

# Trigger Optical Fibre for Converter Valve

Li Xiaobing, Fu Xinhua, Yu Lei, Xiong Ping, Yu Xiaojun

**Abstract:** Optical fibre plays an important role in converter valve communication and thyristor triggering due to its anti-electromagnetic interference, high bandwidth, high insulation and other characteristics. This paper introduces the working principle of the converter valve, expounds the application of the trigger optical fibre in the converter valve, and compares the trigger optical fibre for converter valve with the common communication optical fibre.

**Key words:** converter valve, thyristor, optical fibre, high insulation

## 1 Introduction

Several core technologies of electric power grid in China have been mastered and monopolized by foreign enterprises for many years. However, many domestic upstream and downstream enterprises have made unprecedented breakthroughs in UHVDC, VSC-HVDC, new energy grid connection, grid protection, power dispatching automation, power system security and monitoring, gradually realizing independent innovation and localization of equipment and raw materials, and have walked in the industry frontier in some fields.

The breakthrough in localization and independent innovation of power grid equipment and technologies depends on the breakthrough in technologies such as core raw materials, industrial control technology, optical fibre sensing technology and so on. One of the important directions of these technologies is special optical fibre, industrial control and networking technology of special optical fibre and key optical fibre sensing technology based on special optical fibre.

With the continuous development and progress of various technologies in China, the UHVDC and VSC-HVDC projects independently developed by many organizations in China have been reported. And the technical level and industry status are at the world's leading level. But among them, the special optical fibre with converter valve and control networking

technology has been monopolized by foreign manufacturers.

## 2 Current Status of Optical Fibre for Converter Valve

Within the global special optical fibre industry, only Yangtze Optical Fibre and Cable Joint Stock Limited Company (YOFC), through continuous research and development and accumulation, has developed the solution of special optical fibre for converter valve based on UHVDC and VSC-HVDC projects, which is the first to achieve the localization of key raw materials, and truly enables the manufacturing of power electronic equipment in China to achieve the transformation from following to surpassing. Especially in recent years, many projects, such as UHVDC, VSC-HVDC, UPFC, back-to-back DC transmission system, have been completed in China, which basically rely on the special optical fibre solution provided by YOFC and provide a strong guarantee of "zero accident, zero complaint" for the national power grid.

## 3 Converter Valve Principle

The converter valve plays a key role in UHVDC and VSC-HVDC. AC or DC can only be transmitted

after being converted by converter valves (as shown in Figure 1).

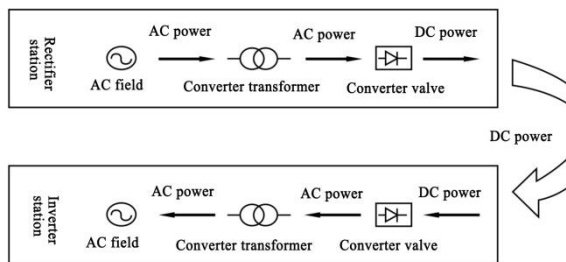


Figure 1 Schematic Diagram of HVDC Transmission System



Figure 2 Converter Valve Equipment (Source: State Grid XJ Group Corporation)

The core equipment of converter valve is thyristor. Thyristor is a kind of switching element, which can work under high voltage and high current, and its working process can be controlled. Under the condition of high voltage, when thousands of thyristors are operating at the same time, the electromagnetic interference intensity will be very high, and the trigger pulse in the thyristor trigger system will be impacted by the strong interference, resulting in thyristor mistakenly triggered, not triggered or deteriorated pulse quality, etc. At the same time, the thyristor rectifiers are often under high voltage state with voltage up to thousands of volts. As a low-voltage weak-current system, in order for the trigger control system to operate normally and safely, it is necessary to take corresponding isolation measures for other related components.

#### 4 Application of Optical Fibre in Converter Valve

The trigger control of converter valve is realized by transmitting laser signal of certain power in UHVDC and VSC-HVDC with special optical fibre for converter valve. At present, optical fibre trigger technology is mainly applied in optic/electric hybrid triggered thyristor (ETT) valve, light triggered thyristor (LTT) valve and VSC-HVDC valve (IGBT, etc.).

Optical fibre has the characteristics of anti-electromagnetic interference, high insulation and stable optical signal, which can solve the problem of pulse transmission interference and high-voltage isolation of low-voltage circuit. Transmission control optical fibre cable is required to have good electromagnetic radiation resistance, high-voltage breakdown resistance, moisture resistance and flame resistance. Trigger signals, power standard connectors and adapters also have a variety of requirements for the geometric and optical performance of optical fibre.

#### 5 Comparison of Trigger Optical Fibre for Converter Valve and Common Communication Optical Fibre

Compared with common optical fibre, it has the following advantages:

(1) Large core diameter and large numerical aperture. It can couple more light power from the light source, transmit more light signals and energy and keep normal operation under high temperature and high pressure, which meet the signal and energy transmission requirements of thyristor triggering and check in ETT valve, LTT valve and VSC-HVDC valve.

(2) The silica optical fibre with large core diameter has wide transmission wavelength range, high mechanical strength, good bending performance and good electrical stability and electromagnetic radiation resistance, so it will not be easily broken in the strong bending condition or the open construction environment during the installation and the use of terminal. The low -OH optical fibre with large core diameter and plastic cladding, compared with the

conventional glass-cladding optical fibre, has higher tensile strength and can better resist the influence of moisture, so it can be widely used in electric power environment.

### 6 Specification and Application Example of YOFC Trigger Optical Fibre for Converter Valve

Based the specific needs of ETT, LTT, VSC-HVDC valve and wind power control and other application scenarios, YOFC has promoted special optical fibre products for valves of different specifications. These products have also been applied in many power grid projects in China, such as Jinping-Sunan  $\pm 800$  KV UHVDC Transmission Project, Hami South-Zhengzhou  $\pm 800$  KV UHVDC Transmission Project, Zhoushan Multi-terminal VSC-HVDC Demonstration Project, Xiluodu-West Zhejiang  $\pm 800$  KV UHVDC Transmission Project, HVDC Transmission Project from Yunnan Jinshajiang Midstream Power Station to Guangxi, Lingzhou-Shaoxing  $\pm 800$  KV UHVDC Transmission Project, Jiuquan-Hunan  $\pm 800$  KV UHVDC Transmission Project, etc.

Trigger optical fibre for converter valve can be customized into special optical fibre with different core and cladding diameters, different coating materials, different coupling powers, so as to be applicable for different connectors.

Table 1 Special Optical Fibre for Valve

Application Scenario	Core diameter $\Phi$ (μm)	Cladding diameter $\Phi$ (μm)	Coating diameter $\Phi$ (μm)	Numerical aperture NA	Type Name	Subscription No.
VSC-HVDC valve	62.5	125 $\pm$ 1.0	245 $\pm$ 7	0.27 $\pm$ 0.02	GB2.5/125-27/250	GB2012-F
ETT	105	125 $\pm$ 2	250 $\pm$ 20	0.22 $\pm$ 0.02	SH05/125-22/250	SB2014-D
	200	230+0-8	500 $\pm$ 25	0.37 $\pm$ 0.02	HPCF200/230-37/500E	HP2140-A
	200	250+0-8	500 $\pm$ 25	0.20 $\pm$ 0.02	GB200/250-20/375	GB2013-Q
LTT	200	230+0-8	500 $\pm$ 25	0.37 $\pm$ 0.02	HPCF200/230-37/500E	HP2140-A
Wind power	200	230+0-8	500 $\pm$ 25	0.37 $\pm$ 0.02	HPCF200/230-37/500E	HP2140-A

In power grid environment, transmission control optical fibre is required to have good electromagnetic radiation resistance, high-voltage breakdown resistance, corrosion resistance, moisture-proof and fire-retardant properties after cabling. YOFC has complete fabrication technology and platform for fibre optical cable based on special environment and special materials. In the power grid environment, on the one

hand, technology and platform are applied for various optical fibres which have light weight and good bending radius through the adoption of special internal and external jacket material for the internal and external protective layers; on the other hand, the tensile and flattening resistance of the optical fibre cable is improved by adding necessary reinforcing elements, at the same time, several main structural types can be designed, such as tight buffered optical cable, loose buffered optical cable, stranded optical cable and bunched optical cable, which can provide reliable protection for optical fibre according to the application situation, and can directly match all kinds of system components in power network and fully serve the application environment such as power network control.

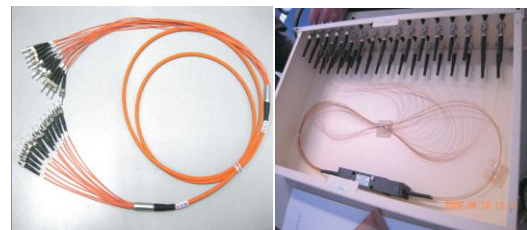


Figure 3 Physical Object of Trigger Optical Cable Assembly

## 7 Summary

YOFC has been serving the construction of electric power grid in China for many years, and is the only manufacturer that can provide special optical fibre and corresponding technical solutions for electric converter valves in China. In engineering cases over many years, YOFC has maintained the good reputation of "zero accident, zero complaint" in the industry. With the endlessly emerging of new power grid technology applications, higher requirements will be put forward

for special optical fibre for electric power.

As a domestic specialist in special optical fibre industry, YOFC will continue to promote the technological innovation of optical fibre and cable, and work with downstream customers to promote the localization of key equipment of power grid. We believe, in the future, we can make it more reliable in communication, more accurate in sensing, more intelligent in control, and better in life through special optical fibre.

## 长飞光纤光缆股份有限公司

Yangtze Optical Fibre and Cable Joint Stock Limited Company

地址：武汉市光谷大道9号（430073）

ADD: No.9 Optics Valley Avenue, Wuhan, Hubei, China(P.C.: 430073)

电话(Tel): +86 400-991-6698

邮箱(Email): [marketing@yofc.com](mailto:marketing@yofc.com)

[www.yofc.com](http://www.yofc.com)