

TECHNICAL SPECIFICATION FOR LIVE-LINE MAINTENANCE

PACKAGE: 14-01

**(ONLINE –ON SITE TRANSFORMER OIL DRYING, DE-SLUDGING AND RE-REFINING”
WORK FOR TRANSFORMERS)**

(1). Prior to handing over the power transformer for online process, Minutes of meeting prior to start the work shall be prepared & test results of transformers and transformer oil before commencing the work are to be recorded viz. IR, Tan delta of windings, bushings, oil parameters as per IS: 1866-2000 & DGA. By engineer in charge

(2). Before and after online process, oil samples shall be tested at any NABL OPTCL Oil testing Lab and should meet the relevant IS as mentioned below.

SI No	Name of Test	Method of test as per IS / IEC / BS
1	Appearance of oil	IS 335-1993
2	Density at 29.5° C	IS 12463/1988
3	Kinematic Viscosity at 27° C	IEC-296
4	Inter facial Tension	BS-148
5	Flash Point.	
6	Pour Point.	
7	Neutralization value	
8	Break down Voltage	
9	Dielectric Dissipation factor (Tan Delta) at 90° C.	
10	Specific resistance (Resistivity) at 90° C	
11	Water contents (ppm)	
12	Sediment & Sludge (% by Weight).	
13	Dissolved Gas Analysis (values Quantity in PPM) Carbon Monoxide Methane Carbon Dioxide Ethane Acetylene Oxygen Nitrogen Hydrogen Ethylene	

(3). Thereafter agency has to start the Online – On site conditioning process in presence of concerned Engineer In charge (TR).

(4). Before connecting the Plant with the transformer, all inlet / outlet arrangement should be clearly specified. The specific safety measures taken to prevent damage / inadvertent tripping of the transformer are to be specified.

(5). Shut down of transformer will be arranged by OPTCL for initial connection, disconnection of valves, hose pipes etc and also for testing to judge improvement of different parameters.

(6). The oil refining plant must have all automatic safety features to maintain oil level , oil temperature etc.

(7). The plant should have over load, over voltage, under voltage protection facilities in it's control panel.

(8). In case of abnormality or deviation in the safety features the inlet and out let valves should shut off automatically not to harm smooth running of transformer.

(9). After confirming that the test results of oil are achieved as per OPTCL's requirement / acceptable values, the on line process will be stopped. After completion of the process if at all, the fresh oil is required to top up in the Transformer, same will be provided by OPTCL free of cost.

(10). The power supply for Online Transformer conditioning unit will be provided free of cost by OPTCL.

(11). Daily log sheet of work done / events to be recorded & maintained.

(12). Safety Precaution of machine shall be controlled with automatic operation. Safety feature to be available are.

(a). Automatic oil level control in Transformer & conservator tank through pressure transducer control of oil at inlet & outlet of machine.

(b). Oil flow control should automatically trip the oil processing plant if leakage is observed.

(c). Check of oil water content in ppm should be available on control panel of machine.

(d). Adequate fire safety equipment shall be available with machine.

(e) The oil refining plant should have sufficient good quality of oil so that the oil level in transformer conservator does not get reduced while initial starting of the plant. Necessary Oil will be supplied by OPTCL.

(f) The technician and operators who will run the oil processing plant round the clock will be allowed to camp near the substation.

13. REQUIREMENT OF OPTCL:

Successful bidder has to continue the above process till following technical parameters of transformer & transformer oil are achieved.

(A). Transformer:

Electric strength (BDV) KV (rms): More than 70

Water content, ppm: Max. 10

Neutralization value mg KOH/g of oil: Max. 0.1

Sediment & sludge, % by wt: Non detectable

Dielectric dissipation factor at 90° C: Max. 0.1

Specific resistance at 90° C, Ohm.cm: Min. 50×10^{12}

Interfacial Tension, mN/m at 27° C: Min. 30

Flash point, ° C: Min. 140

Gas content < 0.01 (as per IS: 9434-1992)

(14). OPTCL will carry out low voltage site tests before & after on line process along with Tan delta of bushings & windings, SFRA in presence of your authorized technical expert.

(15). After satisfactory completion of work bidder has to submit detail report of on line conditioning process to concern engineer in-charge. The report shall include comparison of results of various parameters of transformer & transformer oil before & after work done, analysis, hard copies of Lab test results etc.

**TECHNICAL SPECIFICATION FOR LIVE MAINTENANCE WORK IN
EHT TRANSMISSION LINE AND SUB-STATIONS**

PACKAGE: 14-02

1.0 SCOPE. The Scope of work includes performing live line maintenance work on energized overhead transmission line and substation, voltage ranging from 33kv to 400kv to upgrade and maintain high voltage transmission system components while still in operation. In some circumstances this may be the only possibility, aside from customer or system disconnection. While performing live line maintenance work, the following recommendations based on sound engineering safety principles and extensive field experience shall be adopted by the firms.

Live Line work is to be carried out by line workers who have been trained in working live line / energized lines. A work procedure shall be developed prior to the start of any work and understood by all team members and include the work environment. All crew members must be competent and capable of performing their share of the work

1.1 INTERPRETATIONS: The stated interpretations for the following words shall be applied throughout this chapter:

(1) "May" - Permissive choice.

(2) "Shall" or "Must" - Mandatory under normal conditions.

(3) "Will" - Mandatory, but allowing the responsible employee or party some discretion as to when, where, and how.

(4) "Should" - Advisory. These statements represent the best advice available at the time of printing.

(5) Male pronouns and related terms are used to reference both male and female employees.

1.2 ACCEPTANCE TEST - The required testing provided by the manufacturer of the product in accordance to relevant standards applicable/permitted in India. Acceptance tests shall be specified as a requirement and ensures the performance of tools and tackles used in live line maintenance work.

1.3 BARE HAND TECHNIQUE - Live-line work is performed by placing the worker at the same potential as the conductor/ equipment while maintaining the required clearances from the energized conductor/equipment to ground.

Bond - The electrical interconnection of conductive parts designed to maintain a common electrical potential.

Cable Cart - A metal or metal-lined, open-topped platform equipped with weight-bearing conductive wheels, capable of being attached to power line conductors, and used to transport workers along the conductors.

Certified (employee, craftsman, or professional) - One who possesses a certificate, or has been certified by a recognized authority, attesting that he has been trained or tested and has demonstrated proficiency in performing live-line work.

Conductive Clothing - Metallic or metal-impregnated-cloth protective clothing worn by electrical workers for protection from electrostatic effects of high-voltage energized conductors and equipment.

Damage - Loss in value, usefulness, etc., to property or things. Harm causing any loss.

Defective - An item no longer suitable for the purpose for which it was intended.

Energized - Electrically connected to a source of potential difference, or electrically charged so as to have a potential different from that of ground.

Grounded - Connected to earth or to some conducting body that serves in place of the earth.

Hazard - Anything which can potentially endanger personnel, impairs safe working conditions, and conceivably causes injury or loss of life.

Hot Line Order (capitalized) - Is a statement with documentation from an Operations Supervisor to a Job Supervisor that the automatic reclosing is turned off and that the equipment covered by the Hot Line Order will not be intentionally reenergized until contact has been made with the job supervisor holding the Hot Line Order. This allows specific work to be done on or near a line or other equipment without requiring that it be disconnected from all sources of electrical energy. The equipment is to be considered energized or “hot.”

1.4 HOT STICK TECHNIQUE - Live-line work performed by a worker placed at ground potential while maintaining the required electrical clearances from ground to the energized conductor/equipment.

1.5 INSULATED AERIAL DEVICE -Vehicular-mounted articulating or telescoping boom-type personnel lift device equipped with fiberglass boom section(s) for insulation and metal-lined fiberglass bucket(s) or metal platform for personnel support, designed, constructed, tested, and certified in accordance with ANSI A92.2, “Vehicle Mounted Elevating and Rotating Work Platforms.”

1.6 INSULATED LIVE-LINE TOOLS -All hand-held and structure-mounted tools having an insulated section or nonconductive property that is designed, tested, and approved for contact with energized conductors.

1.7 JOB HAZARD ANALYSIS - A study of a job or activity to 1) identify hazards or potential accidents associated with each step or task and 2) develop solutions that will eliminate, modify, or prevent such hazards or accidents.

1.8 JOB SUPERVISOR - Any person authorized to request, receive, and release Clearances of Hot Line Orders and who is charged with the responsibility for the job.

1.9 ADMINISTRATIVE REQUIREMENTS:

(i) General. Each employee involved in live-line maintenance activities is responsible for being knowledgeable in the applicable safety requirements and proper live-line procedures. Managers and supervisors are responsible for ensuring that each worker complies with these guidelines and procedures.

(ii)Hot Line Order. Live-line maintenance shall be performed under an authorized Hot Line Order (HLO) and all associated automatic reclosing devices shall be deactivated and properly tagged. Work or tests shall not be performed on protective relays, control circuits, or communications systems which could result in a loss of control or disabling of circuit breakers involved in the HLO or a loss of communications between crews and the operations center.

(iii)Electric Storms. Live-line work shall be discontinued while there is any indication of lightning or other inclement weather in the surrounding area.

(iv)Written Procedures. A written procedure shall be available for each type of live-line maintenance performed. Each written procedure shall specify the minimum crew size required by classification, the principal tools to be utilized, and each major step in the procedure to be performed. Procedures shall be periodically reviewed or updated to reflect current work practices, safety concerns, and new equipment. The specific written procedure for the live-line maintenance to be performed shall be available to the crew at the tailgate safety meeting. This procedure will be discussed before performing the live-line maintenance. Live-line maintenance must not be attempted with less than the minimum number of qualified personnel

as stated in each written procedure. A written Job Hazard Analysis (JHA) is required for live-line maintenance. A JHA is an integral part of the preparation for live-line work, and as such, it shall be reviewed and discussed prior to engaging in the live line work. Changes to the written procedure made during the work shall be developed through discussion among experienced craftsmen and supervisory personnel.

(v) Supervision. Live-line maintenance shall be monitored by a supervisor or acting supervisor trained and certified. The supervisor shall observe and direct the work while maintenance is being performed and is to remain on the jobsite in nonworking status and pay strict attention to the on-going procedural activities while procedural live-line work is being done. The supervisor shall be aware of the physical and mental condition of each crew member. No one, including the supervisor, shall be allowed to work in a condition that could jeopardize the safe operation of the crew or equipment.

(vi) Craftsmen Instruction and Certification. Only certified personnel shall perform or supervise work on energized lines or equipment. Certification for live-line work should ensure that an individual is not only knowledgeable but also competent in performing work on energized equipment.

(1) Certification. Certification is required for those performing the bare hand or hot stick technique.

(2) Physical Condition. Craftsmen shall pass an annual physical examination for performing live line maintenance work.

(vii) **Workman compensation:** Safety and work man compensation insurance is completely under the scope of the bidder.

2.0 LIVE-LINE MAINTENANCE. Live-line maintenance does not include such activities as switching, hardware tightening, climbing inspection, hole digging, pole setting, conductor stringing, etc.

(i) Live-Line Tools - Equipment used in live-line maintenance procedures including but not limited to hot sticks, pole gins, switching sticks, and insulated ladders.

(ii) Minimum Electrical Approach Distance - The minimum working distance from energized conductors and equipment for personnel. This includes:

a) The minimum approach distance to be maintained by workers and objects carried by them (except insulated live-line tools) from energized conductors and equipment.

b) The minimum distance workers shall maintain themselves and their support platforms, or be maintained by other means, from grounded parts or other energized conductors or equipment when approaching, leaving, or bonded to an energized conductor or piece of equipment.

c) The minimum distance any piece of mechanized equipment may be set up or operated from an energized conductor or piece of equipment by other than properly trained and supervised O&M personnel.

(iii) Nonconductive Rope - A flexible rope of twisted or braided synthetic polymer fibers maintained in a clean dry condition for use in conjunction with live-line maintenance. Nonconductive ropes can be used as hand lines or taglines. Bidders have to specify the breakdown voltage of the ropes used.

(iv) Non-destructive Evaluation (NDE) - Determination of the condition of a product without over-stressing or deteriorating any feature or component part of the product. Some of the

accepted NDE methods are X-ray, ultrasonic, magnetic particle, dye penetrant, dielectric, load-deflection, and acoustic emission.

(v) Procedure - A particular course of action or way of doing live-line work.

(vi) Safety - The art of performing any activity in an accident-free manner.

(vii) Structure - Material assembled to support conductors or associated apparatus used for transmission and distribution of electricity.

(viii) Worker - Any person authorized to inspect, service, repair, or otherwise be in contact with equipment. The term normally applies to a craftsperson rather than an “engineer,” “inspector,” or “supervisor.”

(ix) **General requirement:**

(a) Line workers doing energized line-work should have satisfactorily completed a formal training course of instruction. Records of training or work experience should be provided and maintained.

(b) Whenever workers are exposed to electric fields, shielding should be provided as required.

(c) A well-developed set of formal, written work rules should be provided for safe implementation of energized line maintenance. All personnel should be familiar with these rules.

(d) Procedures should be continuously examined and updated to take advantage of new equipment, and lessons should be learned during use of present procedures and work methods.

(e) The condition of conductors, tie wires, and insulators should be carefully checked for signs of burns or other weaknesses. When such defects are found, extra special care should be taken while doing the work. Workers at ground level should stay clear of the area underneath the work area to the extent possible.

3.0 HOT STICK TECHNIQUE

(i) Operating Practices. Workers and support equipment (ladders, aerial device, wood structure members, etc.) used in the hot stick technique shall be considered to be at ground potential. Insulated ladders and booms do not require preoperative dielectric tests. Prior to performing the hot stick technique, the supervisor or other designated person shall

a) obtain and read the HLO and

b) determine there is adequate phase-to-phase and phase-to-ground climbing and working space for the voltage being worked. The insulated tools shall be cleaned and marked for the voltage being worked. Actual measurements should be used to determine the location of grounded and energized parts in the vicinity of the proposed work.

(ii) Minimum Approach Distances. Personnel at ground potential shall keep themselves and objects they carry (except insulated live-line tools) outside the minimum approach distances specified in relevant IS.

(iii) Insulator Replacement.

Non polymer Insulators. The decision to replace insulators is usually based on visible damage such as cracks, breaks, or electrical flashover. Broken skirts and “cobs” will often have an insulation value but should be considered electrically defective until tested. On the other hand, insulators that do not show mechanical damage may fail electrically. So, tension insulator strings (dead-ends and suspension points) shall be tested to ensure that electrically defective insulators are identified prior to replacement using the hot stick technique.

Hot stick Maintenance in Substations. Live-line hot stick techniques are permissible in substations where the minimum approach distance can be maintained as per relevant IS.

4.0 BAREHAND TECHNIQUE

Operating Practices. Bare hand work involving hot stick techniques shall comply with section 5. Workers using the bare hand technique shall be considered to be at the potential of the energized circuit when in the working position and must maintain the required minimum approach distances. Prior to performing the bare hand technique, the supervisor or other designated person shall 1) obtain and read the HLO and 2) determine there is adequate phase-to-phase and phase-to-ground climbing and working space for the voltage being worked. The insulated tools shall be cleaned, and the insulated ladders shall be tested prior to use. Actual minimum approach distance measurements should be used to determine the location of grounded and energized parts in the vicinity of the proposed work. Prior to suspending insulated ladders, support platforms, or conductor carts from overhead ground wires or conductors, the conductor shall be inspected for damage such as worn suspension fittings, etc. Prior to using the traveling ladder, inspect the static attachment points on the adjacent structures and install safety grips. When it is necessary that an engineer or other specialist participate in a specific test or inspection program involving the use of insulated personnel-support equipment, the engineer or specialist must be accompanied by a certified craftsman and must have received sufficient instruction to perform the inspections and/or tests safely.

(A) INSULATED AERIAL DEVICES. Aerial devices shall have the minimum dielectric strength required for the voltage being worked. Insulated aerial devices used in the bare hand technique shall comply with the following requirements:

(1) Aerial device equipment shall be manufactured for performing live-line maintenance and shall only be used according to manufacturer's instructions.

(2) In order to prevent arcing across a vacuum space in a hydraulic line, all insulated aerial devices with hydraulic lines to controls at the platform or bucket shall be equipped with check valves in the lines and an atmospheric relief valve in the hydraulic system at the support platform. When the boom is in an energized attitude, the engine shall not be shut down nor the hydraulic pump disengaged.

(3) The hydraulic system of the vehicle may be used to power hydraulic tools at the support platform if it conforms to ANSI A92.2 1990 standards or other relevant standard. Hydraulic driven tools used from insulated aerial devices shall be maintained as part of that aerial device's hydraulic system and not used from other hydraulic systems.

(4) Hydraulic lines for use with hydraulic tools shall neither be built into nor attached to the outside of the insulated boom portion of aerial device equipment.

(5) The support platform of insulated aerial devices may be single or double fiberglass buckets or a single metal platform equipped with an approved open-rail system. Fiberglass buckets shall be metal lined with the liners bonded together on double-bucket equipment. Fiberglass buckets shall not be considered an insulator when using the bare hand technique.

(6) The use of a permanently installed current monitor is recommended for monitoring leakage current in the boom during the bare hand technique. An ammeter, calibrated in 10-microampere (or less) scale divisions, shall be kept with the insulated aerial device. The ammeter shall be tested annually with a certification of the test attached to the meter or its case.

(7) Metal-lined buckets and platforms shall be furnished with a minimum of two bare hand bonding leads. A spring-loaded breakaway clamp shall be attached to each bonding lead.

(8) Insulated aerial devices shall be annually inspected and tested in accordance with appendix C.

(9) A minimum approach distance table reflecting the minimum approach distances shall be printed on a plate of durable nonconductive material mounted so as to be visible to the operator of the boom.

Preoperative Tests. Before raising the insulated aerial device into the work position, all controls (ground level and bucket or platform level) shall be checked. In addition, for insulated aerial devices with hydraulic lines to controls at the support platform level, the support platform shall be raised to its maximum height and left in the raised position for 5 minutes for the hydraulic leak down test. Initial contact of an energized conductor shall be made with no one on the support platform or bucket so that the leakage current in the boom may be measured. No one standing on the ground shall be in contact with the vehicle while the leakage current test is being made. The leakage current reading shall be taken while standing on the vehicle before starting the work. A written record of these tests shall be maintained with the equipment.

Safety Procedures. When working on the platform, both legs shall be inside the support platform at all times with at least one foot on the bottom of the support platform. Personnel shall be belted to the aerial device. All work at elevated heights must adhere to fall protection requirements. One person, capable of operating all controls, shall be stationed on the ground near the vehicle when personnel are on the support platform. This person shall keep other persons from walking under the work area and keep them clear of the vehicle when the support platform is elevated. All movements of the lift assembly shall be controlled by the workers when they are on the support platform, except under emergency conditions. Under these emergency conditions, the ground operator shall mount the vehicle by means of an insulated device or such that he does not simultaneously contact the vehicle and ground. No one on the ground shall be in contact with the vehicle or protective ground cable while the support platform is in an energized position.

Minimum Approach Distances. A nonconductive measuring device shall be readily accessible to assist employees in maintaining the required minimum approach distance. When approaching energized equipment from an aerial device the distance between the worker envelope and any part of the un-insulated section of the boom must be greater than or equal to the minimum phase-to-ground distance

(1) When a worker is accessing the outside phase of a structure, from the outside the distance between the worker envelope and any part of grounded equipment, must be greater than or equal to the minimum electrical approach distance.

(B) INSULATED LADDERS. Insulated ladders may be used as personnel support for live-line maintenance using the bare hand technique on energized conductors and equipment with a phase-to-phase voltage rating of 33kv to 400kv, provided minimum distances specified are maintained. Only ladder sections made of FRP shall be used as insulated ladders in live-line maintenance using the bare hand technique.

Preoperative Tests. Insulated ladders shall be tested for leakage current at the beginning of the day, each time a higher voltage is to be worked, and when additional tests are needed. A fused and protected micro. Ammeter shall be used for testing the dielectric current through the ladder legs with each leg bonded together at the metering point. If the measured dielectric ladder-current, after one minute, is less than 1/3 microamperes for each kilovolt of nominal phase-to-ground voltage (refer to table below, rounded up to the nearest 10 μ A), the insulated ladder may be used for bare hand work.

Voltage (kV) Phase-to-Phase	Voltage (kV) Phase-to-Ground	Acceptable Dielectric current (μ A) for Insulated Ladders $\mu = 10^{-6}$
72.6 - 121	67	less than 30
138 - 145	80	less than 30
161 - 169	93	less than 40
230 - 242	133	less than 50
345 - 362	200	less than 70
500 - 550	318	less than 110

Minimum Approach Distances. If the structure does not have the minimum total approach distance required by the following, the line must be worked by the hot-stick method or worked de-energized. The insulated ladder shall be secured and positioned to provide (at least) the minimum phase-to-ground distance plus a worker envelope that allows for the worker. This distance varies and is dependent on the access procedure performed.

Usage. A craftsperson on the insulated ladder may use a live-line tool attached to the energized conductor or piece of equipment to help guide himself to and from the bonding position. The live-line tool shall be removed when the worker is bonded to the energized conductor or piece of equipment. Neither the energized end of the insulated ladder nor the worker shall be solidly fastened to a conductor, insulator string, or other component so that in the event of an accident the worker may be pulled free without having to aid in his own rescue. Before working on an energized conductor or piece of equipment, the worker on the insulated ladder shall bond his conductive clothing to the conductor or piece of equipment by means of a spring-type breakaway clip attached to a conductive clothing bonding lead. Additionally, if two workers are working at the same location on an insulated ladder, they shall bond their conductive clothing together. Once the worker is bonded to the energized conductor or piece of equipment, tools may be passed to the worker only after the tools are touched to the energized conductor or piece of equipment.

Nonconductive Rope-Supported Platforms. Nonconductive rope-supported platforms may be used as personnel support for the bare hand technique. For ladders mounted in a fixed position between an energized phase and ground, the clear length of the ladder between the support bracket and the point of contact with the phase must be the minimum approach distance **plus 2.4 meters (8 feet)** before the worker can transfer on to the ladder. The ladder must not be attached to the point of contact (energized end) but fully supported from the structure (de-energized end) only.

Insulator Replacement.

Non-polymer Insulators. The two types of non-polymer insulators used in transmission lines are porcelain and glass. Porcelain insulators have a coloured surface and when chipped leave a white surface whereas glass insulators are translucent, and have a tendency to shatter rather than chip. The decision to replace non-polymer insulators is usually based on visible damage, such as cracked or broken skirts or electrical flashover. Broken skirts and “cobs” will often have an insulation value, but should be considered electrically defective until tested. On the other hand, insulators that do not show mechanical damage may fail electrically. Although this predominately occurs in tension insulator strings, all insulators shall be tested for bare

hand work to ensure that electrically defective insulators are identified prior to replacement. Post-type and multi net porcelain horizontal struts can usually be tested with a single-prong tester. Replacement porcelain or glass insulators should be electrically tested prior to installation.

Polymer Insulators. All polymer insulators must be visually inspected for carbon tracking and audibly inspected for corona, particularly at the interface of the polymer rod and the insulator skirt. If there is indication of carbon tracking, severe mechanical damage, or corona, bare hand maintenance will not be permitted. Replacement of non-polymer insulator strings with new polymer assemblies is an acceptable live-line practice (note: The electrical and mechanical characteristics should be coordinated with A2200, Division of Facilities Design).

Bonding and Static Ground Leads. Personal safety in bare hand maintenance can be critically impaired by improper restraint of bonding straps and static ground leads. It is essential that excessive strap and lead length be restrained.

Conductive Clothing Bonding Leads. Conductive footwear and clothing shall be worn in prior to starting of the work. Storage pockets are provided for the unused bonding lead. The accidental dropping of a bonding lead could cause a flashover when working in confined areas while in an energized condition or when on a grounded feature above energized facilities. The spare bonding lead shall be rolled up and taped before being placed in the storage pocket. The bonding lead being used shall be maintained in the shortest length practicable for the specific working conditions by either rolling or taping or by “knotting” any unneeded length. Bonding straps and connections shall be inspected before use. At least one bonding strap shall remain attached to the energized conductor or piece of equipment while work is being performed. If more than one person is involved in the work, clothing bonds shall be tied at an equal potential location or the personnel shall be bonded together. When installing a conductor repair sleeve or splice, workers shall be bonded to each side of the work area but this will never substitute for a temporary current-carrying jumper at the work site.

Support Platform Bonding. The bucket or platform used as a support platform on an insulated aerial device is normally bonded to the energized conductor or equipment by means of metallic braid bonding straps. Also, a wand bonded to the support platform is normally used for initial energization and de-energization of the support platform at the higher voltages. The length of the bonding straps and the wand shall not extend below the bottom of the support platform, if dropped.

Live-Line Tool Bonding. If energized conductors or equipment are to be left supported by insulated live-line tools overnight or longer, and rope or nylon straps are an integral part of such suspension, the drop in potential across the nylon or rope may cause deterioration and burning of the nylon or rope.

Static Ground Lead Bonding. When shunting the cold-end insulator in dead-end insulator strings, the shunt cable may be long enough to cause a flashover if dropped. The shunt shall always be kept in a tool bag when not in use. Extra shunt cable shall be rolled up and securely taped during use.

Conductor Repair and Splicing. When installing a repair sleeve or splicing an energized conductor under a HLO, the jumper and attaching hardware must have a minimum rating of the expected current on the conductor that day. The supervisor working with the dispatcher will establish a current limit to be placed on that line until the splicing is completed.

(C) BARE HAND MAINTENANCE IN SUBSTATIONS: Live-line bare hand techniques are permissible in substations where the minimum approach distance can be maintained in accordance relevant standard.

Equipment will be used in accordance with the following basic minimum requirements:

(1) Equipment Grounding. The equipment being used as a fixed-base support for the insulated ladder shall be grounded in accordance with relevant standard.

(2) Preoperative Tests. Dielectric ladder-current tests are required for ladders used in the bare hand method.

(3) For work at the energized terminal end of a bushing on a circuit, the support platform must be positioned so that none of the bushing insulation is shunted by the support platform, with distances from grounded parts and other phases not less than specified minimum approach distance.

**TECHNICAL SPECIFICATION FOR LIVE LINE INSULATOR WASHING
IN EHV TRANSMISSION LINE AND SUB-STATION**

PACKAGE: 14-03

(Live line insulator washing in EHV sub-station & transmission lines)

For Live line washing only demineralized (DM) water is to be used having volume conductivity of less than 10 micro mho per cc. The bidder has to arrange necessary DM water and all other T&P (water tank, hot line washing machine & nozzle with the specified hose pipe including leakage current monitor kit to be connected in series with the jet) required for the process.

The DM water is to be released from adequate distance through a nozzle from the live part with sufficient pressure (500 to 1500psi) in such a way that the jet moves in the form of small discontinuous particles (aerosol) resulting in zero leakage current (limiting value of leakage current is 1 millionth ampere) through the hose pipe and the connected equipment. The pressure required for aerosol formation of DM water and the distance from which the water jet is to be sprayed so as to limit the leakage current to specified value should be confirmed before starting the work. All T&P connected with hose pipe should be earthed so as to earth any leakage current passes through it. Two jets directed from different angles shall be used to clean the insulators starting from the lower most insulator up to the uppermost insulator slowly. The washing process is to be continued till the hissing sound due to corona gets completely eliminated. Care must be taken to ensure that during washing water droplets do not fall on the un-cleaned insulators due to wind or any other reason. The hose pipes should have sufficient strength to withstand the pressure for continuous applications. Power supply to the pressure building pump will be arranged by OPTCL when working inside switchyards but for working in lines the contractor has to arrange alternative sources. Live line washing shall not be carried out during cloudy, rainy, moist, foggy, stormy, windy and dark conditions. Skilled manpower with requisite personal protective equipment (PPE) are to be engaged in this exercise.

All sorts of Safety Rules, Labour Laws, Factory & Insurance Acts framed by Govt. of India are to be abided by the contractor. Specification of International Electro-Technical committee Publication No. IEC 60507 may also be referred for different work procedures. Precaution must be taken to avoid any sort of flashover during washing. The contractor will be solely responsible for negligence in taking appropriate action to avoid flashovers. Transformer bushings and LAS will not be washed in live condition to avoid flashover. OPTCL will arrange shut down for working on these equipment.

The successful bidder has to arrange certificate from Chief- Electrical-inspector of Odisha for working in live line.

-END-