Underground Cabling; An Expensive but Encouraging option

Sanket Menjoge

Manager, Feedback Infra (P) Ltd. Andheri (E), Mumbai- 40059, India.

Abstract

Underground cabling plays a crucial role in providing 24X7 reliable power supply. It offers lots of benefits such as resilience's in severe weather conditions, ease of network expansion in densely populated areas and protection against theft.

Underground cabling by distribution utilities are preliminarily being done under government's Integrated Power Development Scheme (IPDS).

Underground Cabling is important for network expansion in transmission segment since these cables entail minimum right of way (RoW) and required fewer clearances. While underground cabling is undoubtedly an expensive choice, demand continues to be driven by the need of reliable supply, safety and aesthetic considerations, and the availability of clearances.

The paper presents the" Underground Cabling" that needs to be adopted to reduce the aggregate technical & commercial (AT&C) losses. The advent of Underground cabling's will have helped in providing efficient & reliable power supply.

Keywords: UG (Underground Cabling). IPDS (Integrated Power Development Scheme***), GOI (Govt. of India)***

Introduction

Power Cable is an electrical conductors usually held together with an electrical conductor's usually held together with an overall sheath. The assembly is used for transmission of electrical power. Power cable may installed as wiring with in buildings, buried in the ground, run overhead.

Electrical cable classification can be done in two ways

- On basis of voltage level
- On basis of insulation material used

❖ Classification of cables according to voltage is as follows

- Low Tension (LT) cables - up to 1000 V
- High Tension (HT) cables- up to 11000 V
- Super Tension (ST) cables- 22 kV to 33 kV
- Extra High Tension (EHT) Cables- 33 kV to 66 kV
- Extra Super Voltage (EST) cable -132 kV and above

❖ Classification of cables according to Insulating material is as follows

- Rubber
- Vulcanised India Rubber (VIR)
- Paper Insulator Lead Sheath cable (PILC)
- Polyvinyl chloride cable (PVC)
- Cross-linked Polyethylene cable (XLPE)

With growing demand for power in urban areas & industries, Cables and conductors are crucial elements of a transmission and distribution (T&D) network. The cable and conductor market in India has witnessed strong growth over past few years on the back of expansion in power sector as well as infrastructure sectors. In the power sector, the government's continued focus on 24 X7 reliable power supply, reduction in T&D losses and universal household electrification has helped drive demand in the cable and conductor market and this raising trend is expected to continue in the near term.

Cable design and materials have evolved over the years with dry extruded cables increasingly replacing wet paper insulated ones. XLPE is being preferred over HDPE and low density polyethylene for extruded insulation owing to higher operating temperature and lower cost.

XLPE now available for all transmission applications as its services has been proven for higher voltages and medium voltages cables for over 25-30 years.

Growth drivers:

Underground cables are less prone to damage caused by severe weather conditions such as lightning, hurricanes, cyclones, typhoons, tornados and freezing as they are not exposed to the environment.

Besides underground cables are protected against power theft, thereby reducing technical and commercial losses. In an underground cabling system it is almost impossible to tap the conductor, thereby checking illegal connections.

Another growth driver is network expansion. Underground cable require minimum RoW and other clearance such as wildlife and forest clearance, which often delay transmission projects. In the distribution system UG cables help in network expansion in densely populated areas. Since these cables are laid under the ground, they do not require physical ground space. They also add to the aesthetics of the area as they do not obstruct the view.

Indian Railways plans to achieve 100 % electrification of its broad gauge network by 2022, electrification plans are expected to create huge opportunities for cable & conductor manufacturing industry.

Government Scheme:

At the distribution and sub-transmission levels, the majority of underground cable projects are being implemented under IPDS. The scheme has envisages the implementation of underground cable aggregating 18,008 km across various states. Maharashtra has highest target of 5,762 km followed by Uttar-Pradesh with Rajasthan with 2179 km (Source- CEA). UG cabling projects are also been proposed under Smart Cities Mission to ensure reliable power supply and enhance the aesthetics. Underground distribution cabling projects are also being implemented under other state and central government scheme for network improvement

Estimated cost

As per Central Electricity Authority, the cost of an underground cabling system is three to four times that of an equivalent overhead system.

Cost comparison between overhead, underground and Aerial Bunched cable			
	Tentative estimated cost per km (Rs. Million)		
Voltage Level	**Overhead cables**	**Underground cables**	**Aerial Bunched cables**
LT	0.35	1.3	0.80
11 kV	0.50	2.0	1.35
33 kV	1.20	3.5	-
66 kV	4.50	8.0	-
Source : Central Electricity Authority			

Maintaining Underground cables:

The fault in electrical system are unavoidable, but it is essential that they undergo routine maintenance in order to ensure the reliability of power supply.

Identifying underground cable faults can be challenging, however, modern technologies have made this process more efficient. Two basic techniques for detecting faults in underground cables are time domain reflectometry (TDR) and High Voltage Radar (HVR) Methods.

TDR tests UG cables by using low energy signals, making it possible to locate faulty section without causing insulation damage. The results are displayed as graphs.

HVR methods of three types – Arc reflection, surge pulse reflection and voltage pulse refection.

In arc reflection, a TDR device, filter & thumper work collectively to provide approximate distance to any possible fault. Surge pulse refection uses storage oscilloscope, current thumper and current coupler to ionise distance.

Considering the indispensable nature of cables, its important to ensure timely maintenance. Such routine check-ups give actual information regarding fault locations and situations, and quantify the severity of faults in cables.

Areas of Concern

One of the key concerns for UG cabling is damage caused to the cables from other underground activities. The unco-ordinated underground development activities undertaken by multiple agencies and private contractor's results in frequent cuts, leading to depreciated life of the cable and increase the operating costs. Besides, the cable insulation deteriorates over time owing to various load cycles. Over time, the cable insulation weakens, which increase potential for line faults. Since these cable are underground, they requires specialised techniques for fault detection and restoration and repair time is much longer.

Conclusion

Underground cabling is boon for the transmission and distribution segment, as it helps in network expansion in densely populated areas, minimises power theft and requires minimum clearances. Undertaking underground cabling projects based on specific needs and requirements of an area is essential for the meeting the government goal of providing 24 X 7 reliable supply. In distribution segment, Arial bunched cable(ABC's) are increasingly being deployed by the utilities as compare to conventional bare conductors in overhead bare conductor in overhead distribution system, ABC's provide more safety, reliability and system economy, reduce power losses & entail lower installations, and operations and maintenance cost these are ideal for ruler distribution as well as for installation in difficult terrain like hilly areas, forest areas and coastal areas.