Safety Measures Performed during UG Cables Fault Identification

K. Duraisamy and Dr.E. Palanisamy

Abstract--- It is with pleasure this forward to the Guide for Safety with Underground cable in Salem city power services. I am mainly pleased that during the procedure of development, those industries involved with underground facilities have been asked and have been able to contribute to the endorse safety methods. This report changes an earlier form, and sets out accord work process and preferred work operation for the location and revealing of underground services. As such, the story should assist those who have responsibilities under the Health and Safety in Employment. The Electric Engineers' Association (EEA) is to be an honor for easy the growth of this guide and acknowledge the support of the specific utility companies and utility associations in the printing of this document. The confident that those who use it will find it very useful in assisting them to manage hazards in the underground services work environment. By using the statistics contained in this guide, industry members can be confident that they will be acceptable operating their risks. This can only lead to increasing health and safety in the workplace. One of the main dangers which may arise when digging is that of possible injury from underground power cables. The illustrations below outline the most ordinary circumstances leading to contact with live electricity cables. Injuries resulting from damage to living power cables are usually caused by the explosive effects of arcing current and by associated fire or flames. Electrical fires can be catastrophic if damage spreads to other nearby services such as gas pipes. Such disaster is caused by failure to take all reasonably practicable precautions to prevent accidental contact with underground facilities.

K. Duraisamy, PG Scholar, Dept of Mechanical Engineering, Excel College of Engineering and Technology, Salem Main Road, Pallakapalayam, Tamilnadu. E-mail:durairesides@gmail.com

Dr.E. Palanisamy, Principal, Excel College of Engineering and Technology, Salem Main Road, Pallakapalayam, Tamilnadu.

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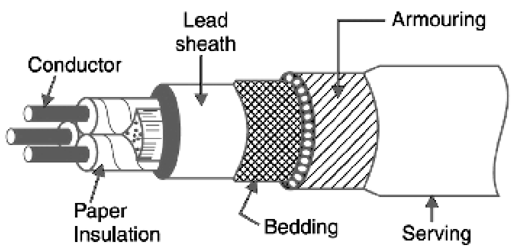
I. INTRODUCTION

Damage to living underground cables during excavation works is the cause of an increasing number of the disaster which can result in severe burn injuries to people at work and disruption of consumers' electricity supplies. Occasionally such disasters prove fatal. Injuries are rarely caused by direct electric shock but usually take the form of projectile impact injury and burns to hands, face, and body due to the flammable arcing current at the point of touching or any fire which may explode. The motivation of these guidelines is to promote greater awareness of the dangers present when work is undertaken near underground cables without adequate precautions and to indicate procedures and practices that will minimize the possibility of accidents occurring. The guidance given is heartily commended to all organizational, people associated with association work, especially the standard of the nearest co-task with NIE Networks who are for the most part the proprietors of underground cables which might be available on a site. This applies both to the arranging and carrying out of work. Particular data or guidance concerning the area of wires and advice on appropriate measures to be taken can be obtained from Networks. When tasks are being planned information about the position of underground cables should be obtained from NIE Networks or other owners. Under the broader application of the Health and Safety at Work (NI)the obligations put on a business incorporate, in addition to other things, the arrangement and upkeep of frameworks of work that are, so far as is sensibly practicable, safe and without dangers to health, and the arrangement of such data, direction, preparing and supervision as is essential to guarantee, so far as is sensibly practicable, the health and security at work of his representatives and place them into impact in the circumstances extra to those to which the Regulations apply. The Order additionally forces on every worker an obligation to take sensible nurture the health of himself and of different people who might be influenced by his demonstrations or exclusions at work.



Underground Cables Fault Identification

He also has to co-operate, so far as is essential, to enable his employer to comply with any tax or requirement imposed on the employer. To maintain records and plans of underground cables on public property and to make available relevant information at the request of an enquirer. Other owners of underground wires ought to be set up to create accessible, applicable knowledge, so far as is sensibly practicable, at the demand of an enquirer. The plan and development of underground transmission lines contrast from overhead lines as a result of two noteworthy specialized difficulties that should be overcome. These are giving adequate protection so links can be inside creeps of grounded material and scatter the heat created amid the task of the electrical wires. Overhead lines are divided from each other and surrounded by air. This review contains data about electric transmission lines which are introduced underground, instead of overhead on posts or towers. Underground cables have unexpected specialized necessities in comparison to overhead wires and have distinctive natural effects. Due to their unique physical, ecological, and development needs, underground transmission by and massive costs increasingly and might be more muddled to build than overhead lines.

II. Literature Review

The leading Distribution system operator in Portugal operates of medium-voltage (MV) network of which are underground insulated cables. This topology is more reliable than overhead systems. However, it is more costly and time consuming to repair in the event of a failure. Thus, it is crucial to ensure the reliability of these systems. Bearing this in understanding has taken several measures to improve the safety of underground networks with a focus on performing new acceptance and commissioning tests on MV insulated cables. To perform ordering tests to verify that the characteristics of the over heath did not debase after some time or amid the establishment procedure, it is necessitated to have an outer conductive layer directly above the over the heath. This conductive layer is usually black due to carbon black materials used to provide conductive properties to cable compounds.

The fact that cables have black colored over heath brings new difficulties for the administrators when introducing link extras that require evacuation of the external conductive layer. Consequently, this work presents the evolution of MV underground cables, a description of the identified challenges, and a solution that better fulfills requirements. The Portuguese leading distribution system operator (DSO), operating in all continental territories of the country. The distribution network comprised, at the end of medium voltage (MV) underground insulated cables, which is rough of the total MV network. Also, roughly of new MV underground insulated cables, representing an increase of about of the whole underground insulated wires introduced. These MV underground protected cables are by and large more dependable than overhead lines, which are substantially more uncovered and create the majority of the brief length interferences. This work is aimed at all those that are engaged in picking or determining medium voltage protected cables. It expresses a few focal points of having an outside conductive layer that was identified, such as the ease of performing acceptance and commissioning tests to verify the electrical integrity of the over the heath. It likewise gives a few bits of knowledge in suspecting or investigating a few difficulties that may emerge from having the two segments with the same color, such as the challenges in leading dimensional confirmation tests and the aftereffects of not entirely expelling the outside conductive layer while applying cable embellishments. Auxiliary substations' earthing frameworks are associated with each other utilizing metallic screens of the underground cables additionally in rural and rustic zones these days. Topology is not the same as the earthing frameworks in downtown areas, where earthlings are connected via multiple mesh connections forming a solid ground level. The standards and the Finnish (high-voltage installations) do not consider the case of connected earthing. In considers were propelled to explore this issue. As indicated by aftereffects of the examinations, the associated earthlings should be evaluated as a whole, and not separately as in the above systems. There is a requirement for reestablishing earthing system outline standards because, right now, the associations between the optional substations are not methodically considered in the non-urban zones' earthing plan. Results demonstrate that the subsequent impedance was commonly lower than the optional substations' earthing protections. It implies that there is awesome potential for reserve funds in the earthing system without taking a chance with the safety. Besides, there is a need to create earthing impedance estimating strategies. Techniques that are utilized for overhead system earthing estimations are not frequently appropriate for the cable network. Underground cables in medium-voltage systems have turned out to be normal likewise in non-urban regions. Clients are progressively subject to the consistent quality of electricity supply, and furthermore, conveyed age, for example, sun based and wind units must also, distributed generation such as solar and wind units must have reliable connections to the grid. Shortly, electric vehicles' recharging infrastructure and energy storages will put even more pressure on the distribution networks reliability.

III. Proposed Architecture

Conduit or ducts of smooth stone or cast iron or concrete are laid in the ground with utility holes at suitable positions along the cable route. The cables are then pulled into position from utility holes. Fig. Below shows a section through four-way underground duct line. Three of the ducts carry transmission cables, and the fourth duct carries relay protection connection, pilot wires. This method compares the currents in the shields as illus. In function of the differences in magnitude and phase between them, the technique distinguishes the location of the single-phase ground fault. For this entire fault identification method is quit basics techniques and it has some problem for identification Care must be taken that where the conduit line alters course; profundities, plunges, and counter balances are made with a long span, or it will be hard to pull an expansive cable between the utility holes. The distance between the utility holes should not be too long as to simplify the pulling in of the wires.

The links to be laid like this require not be armored but must be provided with serving of hessian and jute to protect them when being pulled into the ducts. The drawing below shows Installation of Underground cable in two environments. First one shows direct buried cable installation and the second one shows wire passing through tube mainly where road crossing comes. Another occasion for using tube due to the intersection of other services like water pipeline, telecommunication lines or petrochemical pipelines. The duct should be you PVC encased with concrete all along with the crossing of either road or other services. Numerous incidents occur each year when live cables are damaged during work on housing estates, construction sites, in streets and elsewhere. These measures should include adequate supervision of employees to ensure that the appropriate precautions are stringently applied.

A. Safety Description

Methods of Laying Underground Cables

1. Direct laying.
2. Draw-in System.
3. Solid System.

1. Direct Laying

This method of laying underground cables is simple and cheap and is much favored in modern practice. In this method of putting underground cables, a trench of about 1·5 meters deep and 45 cm wide is dug. The sand keeps the section of dampness starting from the earliest stage subsequently shields the cable from rot. After the link has been laid in the trench, it is secured with another layer of sand of around 10 cm thickness.

The trench is then secured with blocks and different materials keeping in mind the end goal to shield the cable from mechanical damage. At the point when in excess of one wire is to be laid in a similar trench, a level or vertical dispersing of no less than 30 cm is given keeping in mind the end goal to diminish the impact of shared warming and furthermore to guarantee that a blame happening on one cable does not harm the adjoining wire. Cables to be laid along these lines must have a serving on bituminous Hessian tape to protect against corrosion and electrolysis.

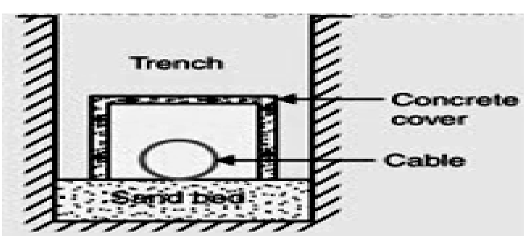


Fig. 1: Direct Laying

2. Draw-in System

In this technique for laying underground links, channel or conduit of coated stone or cast iron or cement are arranged in the ground with sewer vents at reasonable positions along the cable route. The links are then maneuvered into position from sewer vents. Fig. Beneath demonstrates a segment through four-way underground conduit line. Three of the channels convey transmission cables, and the fourth conduit carries transfer assurance association, pilot wires.

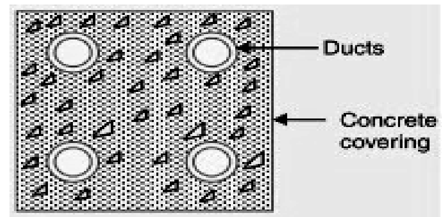


Fig. 2: Draw-in System

Care must be taken that where the conduit line alters course; profundities, plunges, and balances are made with a long span, or it will be hard to pull a massive cable between the sewer vents. The separation between the sewer vents ought not to be too long to rearrange the pulling in of the wires. The wires to be laid along these lines require not be armored but must be provided with serving of hessian and jute to protect them when being pulled into the ducts.

3. Solid System

In this technique for laying underground cables, the cable is exposed in funnels or troughs uncovered in the earth along the cable route. The toughing is of solid metal, stoneware, black-top or on the other hand treated wood. After the link is laid in position, the toughing is loaded with a bituminous or asphaltic compound and secured over. Cables laid in this way are generally plain lead achieved because toughing affords good mechanical protection.

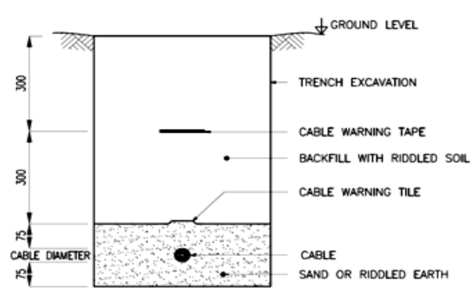


Fig. 3: Solid System

The engineers and manufacturers are slightest made a big deal about how this cables directed to the premises and types of gear. On the off chance that electrical experts brought up the possibility, the feel of the task would touch to the planned level. Subsequently, in the arranging stage itself the courses and size of the power cable trench to be consolidated in the project plan.

Cable Laying Method for Road Crossing and Utility Service Crossing Using PVC Duct

The drawing below shows Installation of Underground cable in two environments. First one shows direct buried cable installation and the second one shows wire passing through duct mainly where road crossing comes. Another occasion for using tube due to the intersection of other services like water pipeline, telecommunication lines or petrochemical pipelines. The machine should be you PVC encased with concrete all along with the crossing of either road or other services.

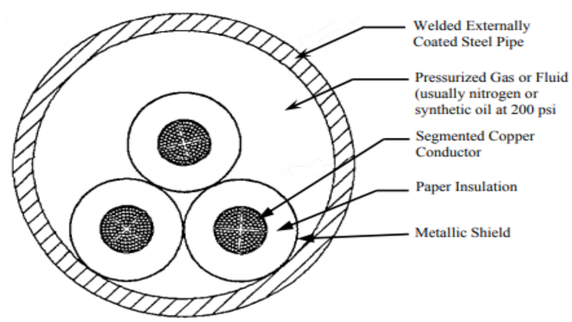
Types of Underground Electric Transmission Cables

There are two primary sorts of underground transmission lines right now being used. One write is built in a pipe with liquid or gas pumped or coursed through and around the table keeping in mind the end goal to oversee warm and protect the cables. The other sort is a robust dielectric cable which requires no liquids or gas and is a later mechanical progression. The basic kinds of underground cable development include:

- High-pressure, fluid-filled pipe (HPFF)
- High-pressure, gas-filled pipe (HPGF)
- Self-contained fluid-filled (SCFF)
- Solid cable, cross-linked polyethylene (XLPE)

High-Pressure, Fluid-Filled Pipe-Type Cable

A high-pressure, fluid-filled (HPFF) pipe-type of the underground transmission line, consists of a steel pipe that contains three high-voltage conductors. Shows an average HPFF pipe-type cable. Every transmitter is made of copper or aluminum; protected with fantastic, oil-impregnated Kraft protection; and secured with a metal protecting (usually lead) and slip wires (for assurance amid development). Inside steel channels, three conveyors are encompassed by a dielectric oil which is kept up at 200 pounds for each square inch (psi). This liquid goes about as an encasing and does not directly power. The pressurized dielectric fluid counteracts electrical releases in the transmitters' protection. An electrical discharge can make the line fall flat. The liquid likewise exchanges warm far from the conductors. The liquid usually is static and evacuates warm by conduction.



In a few circumstances, the liquid is pumped through the pipe and cooled using a warmth exchanger. Cables with pumped liquids require over-the-ground pumping stations, generally situated inside substations. The pumping stations screen the weight and temperature of the fluid. There is a radiator-type gadget that moves the warmth from the underground cables to the environment. The oil is additionally checked for any debasement or issue with the cable materials.

High-Pressure, Gas-Filled Pipe-Type Cable

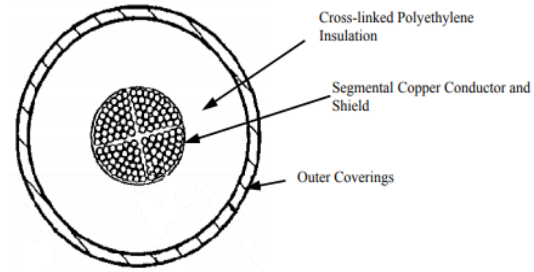
The high-weight, gas-filled (HPGF) pipe-kind of the underground transmission line is a variety of the HPFF pipe-type, portrayed previously. Rather than a dielectric oil, pressurized nitrogen gas is utilized to protect the transmitters. Nitrogen gas is less successful than dielectric liquids at stifling electrical releases and cooling. To make up for this, the conductors' protection is around 20 percent thicker than the shield in liquid-filled channels. More impenetrable shield and a hotter pipe diminish the measure of current the line can securely and proficiently convey. On the off chance that there ought to emerge an event of the hole or break in the cable system, the nitrogen gas is less demanding to manage than the dielectric oil in the encompassing condition.

Independent, Fluid-Filled Pipe Type

The separate, liquid filled (SCFF), pipe-kind of underground transmission, is frequently utilized for submerged transmission development. The conductors are empty and loaded with a protecting fluid that is pressurized to 25 to 50 psi. Also, the three cables are free of each other. They are not put together in a pipe. Each link comprises a liquid filled conductor protected with top-notch Kraft paper and ensured by a lead-bronze or aluminum sheath and a plastic coat. The liquid decreases the possibility of electrical release and line disappointment. The sheath pressurizes the conductor's liquid, and the plastic jacket keeps the water out. This kind of development lessens the danger of an aggregate disappointment. However, the development costs are substantially higher than the single pipe used to build the HPFF or HPGF frameworks.

Solid Cable, Cross-Linked Polyethylene

The cross-linked polyethylene (XLPE) underground transmission line is often called stable dialectically. The strong dielectric material replaces the pressurized fluid or gas of the pipe-type cable. XLPE cable has turned into the national standard for underground electric transmission lines under 200 kV. There is less upkeep with the active cable, however approaching protection disappointments are much four more challenging to monitor and detect. Every transmission line requires three separate wires, like the three conductors as are necessary for over the ground transmission lines. They are not used together in a pipe, but instead, are set in stable conduits or covered next to each other. Each cable comprises a copper or aluminum conveyor and a semi-leading shield at its center. Cross-Connected polyethylene protection encompasses the center.



Two arrangements of three cables (six links) are vital for various reasons, mostly so the limit of the underground framework coordinates the border of the overhead line. This plan helps in restricting the extent of any cables disappointment and abbreviates rebuilding time in a crisis circumstance. Most underground transmission requires expanded downtime for the repair of working issues or upkeep issues contrasted with overhead lines. The twofold Cross-linked Polyethylene Insulation Segmental Copper Conductor and Shield Outer Coverings 5 sets of cables take into account the rerouting of the power through the reinforcement cable set, diminishing the downtime, however, builds the development impression of the line.

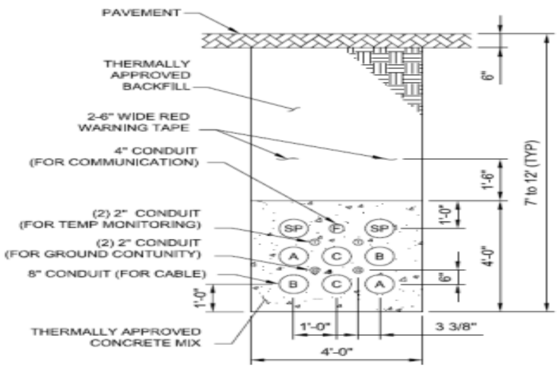
B. Construction of Underground Transmission

Right-Of-Way Construction Zone

Overhead transmission development, underground development starts by staking the ROW limits and checking touchy assets. Existing underground utilities are distinguished and set apart before the beginning of construction. On the off chance that the transmission line is built inside roadways, path terminations will be required and movement control signage introduced. Development exercises and gear will disturb activity stream. By and large, a few hundred feet of activity path is shut amid development. Whenever materials and apparatus are conveyed, extra lengths or trails of movement might be closed. Development zones should be broad and sufficient level to help the development of excavators, dump trucks, reliable trucks, and other essential development gear and materials. Undeveloped segments of the street ROW may require uncovering or fill kept on slopes with the goal that the surface is leveled and nine compacts enough for support of the construction equipment. Construction areas in road ROWs are typically 12 to 15 feet wide with an additional 5 to 8 feet for trench construction.

Conduit Assembly for XLPE Construction

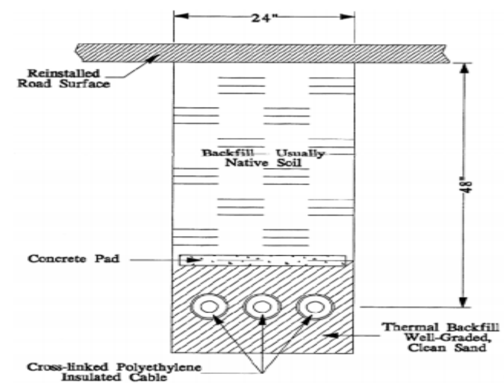
The assembly of conduits and direct-buried method of XLPE construction are illustrated. Underground XLPE cable systems can be direct-buried or encased in concrete duct banks. For duct bank installation, the trench is first excavated a couple of hundred feet.



Then the duct bank is assembled using polyvinyl chloride (PVC) conduit and spacers. Even though using concrete duct banks is more expensive than direct-bury, it is the most common method of installation for higher voltage lines. This is because the construction technique provides more mechanical protection, reduces the need for re-excavation in the event of a cable failure, and shorter lengths of the trench are opened at any one time for construction and maintenance activities.

Pipe Installation

HPFF and HPGF pipe-type installation require the construction of welded steel pipe sections to house the cables. The welding of pipe sections takes place either in or over the trench. Pipe welds are X-rayed and then protected from corrosion with plastic coatings. When the pipe is completely installed, it is pressure tested with either air or nitrogen gas. It is then vacuum-tested, vault to vault, which also dries the canal. The cross-section for an HPFF or HPGF pipe-type underground transmission line.

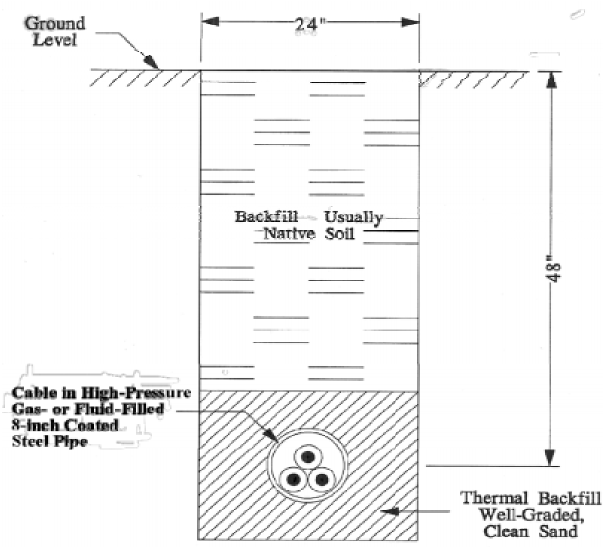


Pipe Installation

Cable Installation

Cable pulling and splicing can occur any time after the duct banks and vaults are completed. Before installation of the cable, the conduit is tested and cleaned by pulling a mandrel and swab through each of the ducts. A typical setup is to lace the reel of wire at the transition structure or any one of the vaults and this winch truck at the further vault. Mainly The cable is then pulled from the transition formation to the contiguous trunk. The direction of pull between logs is based on the path that results in the lowest pulling and sidewall tensions. Cable lengths are spliced within the catacombs.

The majority of the warmth created from covered coordinate cables must be dispersed through the dirt. The determination of inlay write can have a substantial effect on the limit rating. Distinctive soils have different capacities to exchange warm. Immersed soils direct warmth more effortlessly than for example, sandy soils. This reason, the plan needs to decide the sort of earth closest the line. A warm dirt review might be fundamental before development to assist determine the dirt's capacity to move warm far from the front. Much of the time, an exceptional inlay material is utilized rather than soil in the trench around the cables to guarantee adequate warmth exchange to the encompassing soils and groundwater.



C. Underground Construction Considerations

Underground construction could be a reasonable alternative to overhead in urban areas where an overhead line cannot be installed with appropriate clearance, at any cost. In suburban areas, aesthetic issues, weather-related outages, some environmental concerns, and the high cost of some ROWs could make an underground option more attractive. Underground transmission development is regularly utilized as a part of urban territories. However, underground construction may be disruptive to street traffic and individuals because of the extensive excavation necessary. During development, barricades, warning, and illuminated flashing signs are often required to guide traffic and pedestrians. After each day's work, steel plates will cover any open trench. All open concrete vaults will have a highly visible fence around them. When the cable is pulled into the pipe, the contractor should cordon off the work area. There may be time-of-day or workweek limitations for construction activities in roadways that are imposed for reasons of noise, dust, and traffic impacts. These construction limitations often increase the cost of the project. The trenching for the construction of underground lines causes greater soil disturbance than overhead lines. Overhead line construction disturbs the soil mostly at the site of each transmission pole. Trenching an underground line through farmlands, forests, wetlands, and other natural areas can cause significant land disturbances.

UG Cables Fault Identification

Faults are among significant disturbance to power systems. Hence there is a requirement to identify the faulty point in an underground cable to facilitate quicker repair, to improve the system reliability and reduced outage period. Power cable fault location techniques are used in power system for accurate pinpointing of the fault positions. This term "fault" is often used synonymously with the term "short circuit" defined as an abnormal connection (including an arc) of relatively low impedance, whether made accidentally or intentionally, between two points of different potential.

Method of UG Cable Fault Location

After the fault classification, the next step is to, influence the fault location. To detect fault location identifies the physical position of the fault in the power system. This information is beneficial for isolating the fault and restoring the power immediately. There are two major methods for determining the location of fault namely.

a) Circuit theory-based approach.
b) Traveling wave theory based method.

(a) Circuit Theory Based Method

The circuit theory based method locates the fault using voltage and current values and impedance changes. The imaginary part of this equation calculates unknown fault resistance and the fault resistance is alternative in the real part of the equation to get the fault location. Then, the quadratic equation is solved to find the fault location.

(b) Traveling Wave Theory Based Method

The traveling wave theory based method uses the information of voltage and current traveling waves for locating the fault. This technique is mostly used for extra high voltage transmission lines than in distribution lines because distribution system contains many subsections such as laterals and feeders. In a double-ended method, there are two fault locators installed at two substations and depending on the arrival time of waves at both stations, the fault location is calculated.

Jointing of cables

Joint Pits

The joint pits should be sufficient dimensions as to allow jointers to work with as much freedom of movement and comfort as cables proposed to be joined. The sides of the pit should be draped with tarpaulin sheet to prevent the loose earth from falling on the joint during the making. The hole should be well stored with timber, if necessary. An overlap of about 1.0 more of the cables to be joined may be kept, for allowance to adjust the position of the joint. When two or more wires are laid together, the joints shall be arranged to be staggered by 2 to 2.5 mtr.

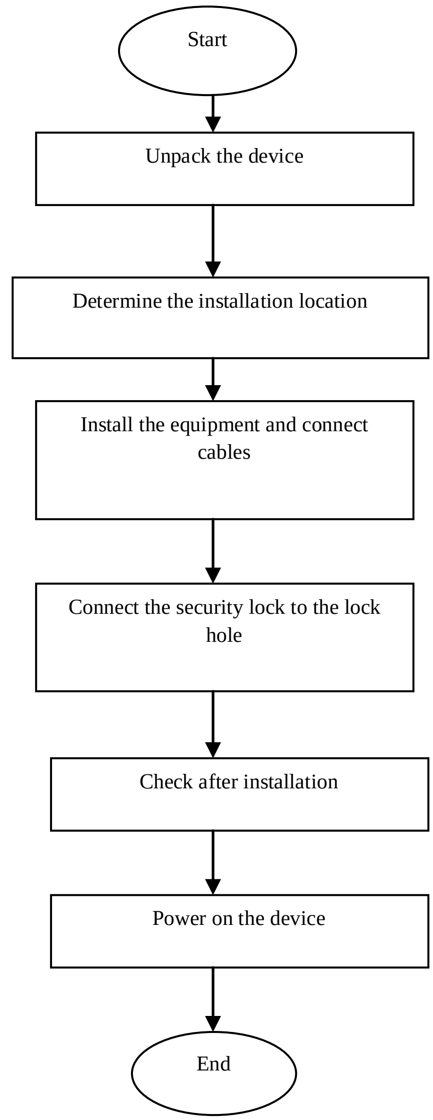
Sump Pits

When jointing cables in the waterlogged ground or under monsoon conditions, a sump pit should be excavated at one end of the joint hole in such a position so that the accumulating water can be pumped or bailed out by buckets without causing interference to the jointing operation. A tent should be used in all circumstances wherever jointing work is carried out in the open irrespective of the weather conditions. The canvas should be so covered as to have only one entrance and the back facing the direction of the wind. The tent cover should be appropriately weighted or tied down on the sides.

Cable Terminations

Cable terminations required are both indoor and outdoor type and invariably be of heat shrinkable type conforming to the specifications vides Sec-iv. Alternatively, push-on or Tape or cold shrinkable type can be used with the approval of CESU with appropriate sheds for rainwater in case of outdoor terminations. All the technical particulars to establish the superiority in the performance of these joints shall be furnished while seeking approval.

Cable Terminations Flow Chart



Safety Description

Guidance on Safe Digging Practice to Locate Underground Cables

Before Starting Work

- complete an appropriate risk assessment safety check
- Where suitably authorized, set up the suitable street signs, boundaries and cones as indicated in "safety at road works and street works, a code of training."

- Wear the fitting high visibility clothing and other individual defensive hardware considered essential to do your assignment securely.
- Check the cable records to decide the number of cables, voltage rating and physical measurements of the cable(s).
- Utilize cable records to decide the estimated line of the cable.
- Utilize a cable shirking device (feline.) to follow the line of the cables and check the course of the wires on the ground.
- Where no cable or other utility records exist, counsel your director.
- Have all other utility illustrations on location and check the position of these another burrowing.

On Commencement of Work

- Maintain a strategic distance from the utilization a hand-held power device or mechanical excavator inside 0.5 m of a known cable or other utility.
- Utilize a mechanical excavator or a power device to break the best surface of the pathway or carriageway.
- Hand burrow, utilizing a round-edged spade or scoop. A pick might be used with care to free large segments of stone. A fork or other pointed instrument might never be utilized.
- Amid uncovering make rehash checks with the feline to decide all the more the situation of any cable(s).
- Regard all cables found as live until demonstrated something else.

Additional Guidance for the Area of underground Cables

- While unearthing in an encased or kept space, test the air to decide the levels of oxygen, harmful gas or combustible gas.
- Where any indications of trouble are apparent in the cable or a joint, e.g., notice, warmth, clamor, or harm –stop work, withdraw and consult the Supervisor.
- Carry out an onsite composed START evaluation and where recognized dependably shore unearthings where there is a danger of fall utilizing materials appropriate to anticipate dislodgement of the sides of the exhuming.
- Refill around links with excellent material, and not utilize in-your-face as this is probably going to cause harm.
- Supplant any notice tiles or tape that may have been bothered.
- Guarantee that material expelled from the track or joint sound is situated in such a way, to the point that it doesn't represent a risk to you, kindred laborers or individuals from the general population.
- Treat different utility hardware, e.g., gas, water, and media communications with deference.
- Report any harm maintained by other administrations to your Supervisor.
- Try not to utilize links as an advantageous advance in or out of a track or joint inlet.

Guidance on Excavating Under Fault Conditions

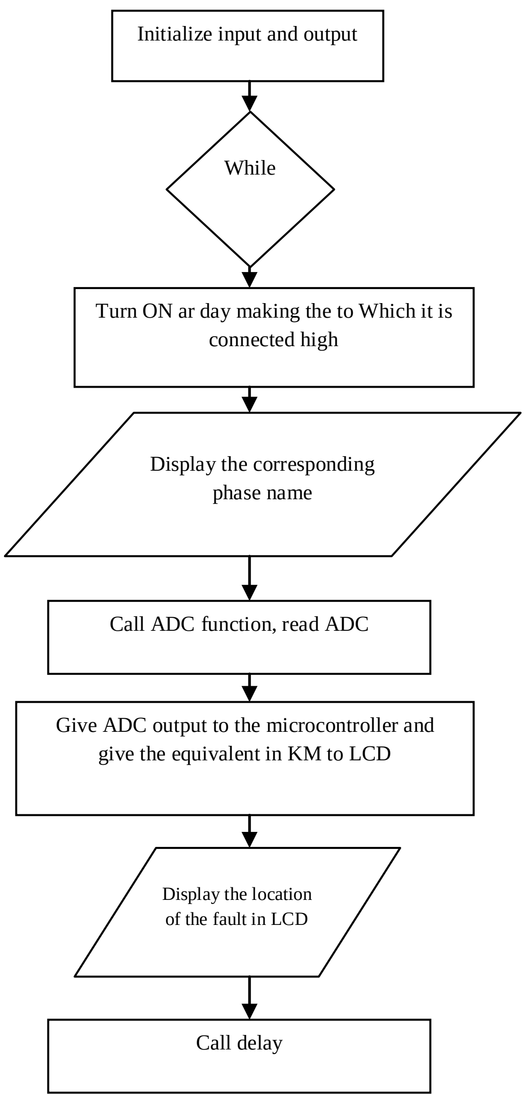
- Where the location of a fault is known or suspected, the top surface (e.g., concrete, tar, or paving slabs) can be removed before the cable is made dead.
- Where the location of a fault is not known, digging can proceed as usual.
- Should any signs of the fault become evident, e.g., smell, heat, noise or signs of cable damage –stop work, withdraw and consult their Supervisor immediately;
- Never -work on a faulty/damaged cable or joint within 1 meter of the damaged section.

Cable Fault Type Identification

Before the location of the fault on the power system, it is essential to determine the type of fault to make a better choice of the method to be used for fault location.

- Isolate the faulty cable and test each core of the cable for earth fault. One terminal of the insulation tester is earthed, and each conductor of the cable is in turn touched with other terminals.
- Then examine the insulation resistance between the conductors. In the case, it is a short circuit fault.

Flow Chat



Open Circuit Fault Method

This type of fault is preferable than short circuit fault, because when the open circuit fault occurs, then the flow of current through an underground cable becomes zero. Disruption in conducting can occur this fault.

Short Circuit Fault Method

Short circuit fault can be categorized into two types, namely symmetrical and unsymmetrical faults

- In comparative fault, three phases are short-circuited in this type of fault. These type of fault is also called as three-phase fault due to this reason.
- In unsymmetrical fault, the magnitude of the current is not equal and displaced by 120 degrees.

Different Technique of Fault Location

Free location methods can be categorized into different types that are discussed below.

i) Online Method

The online method uses and processes the sampled current and voltages to determine the fault points. This method for underground cable is less than above lines.

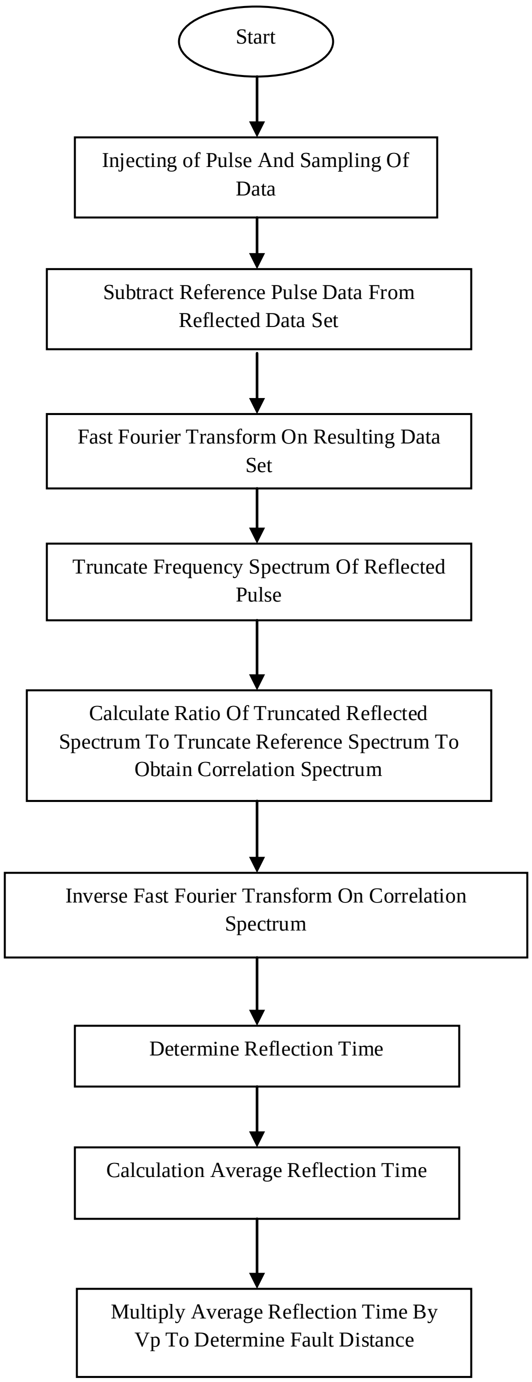
ii) Offline Method

This method uses a unique instrument to test out service of cable in the field. The offline method is classified into two methods such as tracer method and terminal method.

Transient Method

In the transient method, a breakdown is triggered at the cable fault. This affects a low-resistance short circuit for a few milliseconds. These waves are reflected at the cable ends so that they then travel toward each other again in the direction of the cable fault. This, in turn, produces two traveling waves diffusing in opposite directions. There are various ways to decouple and analyze these transients.

U.G Palent



Underground Cable Installation Equipment & Procedures in Salem UG Cable Erection

At the point when the choice is made to "Go Underground" on another dissemination framework, there is a wide range of territories to consider preceding development. In the accompanying paper, we might want to propose a portion of these regions for your thought concerning gear and methodology for underground cable establishment. The three most basic strategies for cable position are Direct Buried, Cable in Conduit, and a Total Conduit System. Most Utilities are as of now utilizing at least one of these techniques with different degrees of progress. The primary framework or procedure customarily attempted is the Direct Buried strategy. Blame or harm caused by burrowing happens, it is incredibly tedious to open the trench and make repairs. Every one of these variables and numerous more influence the consistent quality and life of the conductor. Due to these and different conditions, the Cable in Conduit strategy is considered in a few regions. The cable is set in a course amid the assembling procedure, and this channel ensures the conductor as it lies in the trench, giving it a longer life.

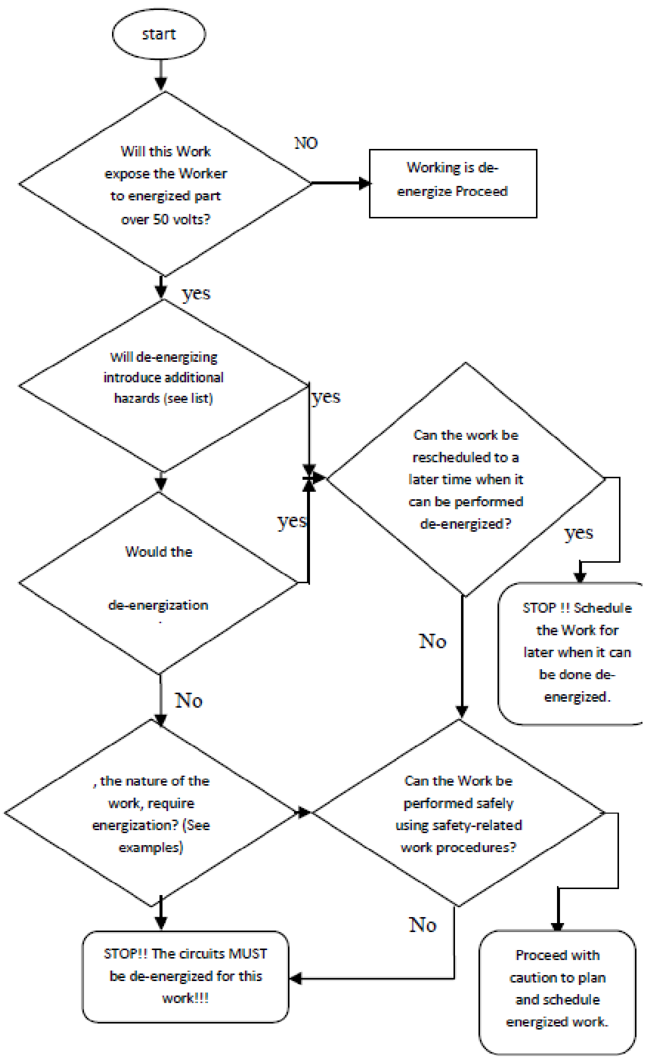
Incipient Fault Detection

The procedure for incipient fault detection includes fault time detection, incipient fault voltage phase angle verification, fault point voltage calculation, fault point voltage THD calculation, threshold comparison, and load loss checking.

System Preparation

A decent framework must be introduced appropriately with consideration given to the arrangement of the trenches, the position of the course, and care utilized while refilling the trenches. B. Thought ought to be given to choosing the extent of inside distance across to guarantee satisfactory fill proportions and calendars, for example, DB-120, SCH-40, or SCH-80 as required in particular regions. C. The pulling cable dramatically affects the determination of the timing of the channel. At first, everybody accepted if the engineered rope is adequate for overhead, it must be sufficient for underground also. Be that as it may, we learned engineered cable produce warm, causes grinding, and consumes the PVC. The most public reaction was to expand the divider thickness of the course or even go to steel 90's keeping in mind the end goal to stop this issue. Since the rope was causing the problem, most pullers today utilize steel pulling ropes. Steel ropes scatter the warmth over the length of the cable and slides around the 90's, rather than consuming them. The maximum distance between vaults depends on system designs, customer requirements, and pulling equipment available.

Work Decision-Making Flow Chart



Installation of New Services near Existing Services

New underground administrations frequently must be laid in the ground that contains existing services. Where it is sensibly practicable to do as such, the utility planning the new installation should aim to site the new facility such that it is separated from all existing buried facilities, while still leaving as much room as practicable for other future services. Where there are any congestion and doubt regarding adequate separation, the personnel responsible for the excavation should contact the owner of other services in the vicinity to discuss both horizontal and vertical clearances. Where the utility laying the new buried ceremony has to reduce the separation beyond that specified by the existing service owner, it should discuss this with the service owner whose function will be affected. This will enable both service owners to consider other options and modify their records as necessary for future reference

Cable Locating Devices

Hum locators are easy to utilize, yet they don't react to emptied or coordinate current cables, and they may neglect to distinguish daintily stacked low-voltage wires (such as those used for street lighting) or well balanced high-voltage wires. The various devices available require a certain degree of skill to operate them and interpret the signals. However, used in conjunction with cable plans they can save a considerable amount of time and costs wasted where damage would otherwise have occurred. A locator with a radio frequency detection mode may otherwise detect these cables and should be used as a Guide for Safety with Underground Services backup check. The transmitter/ receiver mode is the most accurate and reliable location method, but this requires direct access to the cable. This is particularly useful if precise depth, as well as other measurements, are needed, and, where practicable, this mode should be used. It should be noted that street light cables will not normally be energized during the day and in consequence may be difficult to locate accurately by electronic means. Even where the locator gives no indication, cables may still be present, and any cable uncovered may still be live. If a cable recorded on the cable owner's plan cannot be located, appropriate assistance or advice should be sought. If digging has to start before such support or information has been obtained, extreme care should be taken.

IV. CONCLUSION

Underground cables are technically feasible for this 230-V application. Draw-in System would be the preferred cable type installation. However, route conditions would make cable installation very costly, disruptive, and time-consuming. Having these cables on the system would create operational difficulties for this would not be present with overhead lines, and power transfer could be severely curtailed for longer than a month if there were a cable failure. The more significant part of the high zones of thought is necessary strides to guarantee protected, stable, and dependable link establishment. 1. A verified Conduit System. 2. Select a Cable Puller to meet your particular needs. 3. The Reel Trailer ought to be intended to transport the conductor securely. 4. Ensure your gear is protected and secure. 5. Utilize adequate measures of grease. An increase in the safety leads to a significant increase in the cable ampacity, an, i.e., current-carrying capacity of an underground cable line. By continuing in this way, it ends up conceivable to delay or avoid investments related to the installation of an underground line consisting of cables with a greater cross-section.

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