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IEEE Recommended Practice for the Electrical Protection of Optical Fiber Communication Facilities Serving, or Connected to, Electrical Supply Locations

IEEE Power Engineering Society

Sponsored by the
Power Systems Communications Committee



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Abstract: The main emphasis of this recommended practice is the engineering design of optical fiber communication facilities serving, or connected to, electrical supply locations. This document includes methods for providing telecommunication facilities serving electrical supply locations using optical fiber cables extending across the zone of influence (ZOI).

Keywords: electrical power stations, electrical supply locations, ground potential rise, high-voltage environment

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Introduction

(This introduction is not part of IEEE Std 1590-2003, IEEE Recommended Practice for the Electrical Protection of Optical Fiber Communication Facilities Serving, or Connected to, Electrical Supply Locations.)

Some electrical environments, collectively called electrical supply locations, require the application of unique electrical protection techniques because of their special nature. One such environment is the electrical power station or substation. Another is at, or near, power line transmission and distribution structures such as towers or poles. Such structures often provide a convenient site for the location of wireless, PCS, and cellular antennas and their associated electronic equipment that is served by a link to the wired telecommunications network. IEEE Std 487TM-2000 provides additional details on these locations.

This recommended practice assumes that optical fiber cables are to be used to provide telecommunications services to electrical supply locations. Refer to IEEE Std 367TM-1996 or IEEE Std 487-2000.

This document describes applications consisting entirely of fiber and of those hybrid applications where both metallic cables and fiber cables are used. In this instance, the user will be referred to IEEE Std 487-2000 for the metallic portion of the application.

Delays in site activation often occur due to the time involved in obtaining electrical information data for most high-voltage tower or pole sites. The delays may be eliminated by using the fiber optical solutions described in this recommended practice.

This recommended practice has been prepared by the Wire-Line Subcommittee of the Power Systems Communications Committee of the IEEE Power Engineering Society. This standard represents the consensus of both power and communications engineers.

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1. Overview

During a power fault that occurs externally to the electrical power station, some portion of the fault current will return to the electrical power station through the resistance of the station grounding system. A large increase in potential may be developed in and around an electrical power station (ground potential rise zone of influence) with respect to remote earth locations. This ground potential rise (GPR) will result in current flowing into the wire line networks or the power system neutral.

When a fault occurs on the power line transmission and distribution towers or poles, the current will return to the source via the earth and the various metallic paths available. The fault current will divide following the paths of least impedance. Some power systems have a neutral return path, and others do not. The absence of the neutral return path tends to produce a higher GPR. When wire line telephone and secondary neutrals are extended into these locations (no neutral return path), they represent remote earth and provide a significant discharge path during faults. A properly engineered and deployed all-dielectric fiber optic cable will provide immunity from the effects of fault-produced GPR and induction at these locations. Guidance is provided for existing nondielectric fiber optic cables.

The main emphasis of this recommended practice is the electrical protection of optical fiber communication facilities serving, or connected to, electrical supply locations. The overall electrical protection scheme for the particular location should be coordinated for personnel safety and to minimize damages to equipment and service outages.

This document includes methods for providing telecommunication facilities serving electrical supply locations using optical fiber cables extending across the zone of influence (ZOI).

1.1 Scope

This recommended practice presents engineering design procedures for the electrical protection of optical fiber communications facilities serving, or connected to, electrical supply locations. Other telecommunication alternatives such as radio and cables with metallic members are excluded from this document.

1.2 Purpose

This recommended practice presents safe and reliable methods for providing telecommunication facilities serving electrical supply locations using optical fiber.

1.3 Not covered

This document does not cover fiber extension where the equipment (CFJ) is inside the ZOI or where the equipment (CFJ) is on the same grid or ground mat. These are covered in IEEE Std 487™-2000.¹

2. References

This recommended practice shall be used in conjunction with the following publications. When the following specifications are superseded by an approved revision, the revision shall apply:

Accredited Standards Committee C2-2002, National Electrical Safety Code® (NESC®).²

IEEE Std 80™-2000, IEEE Guide for Safety in AC Substation Grounding.^{3, 4}

IEEE Std 367™-1996 (Reaff 2002), IEEE Recommended Practice for Determining the Electrical Supply Location Ground Potential Rise and Induced Voltage from a Power Fault.

IEEE Std 487-2000, IEEE Recommended Practice for the Protection of Wireline Communication Facilities Serving Electric Supply Locations.

NFPA 70-2002, National Electrical Code® (NEC®).⁵

3. Definitions

For the purposes of this recommended practice, the following terms and definitions apply. *The Authoritative Dictionary of IEEE Standards Terms*, Seventh Edition [B10] should be referenced for terms not defined in this clause.

3.1 base transceiver station (BTS): A unit or component of the cell site consisting of all radio transmission and receiving equipment.

¹Information on references can be found in Clause 2.

²The NESC is available from the Institute of Electrical and Electronics Engineers, 445 Hoes Lane, P.O. Box 1331, Piscataway, NJ 08855-1331, USA (<http://standards.ieee.org/>).

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3.2 electrical power station: A substation or generating station.

3.3 electrical supply locations: Any building, separate space, or site in which electrical supply equipment is located that may be subjected to the effects of ground potential rise (GPR) from power system fault currents. This includes generation, transformation, conversion, switching, and delivery facilities.

3.4 ground potential rise (GPR): The product of a ground electrode impedance, referenced to remote earth, and the current that flows through that electrode impedance.

3.5 high-voltage environment (HVE): A location requiring caution because it may experience a ground potential rise (GPR) from power line fault currents and/or lightning strike energy.

3.6 high-voltage interface (HVI): Protective apparatus that provides electrical isolation of wireline communications conductive paths.

3.7 metallic member: A noncommunications metallic cable component such as a shield, vapor barrier, or strength member.

3.8 outside plant: That portion of the telephone network that is normally located outside of buildings. It may consist of aerial, buried or underground facilities and associated terminals, closures, pedestals and supporting structures.

NOTE— See T1.316-1997 [B20].⁶

3.9 optical equipment interface (OEI): Interface between the optical fiber cable facility and the metallic cable for the base transceiver station (BTS).

3.10 personal communications service (PCS): A set of capabilities that allows some combination of terminal mobility, personal mobility, and service profile management.

3.11 wireless: For the purposes of this document, a form of telecommunications using radio links to deliver voice, data, and other information.

3.12 wireless services provider (WSP): A company that provides wireless telecommunication service to customers, e.g., cellular service providers, radio common carriers, and paging companies.

3.13 wireline: A term associated with a network that uses metallic wire conductors for telecommunications.

3.14 zone of influence (ZOI): An area around a ground electrode bounded by points of specified equal potential resulting from the voltage drop through the earth between the ground electrode and remote earth.

4. Abbreviations and acronyms

ac	alternating current
ANS	American National Standard
AWG	American Wire Gauge
BIL	basic impulse insulation level
BTS	base transceiver station
CFJ	wireline cable— fiber cable junction
CO	central office
dc	direct current

⁶The numbers in brackets correspond to those of the bibliography in Annex A.