



GUIDELINES FOR DISPOSAL OF OPTICAL FIBER WASTE

August 2021

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Forward

Bhutan Power Corporation Limited (BPC) has been entrusted to implement the National Broadband Master Plan Project (NBMP) by the Royal Government of Bhutan. The disposal of optical fiber waste generated during execution of this project has become a challenge and the need to have guideline has been felt. In line to this, BPC has come up with the Guideline for disposal of optical fiber waste with reference to relevant laws and regulations of the land. This document outlines the collection, treatment and disposal of optical fiber waste.

BPC is grateful to Department of Information, Technology & Telecom (DITT), National Environment Commission Secretariat (NECS), Bhutan Telecom Limited (BTL), DrukCom Enterprise Pvt. Limited, Tashi InfoComm Limited (TICL), NANO for their valuable inputs and feedbacks to this document.

It is my sincere wish and hope that with implementation of this guideline, we would be able to properly manage the optical fiber waste, which will contribute to realize the National Waste Management Strategy 2019's goal of 'Zero Waste Bhutan by 2030' and to protect our fragile ecosystem.



Mr. Sonam Tobjey
Chief Executive Officer, BPC



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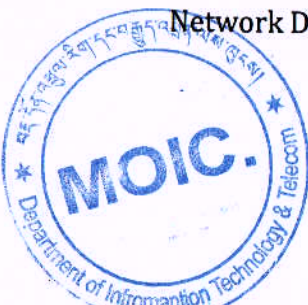
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1. Introduction

Department of Information Technology and Telecom (DITT) under Ministry of Information and Communications (MOIC) has implemented the National Broadband Master Plan Project (NBMP) to establish a fiber optic backbone network throughout the country. Under this project, Bhutan Power Corporation Limited (BPC) is mandated to manage and operate national fiber network of Bhutan. As a part of its mandate, BPC has carried out live line replacement of the existing ground wire with optical ground wire (OPGW) on 220kV, 132kV and 66kV power transmission lines and live line installation of All-Dielectric Self Supporting (ADSS) optical fibers on existing distribution poles. As of December 2020; 18 Dzongkhags have been connected with OPGW and remaining two Dzongkhags and 201 Gewogs have been connected with ADSS cables. BPC has successfully completed installation of 196.81 km of OPGW on 400 kV, 269.11 km of OPGW on 220kV, 517.69 km & 535.08 km of OPGW on 132kV & 66kV power transmission lines respectively. In addition, BPC had also installed 5120.75 km of ADSS cable on the existing power distribution poles of medium voltage (33kV& 11kV) and low voltage (415V) lines as of December 2020.

2. Purpose

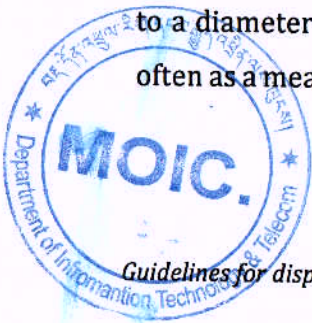
BPC has been executing fiber network works across the country during implementation of the National Broadband Master Plan Project (NBMP). During implementation of the projects, optical fiber wastes were generated. Details are attached in Annexure-I. These fiber optic wastes were listed to be auctioned by BPC. However, there are no buyers and remains in the stockyard.

This guideline is aimed to cover the optical fiber management process by identifying and categorizing such waste and outline the ways of collection, treatment, disposal and recycle of optical fiber waste.

3. Types of optical fiber cables used in BPC

3.1 Optical fiber

An optical fiber is a flexible, transparent fiber made by drawing glass (silica) or plastic to a diameter slightly thicker than that of a human hair. Optical fibers are used most often as a means to transmit light between the two ends of the fiber and find wide usage



in fiber-optic communications, where they permit transmission over longer distances and at higher bandwidths (data transfer rates) than electrical cables. Fibers are used instead of metal wires because signals travel along them with less loss; in addition, fibers are immune to electromagnetic interference, a problem from which metal wires suffer (Fig. 1).

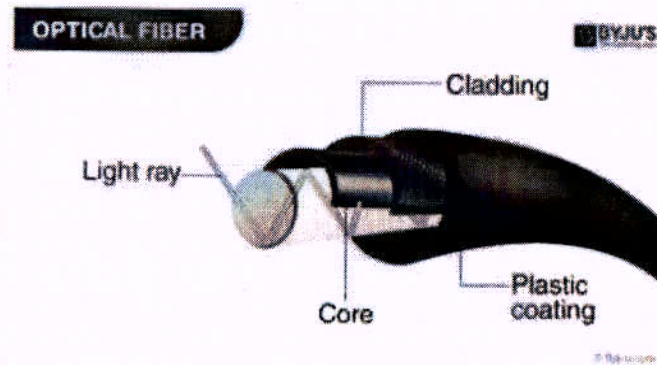


Figure 1: Cross-section of a typical optical fiber

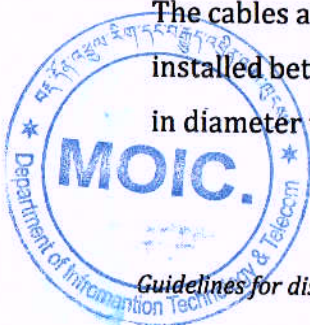
3.1.1 Types of optical fiber cables used in BPC

3.1.1.1 Optical ground wire (OPGW)

An optical ground wire (also known as an OPGW) is a type of cable that is used in overhead power lines that combines the functions of grounding and communications. An OPGW cable contains a tubular structure with one or more optical fibers in it, surrounded by layers of steel and aluminum wire. The OPGW cable is run between the tops of high-voltage electricity pylons. The conductive part of the cable serves to bond adjacent towers to earth ground, and shields the high-voltage conductors from lightning strikes. The optical fibers within the cable are used for high-speed transmission of data.

3.1.1.2 All-dielectric self-supporting (ADSS) cable

All-dielectric self-supporting (ADSS) cable is a type of optical fiber cable that is strong enough to support itself between structures without using conductive metal elements. It is used by electrical utility companies as a communications medium, installed along existing overhead distribution lines and often sharing the same support structures as the electrical conductors. ADSS is an alternative to OPGW with lower installation cost. The cables are designed to be strong enough to allow lengths of up to 700 meters to be installed between distribution poles. ADSS cable is designed to be lightweight and small in diameter to reduce the load on distribution poles due to cable weight, wind, and ice.



In the design of the cable, the internal glass optical fibers are supported with little or no strain, to maintain low optical loss throughout the life of the cable. The cable is jacketed to prevent moisture from degrading the fibers. The jacket also protects the polymer strength elements from the effect of solar ultraviolet light.

4. Optical fiber waste and Health hazards

4.1 Optical fiber waste

Optical fiber is generally produced as primary coated optical fiber. The application of the primary coating is necessary to provide the cladding surface with resistance against moisture and other contamination and which would weaken the bare optical fiber. Other coatings may be applied as required by the cable construction. During jointing or termination processes it is usual to remove the primary coating thereby exposing the cladding surface.

This enables:

- a good bond to be obtained between the cladding and the adhesives used in many terminations
- a good cleaved end to be obtained for fusion splice jointing or polishing in the case of termination.

The cleaving process involves the removal of a length of bare optical fiber that is sometimes called a “shard” or given the generic term “optical fiber waste”. The term “optical fiber waste” is also given to short lengths of primary or secondary coated optical fiber that may be cut from a cable during the installation process. The ends of optical fibers are also often exposed in longer off-cuts of primary coated or secondary coated/buffered optical fibers and cables. In these cases, the primary coating may or may not be present around the ends of the optical fiber. The cable off cuts are given the generic term “optical fiber waste” (Fig. 2).



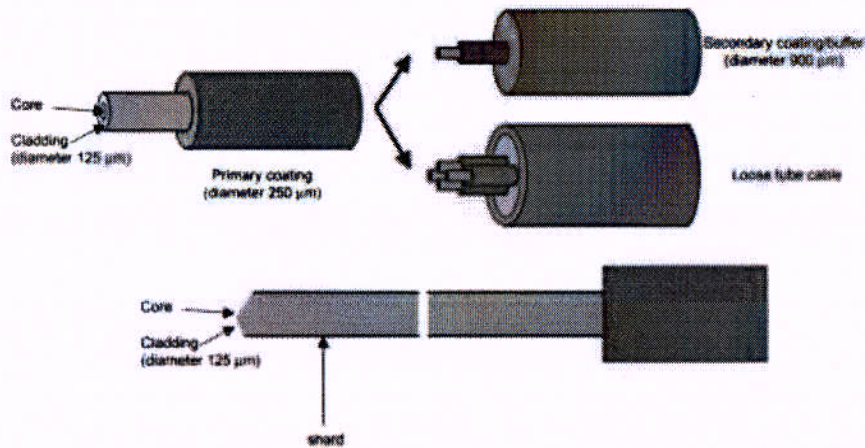


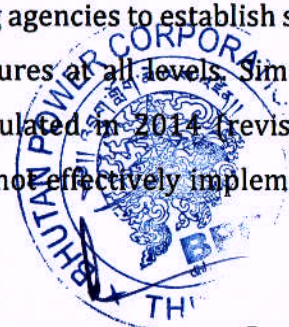
Figure 2: Optical fiber waste during jointing and termination process

4.2 Health Hazards associated with optical fiber waste

Optical fiber shards are only 125 μm (1/8 mm) in diameter and can easily penetrate the skin. Penetration of the skin by these shards can cause pain (sometimes intense if the shard is long enough to reach a nerve fiber or bone) and may cause irritation and inflammation of the affected area. In extreme cases, the wound can become infected. Further, as these shards are difficult to see, particularly when they are of short length, and there is risk of them being carried on the surface of the skin and transferred to other areas such as eyes and mouth. A significant health hazard of optical fiber waste is that once inside the body it is invisible to normal type of analysis including X-rays. If cut pieces of fiber end up in one's food, it could cause internal bleeding and conceivably death. Therefore, it is very important to implement measures targeted to minimize the risk of ingestion of optical fiber shards during the installation process and afterwards when non- expert users may enter the areas containing optical fiber cabling.

4.3 Waste Management in Bhutan

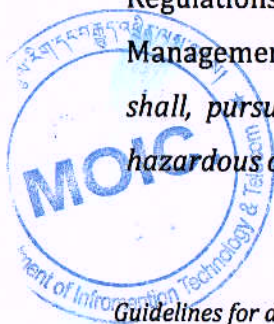
The Royal Government of Bhutan intends to promote environmentally sound waste management practices. The Waste Prevention and Management Act of Bhutan was adopted in 2009 with the view to promote 3Rs (Reduce, Reuse and Recycle materials) and to improve final disposal sites. Subsequently, Regulations on waste management was adopted in 2012 and the amendment of 2016 to establish procedures to implement the purpose of the Act by identifying roles of implementing agencies to establish sound waste management system including monitoring procedures at all levels. Similarly, Integrated Solid Waste Management Strategy was formulated in 2014 (revised in 2016). However, the waste management measures were not effectively implemented



even though the responsible authorities for waste management were clearly specified and identified by Law. This was due to various factors such as limited number of personnel and budget, lack of capacity of implementing agencies, lack of awareness and cooperation of the general public. Taking into account all these facts, National Waste Management Strategy was adopted in 2019. The overall aim of the strategy is to prevent and minimize the generation of waste at source, and to divert materials to be refused, re-used, recovered, and recycled, to minimize the amount of waste going to the landfill. It also aims to make a paradigm shift from traditional linear development model of 'take, make, consume and dispose' to a 'circular economy', where all materials are used in loops at each stage of its production. The goal of the strategy is to continuously move towards "Zero Waste Bhutan by 2030" in partnership with the public and all agencies and development partners. The major objectives of the strategy include; inculcating a deep sense of environmental responsibility by consuming less material, managing waste effectively by following integrated concept for maximum material recovery in order to minimize quantity of waste going to disposal sites; promoting stakeholders' participation in waste management and to ensure proper treatment of all types of waste.

4.3.1 Categorization and Management of optical fiber waste in Bhutan

Currently, optical fiber waste is not listed under any category of waste in Bhutan. However, a '**hazardous waste**' is defined as (a) waste which because of its quantity, concentration, persistence or physical, chemical or infectious characteristics may cause or significantly contribute to an increase in mortality or an increase in serious irreversible, or incapacitating reversible, illness or pose a substantial present or potential hazard to human health or the environment when improperly treated, stored, transported, or disposed of, or otherwise managed and (b) belong to any of the categories listed in Annexes to the regulation on hazardous waste under the Act. '**Sharps**' are defined as needles, syringes, scalpels, blades, broken vials, ampoules and other glass articles, or any other items used or unused that may cause an injury (Waste Prevention and Management Act of Bhutan, 2009; Waste Prevention and Management Regulations of Bhutan, 2016). Chapter II; clause 9 of the Waste Prevention and Management Regulations, 2016; states that, "*The National Environment Commission shall, pursuant to scientific determination, notify stakeholders whether the waste is hazardous or non-hazardous*".



In line to this, National Environment Commission Secretariat (NECS) vide letter no. NECS/WMD/WMFP/23/2021/256 dated July 22, 2021 have categorized optical fiber waste as 'hazardous waste'.

This document outlines the procedures for collection, treatment and disposal of optical fiber waste.

4.3.2 Collection, treatment and disposal of optical fiber waste

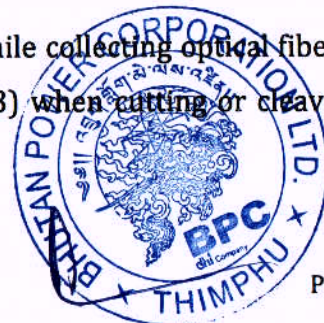
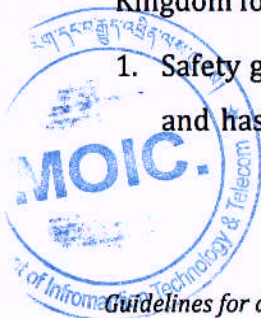
The procedures for collection, treatment and disposal of optical fiber wastes are prepared in reference to The Waste Prevention and Management Regulations of Bhutan, 2012 and Technical support guide for disposal of optical fiber waste, 2005; The Fiber Optic Industry Association (FOIA), United Kingdom.

Chapter II, Clause 16 of Waste Prevention and Management Regulations of Bhutan, 2012; outlines the responsibility of point source that generates hazardous waste; it states that, the Implementing Agency shall be responsible and accountable to:

1. have in place a systematic handling and safe disposal of hazardous waste generated within its jurisdiction;
2. follow pre-treatment process, storage and safe transportation of hazardous waste to designated approved site for such dumping or release;
3. display notifications on hazardousness of wastes at prominent places of the workplace;
4. put label and biohazard symbols on containers to highlight associated risk and danger while handling its contents;
5. provide adequate, appropriate and regular supply of personal protective equipment and ensure all time use by the personnel handling hazardous waste; and
6. maintain detail records of incidents of injuries, accidents and noncompliance to the regulation.

The following paragraph are excerpts from the technical support guide for disposal of fiber optic waste, 2005 by The Fiber Optic Industry Association (FOIA), United Kingdom for handling, treatment and disposal of optical fiber wastes:

1. Safety glasses and latex gloves should be used while collecting optical fiber waste and has to be placed in 'sharp containers' (Fig. 3) when cutting or cleaving it is



- recommended that long lengths of optical fiber be removed that are clearly visible;
2. the exposed ends of optical fiber cable waste shall be taped and shall be placed in tough plastic bags; the bags shall be standard biohazard bags or be labelled "CAUTION, FIBER OPTIC OFFCUTS".
 3. excess cable on drums should have the ends taped over and the end should be secured to the drum
 4. ensure that all waste produced is placed in a small well defined area to enable maximum collection efficiency
 5. Optical fiber wastes should be shredded and incinerated and then can be treated like any other general wastes for disposal.



Figure 3: Example of container for collection of optical fiber waste

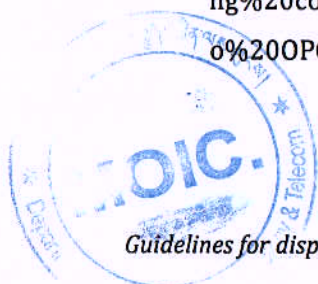
4.3.3 Export of optical fiber waste for recycling

Chapter 2, clause 10 of Waste Prevention and Management Regulations of Bhutan, 2012; states that, "Hazardous waste may be exported subject to the prior written consent of the country of import following necessary packaging and required health and safety procedures within Bhutan". In line with this, the implementing agency may also look to explore ways in coordination with local waste traders and scrap dealers for possibilities to export optical fiber wastes to countries where recycling facilities are available.



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6. Annexure-I

Table 1: Inventory of optical fiber cables in BPC as of March 2021 (Source: Fiber & Network Division, ICD, STS, BPC)

SN	Type of Cable	Meters (m)
	ADSS Cable (New)	
1	24 Fiber	13,138
2	48 Fiber	5,706
3	72 Fiber	7,107
4	24 Fiber (Underground)	7,500
	OPGW	
1	OPGW 24F	14,150
2	OPGW 24F (Underground)	3,218
	Unserviceable Cable	
1	ADSS cable	3,700

