oisd.gov.in
Tele: 0120-2593800, Fax: 0120-2593802
INSPECTION AND SAFE PRACTICES
DURING ELECTRICAL INSTALLATIONS

Prepared by

COMMITTEE ON
INSPECTION AND MAINTENANCE OF ELECTRICAL EQUIPMENT

OIL INDUSTRY SAFETY DIRECTORATE
8th Floor, OIDB Bhavan
Tower A, Plot No. 2
Sector 73, NOIDA-201 301
Preamble

Indian petroleum industry is the energy lifeline of the nation and its continuous performance is essential for sovereignty and prosperity of the country. As the industry essentially deals with inherently inflammbable substances throughout its value chain – upstream, midstream and downstream – Safety is of paramount importance to this industry as only safe performance at all times can ensure optimum ROI of these national assets and resources including sustainability.

While statutory organizations were in place all along to oversee safety aspects of Indian petroleum industry, Oil Industry Safety Directorate (OISD) was set up in 1986 Ministry of Petroleum and Natural Gas, Government of India as a knowledge centre for formulation of constantly updated world-scale standards for design, layout and operation of various equipment, facility and activities involved in this industry. Moreover, OISD was also given responsibility of monitoring implementation status of these standards through safety audits.

In more than 25 years of its existence, OISD has developed a rigorous, multi-layer, iterative and participative process of development of standards – starting with research by in-house experts and iterating through seeking & validating inputs from all stake-holders – operators, designers, national level knowledge authorities and public at large – with a feedback loop of constant updation based on ground level experience obtained through audits, incident analysis and environment scanning.

The participative process followed in standard formulation has resulted in excellent level of compliance by the industry culminating in a safer environment in the industry. OISD – except in the Upstream Petroleum Sector – is still a regulatory (and not a statutory) body but that has not affected implementation of the OISD standards. It also goes to prove the old adage that self-regulation is the best regulation. The quality and relevance of OISD standards had been further endorsed by their adoption in various statutory rules of the land.

Petroleum industry in India is significantly globalized at present in terms of technology content requiring its operation to keep pace with the relevant world scale standards & practices. This matches the OISD philosophy of continuous improvement keeping pace with the global developments in its target environment. To this end, OISD keeps track of changes through participation as member in large number of International and national level Knowledge Organizations – both in the field of standard development and implementation & monitoring in addition to updation of internal knowledge base through continuous research and application surveillance, thereby ensuring that this OISD Standard, along with all other extant ones, remains relevant, updated and effective on a real time basis in the applicable areas.

Together we strive to achieve NIL incidents in the entire Hydrocarbon Value Chain. This, besides other issues, calls for total engagement from all levels of the stake holder organizations, which we, at OISD, fervently look forward to.

Jai Hind!!!

Executive Director

Oil Industry Safety Directorate
FOREWORD

The Oil Industry in India is 100 years old. Due to various collaboration agreements a variety of international codes, standards and practices are in vogue. Standardisation in design philosophies, operating and maintenance practices at a national level was hardly in existence. This lack of uniformity coupled with feedback from some serious accidents that occurred in the recent past in India and abroad, emphasised the need for the Industry to review the existing state of art in designing, operating and maintaining Oil and Gas installations.

With this in view, the then Ministry of Petroleum and Natural Gas in 1986 constituted a Safety Council assisted by Oil Industry Safety Directorate (OISD) staffed from within the industry in formulating and implementing a series of self regulatory measures aimed at removing obsolescence, standardising and upgrading the existing standards to ensure safe operations. Accordingly OISD constituted a number of Functional Committees comprising of experts nominated from the Industry to draw up standards and guidelines on various subjects.

Present document on “Inspection and Safe Practices during Electrical Installations” was prepared by the Functional Committee on “Inspection and Maintenance of Electrical Equipment”. This document is based on the accumulated knowledge and experience of Industry members and the various national and international codes and practices.

It is hoped that the provisions of this document if implemented objectively, may go a long way to improve the safety and reduce accidents in the Oil and Gas Industry. Users are cautioned that no document can be a substitute for the judgement of responsible and experienced engineer.

Suggestions for amendments, if any, to this document should be addressed to:

The Coordinator
Committee on
“Inspection and Safe practices during electrical installations”
Oil Industry Safety Directorate
8th Floor, OIDB Bhavan
Tower A, Plot No. 2
Sector 73, NOIDA-201 301

This standard in no way supersedes the statutory regulations of Chief Controller of Explosive (CCE), Factory Inspectorate or any other statutory body which must be followed as applicable.
NOTE

OIL INDUSTRY SAFETY DIRECTORATE (OISD) publications are prepared for use in the Oil and Gas Industry under Ministry of Petroleum and Natural Gas. These are the property of Ministry of Petroleum and Natural Gas and shall not be reproduced or copied and loaned or exhibited to others without written consent from OISD.

Though every effort has been made to assure the accuracy and reliability of the data contained in these documents, OISD hereby expressly disclaims any liability or responsibility for loss or damage resulting from their use.

These documents are intended to supplement rather than replace the prevailing statutory requirements.

Note 1 in superscript indicates the changes / modifications / additions as approved in 20th Safety Council Meeting held in October 2002.
COMMITTEE
ON
INSPECTION AND MAINTENANCE OF ELECTRICAL EQUIPMENT

LIST OF MEMBERS

<table>
<thead>
<tr>
<th>Name</th>
<th>Designation /Organisation</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>S/Shri.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>B.B. Chakravorty</td>
<td>DGM (SA &amp; PC) IOCL ( R &amp; P)</td>
<td>Leader</td>
</tr>
<tr>
<td>A.K. Anchan</td>
<td>Chief Mgr. (Elect) HPCL ( R)</td>
<td>Member</td>
</tr>
<tr>
<td>M.J. Bordoloi</td>
<td>Suptdg.Engr (Elect) OIL</td>
<td>Member</td>
</tr>
<tr>
<td>A.P. Kant</td>
<td>Project Mgr. (Elect. &amp; Inst.) BRPL</td>
<td>Member</td>
</tr>
<tr>
<td>George P. Paret</td>
<td>Sr.Mgr. (Proj.Elect) CRL</td>
<td>Member</td>
</tr>
<tr>
<td>R. Sankaran</td>
<td>Sr.Mgr. (Mtce.Elect) MRL</td>
<td>Member</td>
</tr>
<tr>
<td>S.C. Upadhyaya</td>
<td>DGM (Elect) ONGC</td>
<td>Member</td>
</tr>
<tr>
<td>R. Srinivasan</td>
<td>Sr.Mgr (Mtce.Elect) BPCL ( R )</td>
<td>Member</td>
</tr>
<tr>
<td>N.V. Mani</td>
<td>Joint Director, OISD</td>
<td>Member</td>
</tr>
</tbody>
</table>

In addition to the above, several other experts from Industry contributed in the preparation, review and finalisation of this document.
<table>
<thead>
<tr>
<th>SECTION</th>
<th>DESCRIPTION</th>
<th>PAGE NO.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0</td>
<td>INTRODUCTION</td>
<td>1</td>
</tr>
<tr>
<td>2.0</td>
<td>SCOPE</td>
<td>1</td>
</tr>
<tr>
<td>3.0</td>
<td>DEFINITIONS</td>
<td>1</td>
</tr>
<tr>
<td>4.0</td>
<td>SPECIAL REQUIREMENTS</td>
<td>3</td>
</tr>
<tr>
<td>5.0</td>
<td>STAGEWISE INSPECTION</td>
<td>4</td>
</tr>
<tr>
<td>5.1</td>
<td>GENERATOR</td>
<td>4</td>
</tr>
<tr>
<td>5.2</td>
<td>MOTOR</td>
<td>6</td>
</tr>
<tr>
<td>5.3</td>
<td>TRANSFORMER</td>
<td>7</td>
</tr>
<tr>
<td>5.4</td>
<td>SWITCHGEAR</td>
<td>9</td>
</tr>
<tr>
<td>5.5</td>
<td>OUTDOOR SWITCHYARD EQUIPMENT</td>
<td>11</td>
</tr>
<tr>
<td>5.6</td>
<td>BATTERY</td>
<td>14</td>
</tr>
<tr>
<td>5.7</td>
<td>LIGHTING EQUIPMENT &amp; ACCESSORIES</td>
<td>14</td>
</tr>
<tr>
<td>5.8</td>
<td>CABLE</td>
<td>16</td>
</tr>
<tr>
<td>5.9</td>
<td>EARTHING GRID</td>
<td>17</td>
</tr>
<tr>
<td>6.0</td>
<td>EQUIPMENT IN HAZARDOUS AREA</td>
<td>19</td>
</tr>
<tr>
<td>7.0</td>
<td>TEMPORARY ELECTRICAL INSTALLATIONS</td>
<td>20</td>
</tr>
<tr>
<td>8.0</td>
<td>DOCUMENTATION</td>
<td>21</td>
</tr>
<tr>
<td>9.0</td>
<td>MISCELLANEOUS</td>
<td>22</td>
</tr>
<tr>
<td>10.0</td>
<td>REFERENCES</td>
<td>23</td>
</tr>
<tr>
<td></td>
<td>ANNEXURE-I</td>
<td>24</td>
</tr>
<tr>
<td></td>
<td>TYPICAL SECTION OF CABLE TRENCH</td>
<td></td>
</tr>
</tbody>
</table>
INSPECTION AND SAFE PRACTICES DURING ELECTRICAL INSTALLATIONS

1.0 INTRODUCTION

Safety in Electrical System deserves maximum attention especially in the hydrocarbon industry, where classified hazardous atmosphere is normally encountered and electricity constitutes one of the major source of ignition (by arcs, sparks and hot surfaces) for fire accidents and explosions etc. Besides equipment damage and property loss, electrical hazards also include injuries and fatalities to personnel due to electric shock and burns.

Institution of Quality Assurance Programmes during the erection stage itself ensures that good quality of materials, superior workmanship under competent supervision, and compliance with standard engineering practices have gone into the work. This is rightly termed "Safety in-built into the System"

Timely inspection and adhering to safe practices as per the guidelines given in this document will go a long way in ensuring safer operations for a longer period of time, of the electrical installations in the Oil Industry.

2.0 SCOPE

This document specifies the minimum inspection requirements and safe practices to be adhered to, in the case of new electrical installations during their erection stage itself. Stagewise inspection of the equipment and installation practices have been discussed. This document is intended only to supplement and not to replace or to supercede the prevailing statutory requirements, which shall also be followed as applicable. Pre-commissioning requirements are excluded from scope for which OISD-137 shall be referred.

3.0 DEFINITIONS

i) Hazardous (Flammable) atmosphere

An atmosphere containing any flammable gas or vapour in a concentration capable of ignition.

ii) Hazardous area

An area shall be deemed to be hazardous area, where:

i) Petroleum having flash point below 65\(^{\circ}\) C or any flammable gas or vapour in a concentration capable of ignition is likely to be present;

ii) Petroleum or any flammable liquid having flash point 65\(^{\circ}\) C is likely to be refined, blended, handled or stored at or above its flash point.

Zone 0 An area in which a flammable atmosphere is present continuously, or is present for long periods.

Zone 1 An area in which a flammable atmosphere is likely to be present periodically or occasionally during normal operation.

"OISD hereby expressly disclaims any liability or responsibility for loss or damage resulting from the use of OISD Standards/Guidelines."
Zone 2 An area in which a flammable atmosphere is not likely to occur in normal operation and if it does occur, it will exist for a short time only.

iii) Non-Hazardous (Safe) Area

An area no part of which has within a hazardous area.

iv) Grouping of Flameproof Enclosures (Apparatus Groups)

Flameproof enclosures shall be classified into two groups as follows:

a) Group- I - for application of coal mining &

b) Group-II- for application of other industries.

Enclosures in Group II shall be further subdivided into IIA, IIB, IIC according to the requirements appropriate to the nature of the flammable atmosphere for which the apparatus is intended.

(For maximum gaps, and diametrical clearances for each group and sub-group of enclosures, Tables 1 and 2 given in IS: 2148 shall be referred).

v) Temperature Classes (T-group)

Permitted maximum surface temperatures of apparatuses, are classified under following six groups viz:

<table>
<thead>
<tr>
<th>Temperature Class</th>
<th>Maximum Surface Temp. (°C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>T 1</td>
<td>450</td>
</tr>
<tr>
<td>T 2</td>
<td>300</td>
</tr>
<tr>
<td>T 3</td>
<td>200</td>
</tr>
<tr>
<td>T 4</td>
<td>135</td>
</tr>
<tr>
<td>T 5</td>
<td>100</td>
</tr>
<tr>
<td>T 6</td>
<td>85</td>
</tr>
</tbody>
</table>

(For details IS: 8239 shall be referred.)

vi) Flameproof (or Explosion proof) Enclosure

An enclosure for electrical apparatus that will withstand, when the covers or other access doors are properly secured, an internal explosion of the flammable gas or vapour which may enter it or which may originate inside the enclosure, without suffering damage and without communicating the internal flammation (or explosion) to the external flammable gas or vapour for which it is designed, through any joints or structural openings in the enclosure.

(For details IS: 2148 shall be referred)

vii) Intrinsic Safety

A circuit or part of a circuit is intrinsically safe when any spark or thermal effect produced normally (that is, by breaking or closing the circuit) or accidentally (for example, by short circuit or earth fault)

"OISD hereby expressly disclaims any liability or responsibility for loss or damage resulting from the use of OISD Standards/Guidelines."
is incapable, under prescribed test conditions, of causing ignition of a prescribed gas or vapour. An
intrinsically safe apparatus is one in which all electrical circuits are intrinsically safe.
(For details, IS: 5780 shall be referred)

vii) For other terms such as "Authorised Person", "Engineer-in-Charge" etc. OISD-STD-137 shall
be referred.

4.0 SPECIAL REQUIREMENTS

All latest statutory stipulations such as Indian Electricity Act & Rules 1956(latest revision), Petroleum
Act & Rules etc., shall be complied with, while carrying out electrical installations, their inspections,
testing and commissioning.

Before commencement of electrical installations it should be checked that equipment and other
materials are received as per approved specifications and in full quantity as ordered.

Damaged item and/or missing component should be got repaired/replaced as per specifications.
During erection all the accessories and loose items shall also be inspected before their
assembly/mounting.

Some of the salient aspects listed below shall also be taken care of:

i) Before commencement of electrical installations, the schemes and one line drawings should
be got approved from the statutory authorities.

ii) It shall be ensured that the manufacturer of electrical equipment (switchgear, panels etc.)
incorporates all statutory provisions. The vendor drawings shall be approved for fabrication
only after ascertaining this aspect.

iii) Hazardous area classification drawings shall be studied and selection of electrical equipment
shall be in accordance with Chief Controller of Explosives (CCE)'s stipulations. All the
indigenous flameproof equipment/ accessories shall have CMRS (Central Mining Research
Station) Test Certificates. In case of imported equipment, even if it is tested and certified from
the country of origin, approval should be taken from CCE for using them in hazardous areas.
No unauthorised repairs, modifications shall be carried out in the flameproof items (Terminal
box, Junction box etc.). Damaged enclosures of flameproof equipment should be replaced
with new ones instead of repairing.

iv) The fire insurance requirements [Tariff Advisory Committee (TAC) requirements] shall be
incorporated in the system. The schematic and layout drawings should be forwarded to TAC
and got approved, prior to commencement of installations.

v) Before taking up any electrical equipment for commissioning, it should be ensured that the
entire installations and wiring connections etc. are carried out as per approved drawings.

vi) Selection of contractor/electrical supervisors/wiremen etc. shall be carefully done. Only
licensed and component agencies (approved by the State Government licensing board) shall
be employed. Full time supervision shall be ensured. The completion certificate and test
certificates shall be issued by the contractor with signature of the full supervision directly
under the employment of contractor.

vii) No temporary electrical connections shall be provided by non-electrical staff. During the use
of such temporary facilities, there shall be licensed electrical supervisor/electrician for safe
operation/maintenance. The electrical works, even for temporary use, shall be carried out
only by licensed electrical contractor through licensed electricians.

"OISD hereby expressly disclaims any liability or responsibility for loss or damage resulting
from the use of OISD Standards/Guidelines."
viii) All modifications in the wiring, scheme etc. shall be included in the As-built drawings and such alterations shall be got approved from the Electrical Inspectorate/DGMS - Director General of Mines Safety as applicable, prior to energisation of installations.

ix) Captive power generation (even installation of Diesel Generators) shall require prior sanction of the Electricity Supply Authorities (as per the provisions of the Electricity Supply Act)

x) There shall be approved electrical line clearance-permit system and list of authorised personnel duly exhibited (as per provisions of Indian Electricity Rules)

xi) The compliance of observations/ requirements noted during the Electrical Inspector's inspection shall be adhered to.

xii) Accidents shall be notified to the Electrical Inspectorate (as per Indian Electricity Rules) and State Government authorities and the recommendations of the statutory bodies as a result of investigation, shall be complied with as required.

xiii) The installations & facilities, procedures etc. shall be updated in line with changing legislations from time to time.

xiv) In case the area classification (due to process modification/expansion etc.) gets revised, the electrical installations should be reviewed whether they conform to revised classification. (For example, earlier classified as zone 2, with "increased safety" or "non-sparking type" fixtures may have to be changed to 'Flameproof' type once the area gets revised to zone 1).

xv) No unauthorised addition of loads or modifications in the installations be carried out without prior statutory clearances from Electrical Inspectorate/CCE etc.

xvi) The system should be got inspected by the statutory bodies and final clearance be obtained for energising the installation after attending the defects, if any pointed out during inspection.

xvii) Even after getting approval from statutory bodies, the equipment should not be energised without checking the interlocks provided. Interlocks should not be defeated under any circumstances.

xviii) Pre-commissioning checks as recommended in OISD-137 should be carried out before any electrical equipment is taken up for commissioning.

xix) During installation all safety operating systems, as provided in the design are available and ensured.

xx) During installation, special precaution, related to laying and termination of cables/wires to electronic/ communication/equipment and such other requirement, shall be adhered to.

5.0 STAGEWISE INSPECTION

5.1 GENERATOR

The following shall be checked/ensured:

i) Manufacturers' erection/ commissioning/operation and maintenance manuals are available.

ii) Approach way to Generator foundations is clear

iii) The crane is checked and confirmed that the same has been tested on load.

iv) All lifting tools and tackles are properly sized and tested.

"OISD hereby expressly disclaims any liability or responsibility for loss or damage resulting from the use of OISD Standards/Guidelines."
v) Only lifting lugs designated for this purpose, on the Generator, are used for lifting.

vi) Generator manufacturers' recommendations for erection, are followed

vii) After placing Generator on foundation the following are recorded:

   a) Insulation Resistance (IR) & Polarisation Index (PI) values of stator and Rotor.

   b) Resistance and temperature of Stator and Rotor windings. (compare with test values recorded at manufacturer's works after making correction for temperature)

viii) Bearing clearances are in order.

ix) Alignment of Generator Rotor and Turbine Rotor is done as per manufacturer's recommendation and readings are recorded.

x) Insulating shims have been provided below Generator and exciter bearing against flow of shaft currents, before aligning rotor.

xi) Bearing housing is dovelled to pedestal after alignment.

xii) By lifting Generator rotor, IR value of rotor shaft with respect to earth is confirmed as per manufacturers' recommendations.

xiii) Generator air gaps at both driven and non-driven end are maintained as per manufacturer's recommendations. However deviation from average shall not be more than + 5%.

xiv) Stator frame is dovelled to base frame after final air gap check.

xv) All couplings viz. between Generator and Turbine, Generator and Exciter are in good condition.

xvi) Generator cooling piping/ducting are in good condition.

xvii) The coolers are pressure tested before taking them in line, in case of water-cooling. (Test pressure shall be 1.5 times the normal working pressure)

xviii) Lubricating oil-piping system is in good condition. The flanges and bolts on lube oil line at the bearing ends are properly insulated to prevent flow of shaft current.

xix) Generator stator and rotor cable connections are okay. Phase sequence of Generator output connections are okay. Bimetallic washers are in good condition.

xx) Space heater winding and Resistance temperature detector connections (RTDS) are correct.

xxi) Lube oil temperature indicators are in working order.

xxii) Neutral connections on stator are intact.

xxiii) Neutral grounding resistor and its value conform to specifications.

xxiv) Neutral grounding earth pit is installed and connected and value of earth resistance is recorded.

xxv) If there is a link switch in Generator neutral, it is properly interlocked with Main Generator synchronising breaker.

xxvi) All bus ducts are checked for proper sealing.
xxvii) Generator stator body earthing and rotor shaft earthing (if any).

xxviii) Earthing bonds on Generator body and terminals boxes (power and neutral side) are made.

xxix) All slip rings and brushes are in order.

xxx) Carbon brush contact pressure is set to recommended value.

xxxi) All temperature and pressure gauges are tested.

xxxii) All auxiliaries of Generator like lube oil pumps, pilot exciter, rotating diodes (if brushless type), condensate pumps, demisters etc. are in order.

xxiii) Synchronising panel, AVR panel, main breaker and synchronising circuits are in good condition.

xxiv) All PTs and CTs and other connections and polarity are in order.

xxv) All protective devices are functioning properly and that the inter-tripping/alarms are OK (by simulation).

xxvi) All interlocks (by simulation) are functioning properly.

xxvii) All metering devices are in good condition.

xxviii) Direction of rotation of barring motor is correct.

xxix) Following are confirmed to be correct: (if not, corrective actions be taken).

a) Air gap

b) Field winding connections

c) Compound winding connections

d) Brush pressure to recommended values

e) (Grease Lubrication for Bearings, replace bearing packing grease with running grease of antifriction bearings. If journal bearings are used check clearances).

f) Provision of Coupling guard(s), if any.

5.2 MOTOR

The following shall be checked/ensured:

i) Name plate details of motors and suitability to the specified area classification.

ii) The insulation resistance between phase and earth and between phases (wherever provisions exist) of motors is measured before and after connection of the power cables.

iii) No unauthorised site modification for flameproof equipment is done.

iv) Double earthing with proper earth conductor size is provided as per IS: 3043 and earth resistance is within specified limit.
v) When pump and motor are not in the same base plate, both are independently earthed.

vi) Foundation bolts are of proper size.

vii) Correct type and size of cable glands are used and correct method of cable termination is adopted.

viii) Cooling system has been installed in accordance with approved drawings.

ix) Space heater and terminations, are in order.

x) The tag numbers of motor and pump are correct.

xi) Remote OFF and Local ON/OFF facility are available.

Wherever remote start is envisaged, one no. Local/Remote Start Selector switch (lockable type) shall be installed to facilitate Remote start when switch is in Remote Start position.

xii) All auxiliary equipment like lube oil pumps, cooling water for bearing are available in good condition.

xiii) Provision of canopy, wherever required.

xiv) Facility for removing motor from foundation (for maintenance) is available.

xv) Freeness of shaft and bearing.

xvi) Refer motor manual for special checks and ensure these are carried out.

xvii) Air gaps are within allowable tolerances.

xviii) Measure the insulation resistance at the end of 30 seconds and 60 seconds and calculate the Dielectric Absorption Ratio of motor windings for motors rated above 600V. This should be of acceptable value as per relevant standards.

xix) Calculate Polarisation Index of windings for critical HT motors by taking insulation resistance at the end of 1 minute and 10 minutes. The acceptable values of Polarisation Index varies according to the class of insulation. (for acceptable values refer relevant standards).

xx) The direction of rotation is correct.

xxi) All the terminal boxes are tight with proper gasket and fasteners.

xxii) Ensure coupling guard has been provided.

xxiii) Mechanical and electrical checks as per IS 900 are carried out.

xxiv) Ventilation and cooling system.

xxv) Condition of bearing grease/oil

5.3 TRANSFORMER

The following shall be checked/ensured:

i) The name plate details conform with specifications.

ii) All the accessories have been fixed properly.

"OISD hereby expressly disclaims any liability or responsibility for loss or damage resulting from the use of OISD Standards/Guidelines."
iii) Proper earthing as per IS: 3043 & 100028 is provided for the transformer body, neutral.

iv) Dielectric strength and acidity of the oil, taking three samples (minimum), (if required, filter the oil)

v) Safety precautions during oil filling, as listed below should be followed:

   a) Oil shall be approved quality

   b) Each oil drum before being used should be tested for dielectric strength/ water content and acidity.

   c) Oil should be filled through streamline filter from the bottom of transformer tank. Use of metal hoses/pipes is recommended for filling transformer oil (in case of rubber hoses sulphur from hoses may get mixed with transformer oil reducing dielectric.

   d) Filling rate should be gradual at moderate rates.

   e) Tank body and oil filling machine shall be securely earthed.

   f) All vents are kept open, while filling, and to be closed after oil starts coming out.

   g) Silicate breather to be taken into line after the transformer is filled with oil and conservator oil level is brought down to the normal level and commission the breather.

vi) Oil filtering and conditioning is to be done as per IS: 100028.

vii) The oil levels in the transformer conservator tank and all the bushings is upto the marked point.

viii) There is no oil leakage.

ix) The silica gel is in reactivated condition.

x) The breather pipe is clear from any blocking and contains oil upto the proper level.

xi) The explosion vent diaphragm does not have any dents, accumulation or any oil and air had been released.

xii) The buchholz is mounted correctly, there is no friction in the movement, and the floats are free. There should be no air bubbles inside buchholz relay.

xiii) All the manufacture's test certificates are available as required.

xiv) Phase sequence and connections for vector group.

xv) The gap of arcing horns for the bushings are provided correctly and earthing connections for the surge diverters have been made.

xvi) The windings and oil temperature thermometer pockets contain oil and the meters are tested and calibrated.

xvii) Provision of copper strip bonding between:

   a) Top cover and transformer tank

*OISD hereby expressly disclaims any liability or responsibility for loss or damage resulting from the use of OISD Standards/Guidelines.*
b) Bushing flange and transformer body

c) Terminal box cover and transformer tank body.

xviii) The operation of the "OFF LOAD" and "ON LOAD" tap changers on all the tap positions are satisfactory and the brake shoes of tap change motor are in order.

xix) The tap position indicated on the transformer and that on the control panel are the same.

xx) The oil level of tap changer tank is correct and oil has been tested for dielectric strength.

xx) The insulation resistance of control circuit wiring, transformer windings, and all the incoming and outgoing cables have been checked and found in good condition.

xxii) The valve in the cooling system and valve between the buchholz relay and the conservator tank are in open position.

xxiii) All the cooling systems including radiators, automatic starting and stopping of fans etc. are functioning properly.

xxiv) Transformer bushing surfaces are clean.

xxv) All the tools and other materials have been removed from the transformer vicinity.

xxvi) Foundation level is checked and the wheel stoppers are provided in position.

xxvii) Fire protection wall is provided between transformers, wherever oil quantity exceeds 2000 litres.

xxviii) The fire fighting equipment is provided.

xxix) Fencing and gate are provided as per IE Rule and earthed with earthgrid.

5.4 SWITCHGEAR

5.4.1) HT/LT/Panel

The following shall be checked/ ensured:

i) The lifting lugs provided on the panel are used for lifting and erection purposes.

ii) Wherever the switchgear room is situated above the ground level, provision for lifting and shifting the switchgear to this room is available.

iii) The clearances around panel are as per approved drawings.

iv) Number of exit/entry doors of switchgear room are as per approved drawings.

v) Panel is firmly bolted to the base plate which should be grouped properly.

vi) Panel is earthed with required number and size of earthing conductors.

vii) Panels are properly leveled and aligned in all directions.

viii) The tag numbers are prominently displayed on each panel on both front & rear sides, and that they match.

"OISD hereby expressly disclaims any liability or responsibility for loss or damage resulting from the use of OISD Standards/Guidelines."
ix) Danger board has been provided.
x) All panel doors fixing bolts are in position and tightened.
xi) Bus bar connecting links are firmly connected with suitable size and type of bolts.
xii) All connections are tight.
xiii) Bus bar insulation wherever provided is in good condition.
xiv) Bus bar support insulators and bushings are not having cracks/damage.
 xv) All the openings have been sealed.
 xvi) All gaskets are in position.
 xvii) Properly tested floor mats have been provided.
 xviii) Insulation resistance value of bus bars is acceptable.
 xix) Control wiring have been done as per approved drawings.
 xx) Relays have been mounted and connected properly.
 xxi) External and internal painting are in good condition.
 xxii) All components in panels are numbered as per approved drawings and connections ferruled.
 xxiii) Shock treatment charts in required number (in local language, Hindi and English) are prominently displayed in switchgear room.
 xxiv) Partition, safety shrouds, explosion vents etc. are in position/in good condition.
 xxv) Fire extinguishers of correct type and capacity have been provided, in required number.
 xxvi) Exhaust fan/ pressurisation system wherever provided are in working order.
 xxvii) Bus bar terminal shutters are in order
 xxviii) Unused holes are plugged properly to make panels totally.

5.4.2 HT/LT Breaker

The following shall be checked/ ensured:
i) Breaker rack-in-rack out system are in good condition.
ii) Shutter operates satisfactorily while circuit breaker is racked in and out.
iii) No parts of breakers is damaged. Bushings are without any cracks/damage and clean.
iv) Breaker is in fit condition for operation (oil level/SF6 pressure etc.)
v) Breaker interlock mechanisms are operative.
vi) All releases are provided and connected properly as per design drawings.

"OISD hereby expressly disclaims any liability or responsibility for loss or damage resulting from the use of OISD Standards/Guidelines."
vii) Alignment of fixed busbar contacts has been properly done with drawout contacts of breakers.

viii) Breaker contact resistance by milli volt drop test is within recommended values.

ix) Spring tension of female contacts (tulip) is in order.

x) Insulation resistance value of breaker is in order.

xi) Breaker operates satisfactorily in "TEST and SERVICE" position.

xii) In case of ACBs, arc chutes should be clean and properly fixed.

xiii) Breaker 'ON' - 'OFF' (Electrical & mechanical) indications are working.

xiv) Breaker carriage alignment is in order inside the cubicle.

xv) Breaker earthing contacts are in order.

xvi) Carriage contact system is in working condition.

xvii) Gaskets of panel doors and covers are in position.

xviii) Earthing bond between panel and door are provided.

xix) Oil level viewing glass of all doors are in position and clean.

xx) Tested oil is used for oil circuit breakers.

5.5 OUTDOOR SWITCHYARD EQUIPMENT

The following shall be checked/ ensured:

i) Structure (metallic)
   a) All foundations are ready and elevation levels are made as per drawings.
   b) Structures are fabricated as per design and are in good condition.
   c) Structures are erected in position maintenance safety clearances and all fasteners are tightened properly.
   d) Alignment of structure in order.
   e) Base of structure is plastered all sides and sloped for avoiding water accumulation.
   f) Earthing of structure is done (by strip welding, not by bolting) and connected to grid.
   g) Rust protection paint is applied wherever necessary.
   h) Identification colours for phases is marked on structure.
   i) Tagging of equipment is marked on structure for easy identification.

ii) Insulators
   a) Are of correct voltage rating.

"OISD hereby expressly disclaims any liability or responsibility for loss or damage resulting from the use of OISD Standards/Guidelines."
b) No cracks/damage/ and surfaces are clean.

c) Handled with care to avoid damage.

iii) Conductors and Bus bars

a) Are of approved design and specification.

b) Stringing is done using proper tools & checks.

c) Sag is maintained to have minimum tension under all weather condition and conform to required line and ground clearances.

d) Expansion joints, if any, on tubular bars, are in good condition.

e) Dead ends of tubular bus bars are sealed to avoid entry moisture, dust etc.

f) Proper fasteners are used for connection and termination.

iv) Protection

a) Overhead earth screen/mast is as per approved design.

b) Switchyard fencing and gate are provided as per IE Rules & Fences earthed and connected to earth grid at number of points (preferably by welding joints)

c) RCC cable trench shall have proper covers.

d) Stone jelly provided should be of proper size and thickness.

e) The water drainage of cable trenches is provided.

v) Lightning Arrestor

a) Voltage and current rating of arrestor match with the approved drawings.

b) Location and spacing between arrestors is as per approved drawings.

c) Height of grading ring above ground is as per approved drawing.

d) Explosion vent is directed away from adjacent equipment.

e) Porcelain surfaces are clean and not damaged.

f) Connections to earth do not pass through any metal pipe.

g) Earth connection from arrestor to counter is insulated from earth.

h) Separate earth pit has been provided for arrestor.

i) Insulation resistance value of arrestor is in order.

j) Line connection is made as recommended.

vii) CT & PT (Current & Potential Transformer)

a) The name plate details are as per approved drawings.

“OISD hereby expressly disclaims any liability or responsibility for loss or damage resulting from the use of OISD Standards/Guidelines.”
b) Insulator surfaces are clean and free from dust and not damaged.

c) Oil level (if applicable) is normal.

d) No oil leakage.

e) The connections are made properly.

f) Insulation resistance values of CT and PT are in order.

g) Explosion vents in housing of CTs/PTs are in good condition.

h) Identification colours for phases are marked on CT/PT units.

vii) **Isolator**

a) Name plate details are as per the approved drawings.

b) Clearances for isolators are as per approved drawings.

c) Clearances for isolators are as per approved drawing.

d) Clearances for isolator operating mechanism is in order.

e) Moving parts of mechanism are lubricated.

f) Interlock mechanism with earth switch, if any, is operative.

g) Interlock mechanism between isolator and circuit breaker such that isolator always operate only off load.

h) All three phases close/open simultaneously, including alignment of contacts.

i) Contact pressure is as recommended by manufacturer.

j) Isolators and operating handles and earthed properly.

k) Operating handle is painted red and earthing switch handle (if any) is painted green.

l) Line connections are tight.

m) Locking devices in open and closed conditions are in order.

viii) **Circuit breaker**

a) Circuit breaker base alignment of all the 3 poles.

b) Separate earthing for all the three poles.

c) No part of breaker is damaged.

d) Interlock mechanism.

e) Controlling cabling with marshaling box.

f) Gasket cover to be tightened, unused holes are to be closed.
g) Ensure weather/vermin proofing busbar connection and the stress free bus terminations.

h) Top up the oil to normal level

i) SF6 gas pressure

j) All the insulators must be thoroughly cleaned.

k) Base foundation bolts must be provided with grease to avoid rusting.

l) All explosion vents are not chocked/blocked.

5.6 BATTERY

The following shall be checked/ensured:

i) Name plate details and number of cells are as per approved drawings.

ii) Sufficient clearance is maintained around battery bank for ease of maintenance.

iii) Acid proof tiles have been provided (for lead acid batteries).

iv) An eyewash shower and wash basin are available nearby.

v) Voltage and specific gravity of all cells are as per manufacturer's recommendations.

vi) Cell terminal connections are tight and coated with petroleum jelly.

vii) Stand and cell insulators are clean.

viii) Wooden stands are painted with anticorrosive paint.

ix) Cell numbers are properly fixed to cells.

x) Float level indicators are free.

xi) Gas vents are provided and free from blockage

xii) Cells have not developed any crack/damage/leak.

xiii) Cells are mounted on treated wooden racks and insulated bases.

xiv) Suitable drainage has been provided for likely electrolyte spillage.

xv) Acid treatment chart is prominently displayed inside the room.

xvi) Cable connections are made with recommended lugs.

xvii) Alkaline batteries are not in the same room where lead acid cells are installed.

Note:

During installation of battery, appropriate Personal Protective equipment should be used.

5.7 LIGHTING EQUIPMENT & ACCESSORIES

The following points shall be checked/ensured:

"OISD hereby expressly disclaims any liability or responsibility for loss or damage resulting from the use of OISD Standards/Guidelines."
i) The area classification of the location.

ii) The installation and its components meet the requirements as set by the environmental conditions, and are appropriate to area classification.

iii) The installation conforms to approved drawings.

iv) The location facilitates maintenance of equipment.

v) The distribution box, circuit numbering and loading, are correct.

vi) Connectors are provided in junction boxes and fittings and are of antivibration design wherever necessary.

vii) Switch rating is adequate and as recommended by the designer.

viii) Fuse ratings of the circuits and protective devices are adequate and as recommended by the designer.

ix) All fasteners are provided and tightened (especially for flameproof fixtures) - safety features, such as separation sheets, fuse base screening interlocks, door switches, padlock facilities and pad locks, are in order.

x) No unauthorised site modification is done on flameproof enclosures.

xi) Outdoor lighting panel has weather protection (IP :55) and in provided with canopy wherever necessary.

xii) The gaskets are in position.

xiii) The cable glands are inspected for tightness.

xiv) The glands and lugs are used correctly according to feeder cable size.

xv) The earthing bus bar and cable earthing connections inside the distribution box are made properly.

xvi) The equipment external earthing from the earthing grid is made properly.

xvii) The lighting fixture is earthed externally with adequate size of GI wire (Minimum No. 10 SWG) wherever 2 core cables (in building etc.) are used. In case of usage with 3/4 core cables, 3rd/4th core of the cable should be used for internal earthing connection inside the lighting fixture - surface PVC conduit. the earth wire is run exterior to the conduit, without touching conduit, maintaining proper clearance.

xviii) The earthing resistance.

xix) The fixture is firmly supported.

xx) Support structure and poles are earthed and painted.

xxi) Unused entries are blocked with metallic grommets.

xxii) In flameproof enclosures, unused entries are blanked with flameproof threaded metal plugs.

xxiii) For open type wiring, only cable of recommended type is used.
5.8 CABLE

The following shall be checked/ensured:

1) Cable Laying
   a) Cable size, voltage grade and type should comply with Approved For Construction (AFC) drawings.
   b) Cable laying is done strictly as per Indian Standard.
   c) No damage arises to the cables during laying.
   d) Cable routing is planned to be away from heat sources, gas, water, oil, drains piping air-conditioning duct etc.
   e) Cables are identified close to their termination point, (Cable numbers are punched on aluminium straps 2 mm thick and securely fastened to the cable, wrapped around it) and also along the route at recommended intervals, by cable number tags.
   f) Cable route markers are provided in a permanent way at location of changes in the direction of cables and at intervals of not more than 30M and at cable joint locations.
   g) The concrete cable trenches are filled with sand, to avoid accumulation of hazardous gases and RCC covers of trenches in process area are effectively sealed to avoid ingress of chemicals and oil.
   h) As far as possible, each cable tray contains only one layer of cables and minimum required vertical clearance between racks is maintained.
   i) In the case of cables laid directly underground, the trench bottom is filled with a layer of sand and a protective covering of 75 mm thick second class red bricks then be laid flat, over the sand (Ref. Annexure No. 1 for typical section).
   j) Before covering with sands, every cable is given an insulation test and cable which proves defective is replaced.
   k) It should be ensured that all the cables (power, control, lighting and communication) are laid completely as per cable schedules and are tested for continuity.
   l) All wall openings/pipe sleeves are effectively sealed after installation of cables to avoid seepage of water inside building/lined trench.
   m) Where cables rise from trenches to motor, control station, lighting panels etc. these are taken through GI protection pipe sleeves ends of which should be sealed after cabling.
   n) Conduit ends above grade are plugged with approved weather proof sealing plastic compound.
   o) At road crossing and other places where cables enter pipe sleeves, recommended bed of sand and bricks are provided so that the cable do not slacken and get damaged at pipe ends. Metallic pipe ends should be bell mouthed.

"OISD hereby expressly disclaims any liability or responsibility for loss or damage resulting from the use of OISD Standards/Guidelines."
p) A separate earth strip is run along each cable tray. Equipment earthing is taken from the earth grid and not from the cable rack earthing.

q) Cables are clamped on trays using aluminium clamps at intervals not exceeding 3 meters.

r) Cable joints in power & control cables are avoided as far as possible. In case a joint is unavoidable, the following are ensured:
   - The number of joints is restricted to minimum.
   - The locations of joints are identified with permanent markers.
   - All joints in hazardous areas are preferably underground (especially for H.V. cables).
   - All joints are carried out as per cable manufacturer’s recommendation.

ii) Cable Termination

   a) Identification number tags of the cable for the equipment to which the supply is fed are provided correctly at both ends of the cable.

   b) The tag size is not less than 2 mm thick and 20 mm wide and of enough length to contain all required details.

   c) Cable termination is done with proper crimping lug and use of antioxidant paste.

   d) For cable glands of flameproof design, identification mark on the gland preferably embossing symbol as per IS should be available, and the required CMRS certification is verified.

   e) The ferruling on all terminations conforms to wiring drawings.

   f) Tightness of all terminations. (Confirm the bimetallic washer, if required, is correctly installed).

   g) Earthing connections and earth continuity are in order.

   h) Wherever lugs are used for termination, size of lug matches with cable core and material of lug is suitable for application.

   i) Proper mechanical protection for the cable is available.

   j) Pipes, if provided, are sealed on both ends.

   k) Bending radius is as per BIS standard.

   l) Before backfilling cable trench, the straight through joints of High Tension cables are tested for leakage current.

   m) Cable terminations are done as per the manufacturer’s instructions.

   n) Insulation resistance values between phases and phase to ground (after termination) in order.

   o) Cables near the termination are supported to relieve the strain on the terminals.

5.9 EARTHING GRID

"OISD hereby expressly disclaims any liability or responsibility for loss or damage resulting from the use of OISD Standards/Guidelines.”
The following shall be checked/ensured:

i) The earthing installation has been done in accordance with IS : 3043, approved earthing drawing and specifications.

ii) The earth mats should be provided as per the AFC (approved for construction) drawings.

iii) The main earth loop is laid at a depth of 500 mm below grade level. Wherever cable trenches are available, the earth lead is laid in the trenches, and firmly cleated to the sidewall of concrete lined trenches. The earthing strip is protected against mechanical damage in process unit areas, the earthing conductor is run along cable trays wherever possible. The earthing conductor is suitably cleated and electrically bonded to the cable tray at regular intervals. The earthing for equipment is tapped from the main earth conductor and not from the cable tray structure.

iv) All joints in the main earth loop are made in such a way that reliable and good electrical connections are permanently ensured. All joints below grade are welded and suitably protected by giving two coats of bitumen and covered with hessian tape. All joints above grade should be given two coats of bitumen to avoid oxidation and insulation film formation of the strip surface. However, if there are specific design guidelines are available the same will prevail to take care of corrosion problems and to ensure thereby good reliability of earthing connections.

v) When two earth strips are jointed by means of welding, lap welding with an overlapping of strip equivalent to double the width of the strip is available and all the four sides are continuously welded. All joints above ground are by means of connector/lugs. A minimum of two bolts of adequate size is used for this purpose.

vi) Conduits in which cables have been installed are effectively bonded and earthed. For this bonding, not less than 6 SWG wire and hose clip are used with brass or GI nut & bolt with min. 5 mm dia.

vii) Earthpit locations are identified by permanent markers.

viii) All earth electrodes are tested for earth resistance by means of standard earth test megger.

ix) Earth resistance of the grid or mat should be maintained sufficiently low and should meet ISI requirement.

x) The electrodes have a clean surface, not covered by paint, enamel, grease or other materials of poor conductivity. All earth electrodes are so located avoiding interference with road, building foundation, column etc.

xi) Individual earth electrodes are provided for each lightning arrester and lightning mast.

xii) In case of conveyors, the earth strip runs along the entire length of conveyor.

xiii) Disconnect facility is provided for the individual earth pits to check their earth resistance periodically.

xiv) All electrical equipment are doubly earthed in connecting two points on equipment to a main earthing grid. The earthing ring should be connected via links to several earth electrodes. The cable armour will be earthed through the cable glands for L.T. cables. For HT cable, the armour shall be brought out & connected to the earth bus.

xv) In hazardous areas, all major process equipments are connected to the earthing grid by means of welding or nut/bolt connections. In case of nut/bolt connections, spring and back

:"OISD hereby expressly disclaims any liability or responsibility for loss or damage resulting from the use of OISD Standards/Guidelines."
washers are used. All pipes are bonded and earthed on entering the battery limit of the process area.

xvi) The shield wire is connected with the main grid solidly and not through supporting steel structures. All paint, scale, and enamel is removed from the contact surface before the earthing connections are made.

xvii) All earthing connections for equipment earthing are taken from the earth plate mounted above ground, wherever provided.

xviii) Anchor bolts or fixing bolts are used for earthing connection.

xix) All hardware used for earthing installations are hot dip galvanised or zinc passivated. Also spring washers are used for all earthing connections of equipment.

xx) Lighting fixtures and other LT equipment are earthed through the extra core provided in the cable for this purpose.

6.0 EQUIPMENT USED IN HAZARDOUS AREA

The following shall be checked/ensured:

i) Apparatus is appropriate to area classification.

ii) Surface temperature class is correct.

iii) Apparatus sub group is correct.

iv) Apparatus carries the correct circuit identification (apparatus should be positively identified with its circuit to ensure that correct isolation can be carried out).

v) Enclosures, glasses and glass/metal seals are satisfactory.

vi) Machined surfaces are free from corrosion, dirt and paint.

vii) Clearances or gaps are as per approved standard.

viii) There are no unauthorised modifications.

ix) Bolts, glands and stoppers are complete and tight.

x) The equipment is free from dust, dirt and shall be painted if necessary.

xi) All conduits runs and fittings are tight and free from corrosion.

xii) Earthing is made as per standard IS : 3043

xiii) Condition of enclosure gaskets is satisfactory.

xiv) Electrical connections are tight.

xv) Motor fans & couplings are not rubbing on cowls guards.

xvi) Lamp rating & type are correct.

xvii) Wherever compound filling is required, it should be as per installation drawings.

xviii) There is no leakage of compound from stopper or cable boxes.

"OISD hereby expressly disclaims any liability or responsibility for loss or damage resulting from the use of OISD Standards/Guidelines."
xix) There is no damage to cables, cable sheaths or cable glands (Particular attention should be paid to flexible cable used with portable apparatus).

xx) Apparatus is properly protected against corrosion, weather, vibration & other adverse factors.

xxi) Guards, where used, are available in correct position.

xxii) Supporting arrangements are strong and adequate.

7.0 TEMPORARY ELECTRICAL INSTALLATIONS

Check that temporary installation conforms to safety requirements and additionally complies with following recommendations.

i) Load requirement of temporary installations is firmly established and that the load drawn at the times is well within capacity of temporary installations. Maximum permissible no. of welding machines to be connected from individual outlet shall be such that the total connected load shall not exceed the rating of the outlet.

ii) Properly sized plug socket are used to cater the load requirements. All electrical gadgets used shall be of industrial type only and no domestic type shall be used.

iii) Earthing is provided for all portable/static equipments as per IS 3043. In case of 3 phase temporary panels double earthing is to be provided. If required, separate earth pits to be made and resistance recorded. Properly sized not less than No. 8 SWG GI wire shall be used.

iv) Periodical monitoring of load is done to ensure compatibility with switch rating/ cable sizing.

v) Only HRC fuses shall be used and not rewireable type.

vi) Local isolation is accessible and phase and earth can be simultaneously isolated.

vii) Voltage rating of supply matches with safety requirements as stipulated in Factory Rules. For example, when working inside vessels or at heights etc. voltage of electrical appliance shall not be more than 30 volts. In case higher voltage is necessary, isolating transformer shall be used which should have primary and secondary both physically and electrically isolated.

viii) All electrical appliances are properly protected against rain, water, dust etc.

ix) Portable equipment are transported from one site to another only after it is disconnected electrically.

x) Only approved make of switchboard shall be used.

xi) In case the duration of temporary installation exceeds 3 months, approval of schemes for installation shall be obtained from statutory authorities.

xii) Length of flexible wire shall be limited to maximum 30 mts. and there shall be no joints in this length.

xiii) 2 core wires shall be used only for 24 volts and above this voltage, 3 core wires shall be used (P,N & E)

xiv) Whenever portable equipment are used, provision of ELCB shall be considered.

"OISP hereby expressly disclaims any liability or responsibility for loss or damage resulting from the use of OISP Standards/Guidelines."
xv) Three-phase power supply connection in LT system should be through 3-1/2 core cables. However in case of LT system having single-phase loads connection should be through 4 core cables.

xvi) Before energising the installation, the engineer-in-charge or his authorised representative should certify the soundness of installation, after conducting prescribed tests as per I.S./I.E. Rules.

Note:
Temporary installations cover construction Power requirement also.

8.0 DOCUMENTATION

i) The installation of equipment shall not commence without keeping ready the following basic documents:
   a) All approved for construction (AFC) drawings (including layout, single line diagrams etc.)
   b) All approved vendor drawings for equipment and foundations (including schematic, inter connection & wiring drawings)
   c) Statutory clearances from the Chief Electrical Inspectorate/DGMS/CEA, CCE as applicable.
   d) Test certificates from the manufacturer for having successfully conducted all the prescribed tests at the manufacturer’s works (dually certified by owner’s Inspector).

ii) The installation after completion shall not be energised without keeping ready the following basic documents:
   a) All the field test reports with satisfactory test results as specified in the I.E. Rules/IS/Technical specifications (dually witnessed and certified by owner’s Inspector).
   b) Completion report from the licensed contractor in the prescribed format given in IS.
   c) Statutory clearances from the Chief Electrical Inspectorate/DGMS/CEA etc. as applicable, for energisation of installation along with duly approved drawings.
   d) As-built drawings incorporating all field modifications/revisions.
   e) Protective Relay settings (supported by the basic calculations to arrive at these settings).
   f) Operation/maintenance instruction manuals and list of recommended spares.

9.0 MISCELLANEOUS

The following recommendations shall be adhered to:

i) Fasteners
   a) Nut-bolts : Cadmium coated MS bolts : Copper, GI

*OISD hereby expressly disclaims any liability or responsibility for loss or damage resulting from the use of OISD Standards/Guidelines.*
b) Washers: Tinned copper, Cadmium coated MS; GI

c) Strips: Copper, GI

d) Clamps: GI, Aluminium, Copper, Aluminium alloy

e) Flexible: Tinned copper connection

f) Lugs: Copper, Aluminium, Bimetal

g) Screws: Brass

ii) Lifting Tackles

a) All lifting tackles shall be suitable for the application under consideration and tested before use. Chain pulley blocks shall be well lubricated and tested before use.

b) EOT cranes shall be tested for proper operation and load tested before use.

iii) Insulating Materials

a) Tapes

Shall conform to relevant IS Standards.

Voltage rating of tape shall be suitable for the application.

Number of layers of tape shall be as per the requirements of Voltage level and environmental conditions.

Tapes PVC, Fibreglass, Polyester, Cotton silicone, Empire (material) and with waterproof/fire resistant characteristics.

b) Sheets

Shall be of bakelite DMC, SMC, fibreglass.

c) Sleeves

PVC, Fibreglass, Silicon, rubber, Heat shrinkable sleeves.

d) Compounds

Bitumen, Epoxy, Plastic, Silicon

e) Varnish

Class B/F, of air drying type, Baking type, Stress grading, Varnish

10.0 REFERENCES

The following codes, standards, and publications have either been referred to or used in the preparation of this document and the same shall be read in conjunction with this document:

1) OISD-STD-137 (Inspection of Electrical Equipment)

"OISD hereby expressly disclaims any liability or responsibility for loss or damage resulting from the use of OISD Standards/Guidelines."
2) OISD-RP-146 (Preservation of Idle Electrical Equipment)

3) OISD-RP-148 (Inspection and Safe Practices During Overhauling of Electrical Equipment)

4) National Electrical Code NEC-1985 of BIS.

5) Bureau of Indian Standards (BIS)
   IS:900

6) Indian Electricity Rules – 1956

7) IEEE regulations

8) API Recommended Practices

9) Instruction manuals for manufacturers.

"OISD hereby expressly disclaims any liability or responsibility for loss or damage resulting
from the use of OISD Standards/Guidelines."
ANNEXURE-I
(TYPICAL SECTION OF CABLE TRENCH)

Typical Section With H.T. & L.T. Cables

NOTE
1. LEAVE SPACE FOR LATER ADDITION OF AT LEAST 2 CABLES OR 15% AVERAGE SPARE SPACE REGARDLESS OF EXPANSION.
2. IF TELEPHONE CABLES ARE Laid IN THE SAME TRENCH, A CLEARANCE OF 300 MM SHALL BE PROVIDED BETWEEN POWER AND TELEPHONE CABLES.

(DIMENSIONS IN MILLIMETRE)