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Guidance on Practice for Deployment of Fibre Optic Cables to Offshore Oil & Gas Facilities

GP 59-35

BP GROUP
ENGINEERING TECHNICAL PRACTICES

Foreword

This is the first issue of Engineering Technical Practice (ETP) GP 59-35. This Guidance on Practice (GP) is based initially on input from an external consultancy, WFN Strategies LLC. The material is ordered to indicate the stages that would usually take place during purchase and deployment of a fiber optic cable network intended to supply telecom facilities to all types of fixed offshore location. It is assumed that the process will need to broadly follow the BP's five stage Capital Value Process (CVP) for projects (Appraise, Select, Define, Execute, Operate) and the lifecycle stages can be mapped as required into the BP CVP framework.

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Introduction

This Guidance on Practice (GP) will clarify the BP Group policy with respect to the design and installation of fiber optic cables to offshore locations. The intent of this GP is not to examine all possible situations, or to provide prescriptive processes, but rather to aid the network design engineers in settling on a network design, procurement and operation plan that is fit for purpose.

It is recognized that BP may on some occasions be in the role of system purchaser and operator, on other occasions BP will be leasing capacity on a network which is owned by a third party and may also be shared between a group of Hydrocarbon companies operating in the region. Although the latter role relieves capital expenditure and direct activity, there is still a need to be certain that the necessary stages are being followed, and a considerable amount of due diligence will be required prior to signature of the capacity lease contract..



1. Scope

This GP provides guidance for the selection, design, and installation of fiber optic cables to offshore oil and gas facilities.

2. Normative references

The following normative documents contain requirements that, through reference in this text, constitute requirements of this technical practice. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this technical practice are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies.

International Telecommunication Union – Telecommunication Sector (ITU-T)

ITU-T G.652	Characteristics of a Single-Mode Optical Fibre Cable Series G: Transmission Systems and Media, Digital Systems and Networks Transmission Media Characteristics - Optical Fibre Cables-Study Group 15
ITU-T G.654	Characteristics of a cut-off shifted single-mode optical fibre and cable Series G: Transmission Systems and Media, Digital Systems and Networks Transmission Media Characteristics Optical Fibre Cables-Study Group 15
ITU-T G.976	Test Methods Applicable to Optical Fibre Submarine Cable Systems Series G: Transmission Systems and Media, Digital Systems and Networks Digital Sections and Digital Line System - Optical Fibre Submarine Cable Systems-Study Group 15

3. Terms and definitions

For the purposes of this GP, the following terms and definitions apply:

Bit Error Rate (BER)

the ratio of errored bits to total bits in a specified period.

Beach Manhole (BMH)

is usually considered as the boundary between sea cable and land cable.

Burial Protection Index (BPI)

a measure of the protection offered by burial, taking account of the seabed material properties, the burial depth, and other relevant factors.

Branching Unit (BU)

a subsea housing which terminates and connects more than two cables

Double Armored cable (DA)

cable protected by two similar long-lay helices of heavy wire as an armoring layer. Not very resistant to penetration by seabed implements such as anchors but very strong in tension.

Dispersion Shifted Fiber (DSF)

optical fiber designed for a wavelength of zero chromatic dispersion moved out of the 1300 nm band, often into the 1550 nm band.



Desk Top Study (DTS)

an initial, relatively low cost map-based survey for early planning and to confirm a route as worth making a more detailed (ship based) route survey.

Deep Water (DW)

may be characterized as the depth of water beyond which external aggression is unlikely to affect submarine cable, currently around 1000 m and deeper.

Dense Wavelength Division Multiplexing (DWDM)

a method to increase fiber capacity by carrying information on many (can be >8) colours of pulsed light which can be separated at the receiver using filters.

Erbium Doped Fiber Amplifier (EDFA)

a length of optical fiber doped with Erbium which can provide optical gain to a signal in the 1550 nm band when fed with steady power at ~980 nm or ~1480 nm.

Factory Acceptance Test (FAT)

the point at which manufactured sub-assemblies or sections of cable are tested and then accepted or rejected by the purchaser.

Forward Error Correction (FEC)

a technique for extending optical span distances by adding check bits to the data stream to allow a weaker signal to be recovered from the amplifier and receiver noise.

Internet Protocol (IP)

a protocol which provides a universal way of packaging information for delivery across linked network boundaries.

Local Area Network (LAN)

a shared data communication system to which many computers are attached. A LAN is confined to a local area by the limits of the LAN media (e.g. copper wire).

Light Weight cable (LW)

cable intended for low levels of attack, often used in deep water, often relatively small and weak with a polymer as the only outer protection against water pressure and abrasion.

Light Weight Screened cable (LWS)

as lightweight cable, but with metallic tape and polymer layers added over the base structure, thus providing better abrasion and puncture resistance.

Non-Zero Dispersion Shifted Fiber (NZDSF)

optical fiber designed for a wavelength of minimized, but non-zero, chromatic dispersion moved out of the 1300 nm band, often into the 1550 nm band. This fiber is optimised for use in DWDM systems.

Optical Time Domain Reflectometer (OTDR)

a device for assessing lengths of optical fiber by launching light pulses into it and measuring reflections from optical losses and discontinuities.

Post Lay Burial (PLB)

if the cable lay vessel is lacking the time or equipment to bury the cable at the time of lay, then a second mobilization is required to go back for burial. The cable is very vulnerable in the time between lay and burial.



Post Lay Burial Inspection (PLBI)

An inspection of the quality of cable burial, to confirm that the burial is continuous and that the burial depth is sufficient to give the required protection.

Rock Armour cable (RA)

a variant of double armoured cable where the outer armour has a very short helix, thus providing more flexibility and more resistance to penetration, but also reduced strength in tension and potential issues with twist stored in the cable during manufacture.

Routers

internetworking devices. They generate and store routing tables to allow them to correctly forward IP packets (and so the payload also) to the correct destination.

Route Survey (RS)

a detailed study of a corridor of the seabed where it is intended to lay a cable, paying particular attention to obstructions, rock outcrops and other hazards.

Single Armored cable (SA)

a lightweight cable protected by a single layer of armour wires, which may give adequate performance during and after burial in some seabed soil types.

System Assembly and Test (SAT)

the product to be laid in the forthcoming lay operation is assembled in the factory and fully tested against a detailed specification prior to ship loading.

Synchronous Digital Hierarchy (SDH)

an ITU specification for the multiplexing of multiple low-rate digital signals such as voice and low speed data up to the STM-1 level at 155,520 kb/s. Levels above STM-1 are made by multiplexing N* STM-1 signals to achieve an STM-N signal.

SONET Synchronous Optical Network

The original standard developed by ANSI and BellCore aimed at global interconnectivity at high data speeds, predominantly used as a North American standard. The use of OC-N (e.g. OC-3) denotes a line rate composed of N*51,840 kb/s tributaries.

STM-16 Synchronous Transport Module 16

building block of SDH capacity at 2,488,320 kb/s. More generally, STM-N corresponds to N*155,520 kb/s.

Shallow water (SW)

water depths (generally less than 1000m) where the majority of attacks on subsea cable will take place, although exhaustion of fish stocks is forcing fishing into deeper water.

Transmission Control Protocol (TCP)

a transport layer component which sits above IP in the protocol stack and provides reliable data delivery services over connection-oriented links.

Time Division Multiplex (TDM)

the traditional “telephony” method of combining lower bit rate tributaries into defined time slots in a higher speed transmission line rate.



Voice over IP (VOIP)

the technique of delivering real-time voice communication over the Internet and other private IP networks. The umbrella standard is the ITU's H.323 standard. This Recommendation describes terminals and other entities that provide multimedia communications services over Packet Based Networks (PBN) which may not provide a guaranteed Quality of Service. H.323 entities may provide real-time audio, video and/or data communications. Support for audio is mandatory, while data and video are optional, but if supported, the ability to use a specified common mode of operation is required, so that all terminals supporting that media type can interwork.

Wavelength Division Multiplexing (WDM)

a method to increase fiber capacity by carrying information on several colours of pulsed light which are separated at the receiver using filters. Hundreds of STM-16 optical wavelength channels may be multiplexed into a single fiber although considerably fewer are likely to be required in hydrocarbon applications.

4. System engineering

Prior to finalization of the engineering design, a full analysis shall be completed to ensure the solution is appropriate for the purpose. Any discrepancies from the practices provided below shall be reviewed and agreed.

The engineering and installation of submarine fiber cable is very dependent upon factors outside the control of BP. Each installation will have its own set of peculiarities impacting the reliability or susceptibility of the system to damage. The final solution shall take these factors into account and shall include a restoration and repair strategy to ensure that services are impacted as little as possible when physical faults do occur.

4.1. Capacity planning

The system should be designed to deliver no less than 155 Mb/s (STM-1) per facility.

The basis of this is fiber is being used to provide "unlimited" bandwidth to eliminate the requirement for detailed capacity management. Ideally, a pair of fibres should be dedicated to the BP assets within the hydrocarbon basin running at no less than 2.5 Gb/s (STM-16) initially with identified upgrade potential.

4.2. Availability requirements

Engineered availability shall be no less than 99.995%.

The basis of this is to allow future de-manning and fault tolerance for severe weather operations. It should be noted that the supplier will usually include only intrinsic equipment faults in their availability calculation. The supplier generally takes no responsibility for cable selection or choice of installation techniques because they explicitly avoid contractual liability for faults arising from external aggression such as fishing. The external aggression faults will, in general, greatly outnumber intrinsic faults, and so will dominate the true availability calculation. Availability shall be calculated based on ITU recommendation G.911. The calculation requires a detailed knowledge of the component fault rates and external aggression attack rates and, more problematically, a detailed knowledge of the repair times for every fault type.

4.2.1. Cable system maintenance and repair plan

A quantified repair strategy including expected repair times should exist after the route planning phase of the project.

