

An overview of 500kV XLPE cable projects
and
Completion of 500kV PQ test in China



An Overview of 500kV XLPE Cable Projects in Japan (only major projects by JPS)

Year Comissioning	Application (Conductor size)	Section Length (approx.)	Insulation thickness and Joint
1986	Pumped storage P.S.(800mm ²)	190m (620')	35mm thick w/o joint
1987	Pumped storage P.S.(1400mm ²)	610m (2000')	32mm thick w/o joint
1995	Hydro P.S. (800mm ²)	1350m (4400')	32mm thick w/o joint
1997	Thermal P.S.(1200mm ²)	1200m (3900')	32mm thick w/o joint
1998	Pumped storage P.S.(800mm ²)	730m (2400')	27mm thick w/o joint
2000	Transmission in Tokyo Bay (2500mm ²)	1200m (3900') (40km route)	27mm thick w/ EMJ (Extrusion molded joint)
2004	Thermal P.S. (1000mm ²)	1100m (3600')	27mm thick w/o joint
2009	Nuclear P.S. (2500mm ²)	400m (1300')	27mm thick w/o joint
(2010)	Nuclear P.S. (2500mm ²)	1360m (4400')	27mm thick w/o joint

500kV XLPE cable is used for various types of Power Station including transmission. Feeder for P.S. was designed w/o joint for reliability with very long length cable. EMJ for a long cable line is time-consuming (field mold) and almost discontinued. A prefabricated type joint and Oil-less termination will be needed for future project.

An overview of 500kV XLPE Cable Projects in China

(supplied and installed by JPS)

- **6 projects have been already in commercial service without failure.**
- **Most cable lines are for pumped storage P.S. in inclined tunnel or shaft** having great elevation difference (300ft ~ 700ft).
- **Normally GIS termination is used** except one with outdoor termination.



Baoquan
④ 宝泉

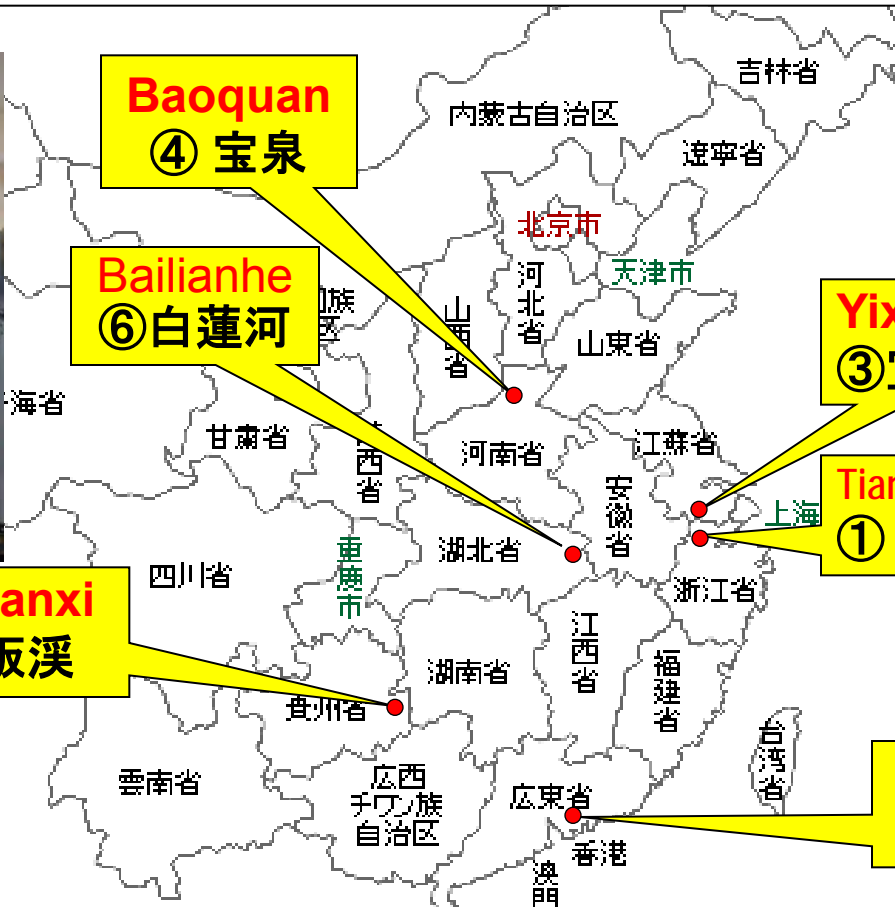
Bailianhe
⑥ 白蓮河

Yixing
③ 宜興

Tianhuangping
① 天荒坪

Sanbanxi
② 三板溪

Huizhou
⑤ 惠州



Commissioning Test of 500kV XLPE cable in China

Practices in China;

- GIS (GIB) is designed to equip with test bushing for testing GIS and/or GIS and cables together.
- For testing 500kV cable system on site, **AC 510kV (1.7U_o) is applied for 1 hour.**
- For long distance transmission line, AC Soak Test (U_o for 24h) is applied.
- It is possible to measure at lower level (U_o) with minimum noise at GIS termination. Especially, if only Soak test (U_o) is carried out, PD measurement is recommended.
- Voltage test on cable jacket is conducted **at DC 20kV~30kV for 15 min.** according to Chinese Standard on site.



Testing view at 510kV AC for 1 hour.

Prequalification Test on 500kV XLPE Cable System

· Development Test on Prefabricated Composite Joint.

In 2001, under co-research with Japanese Utilities, a long-term test on 500kV Prefabricated Composite Joint was carried out **at 1.45 U₀ for 6 month.**

· Prequalification Test in accordance with IEC 62067

IEC 62067 was established and introduced Prequalification test protocol.

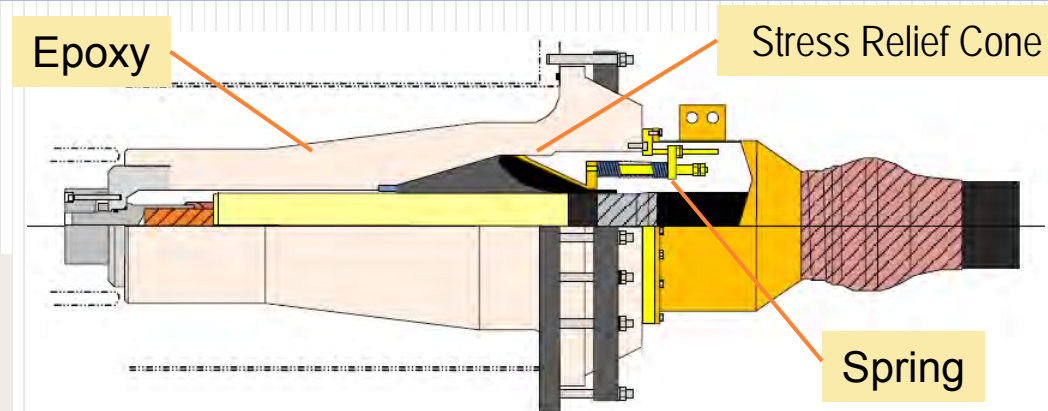
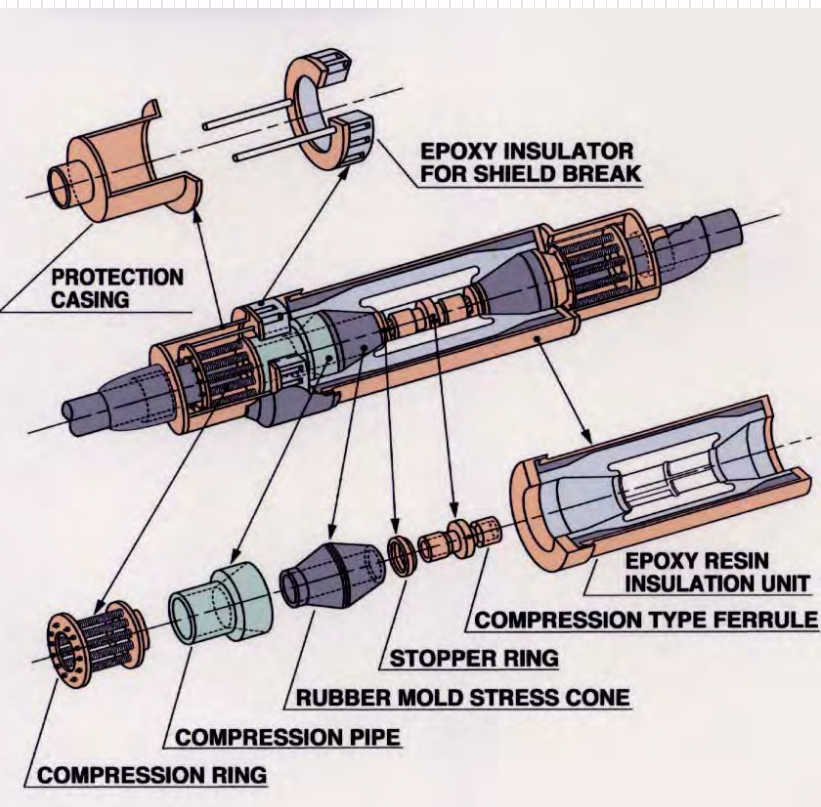
PQ Test requests heat cycle voltage test **at 1.7 U₀ for 1 year.**

To comply with increasing demand in overseas and new standard, in 2009, JPS carried out 500kV PQ test at Wuhan High Voltage Research Institute, P.R. of China, which covers both IEC 62067 and Chinese Std. (GB/T 22078-2008) as **some Chinese users specify different requirement (LIWV 1675kV for 500kV)**

· Tested Objects:

- Cable: **500kV 2500mm² Al-sheathed XLPE Cable, 170m**
- Insulating Joint: **Prefabricated Composite Type, 1 set**
- **SF₆ Sealing End: Dry Type Prefabricated Termination, 2 sets**
- Outdoor Sealing End: Porcelain Insulator + Condenser Cone, 2 sets
(Oil immersed Outdoor termination)

Dry type prefabricated termination and Prefabricated composite joint



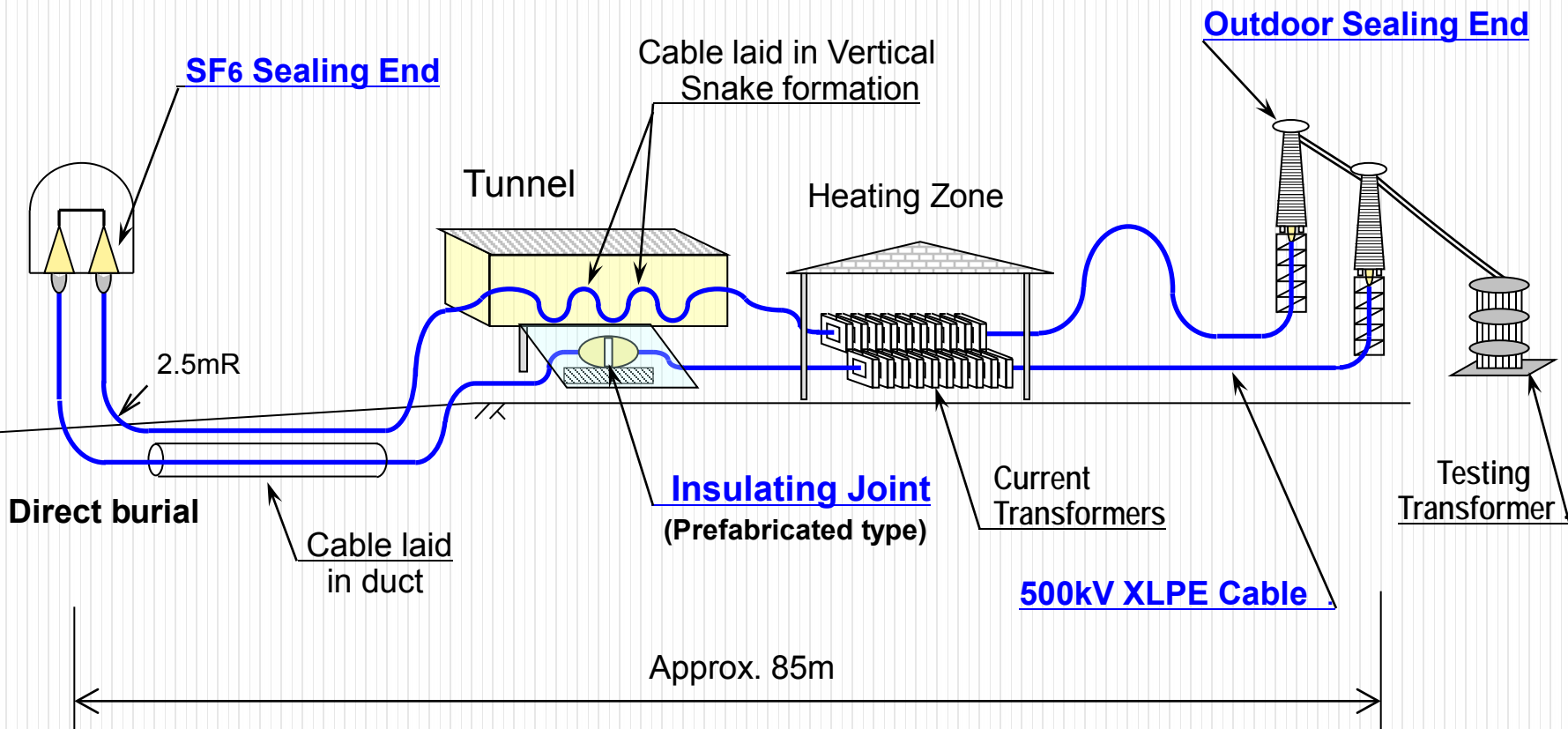
Dry type prefabricated termination

Design concept of **a spring-loaded stress-relief cone with epoxy bushing** is very similar to Prefabricated Composite Joint.

Dry type termination for GIS is common design for 345kV - 500kV according to category of IEC 60859. (Short type, 960mm (38") bushing)

500kV Prefabricated Composite Joint

Configuration of Prequalification Test Line at Outdoor Testing Field of WHVRI (China)

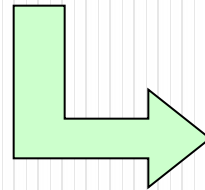


Prequalification Test Set-Up for 500kV XLPE Cable System (1)

SF6 Sealing Ends



Prefabricated Type Joint



**Put in
Joint House**



Prequalification Test Set Up for 500kV XLPE Cable System (2)

Duct Section



**Snake Installation
of Cable in Tunnel**



**Overall
Layout
of the
Test Line**
(Under
Construction)



**Current Transformers for
Heating Cable System**

Outdoor Sealing Ends



PQ Test Results on 500kV XLPE Cable System

(1) Heating Cycle Voltage Test

- Apply AC 493kV (= 1.7U₀) for 8,760h
- 180 times @90°C~95°C

(2) Lightning Impulse Voltage Test

- Lightning Impulse Voltage Tested;
 - (a) ±1,550kV×10times (Specified tests)
 - (b) ±1,675kV×10times (Additional tests)
- Conductor Temperature: at 90~95°C
- IEC 62067 requests impulse test only for the cable (>30m) but the above impulse test was carried out **on the whole test system and also each type of accessories with sufficient length of cable** cut from the test line.

(3) Examination of Cable System

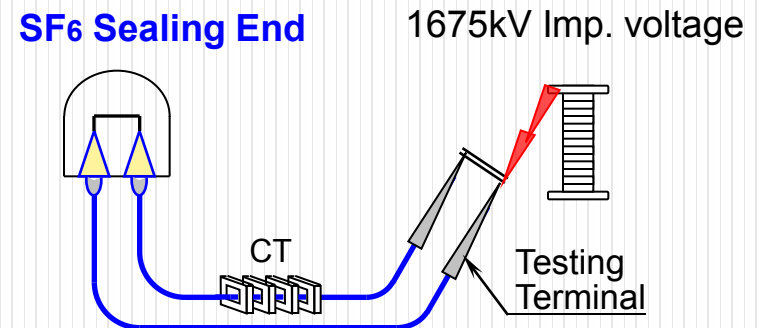
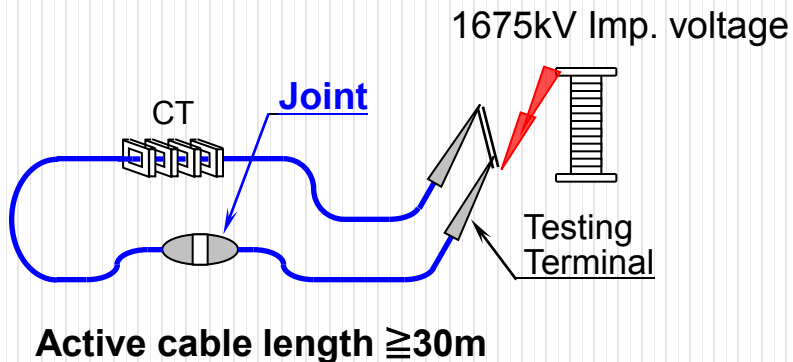
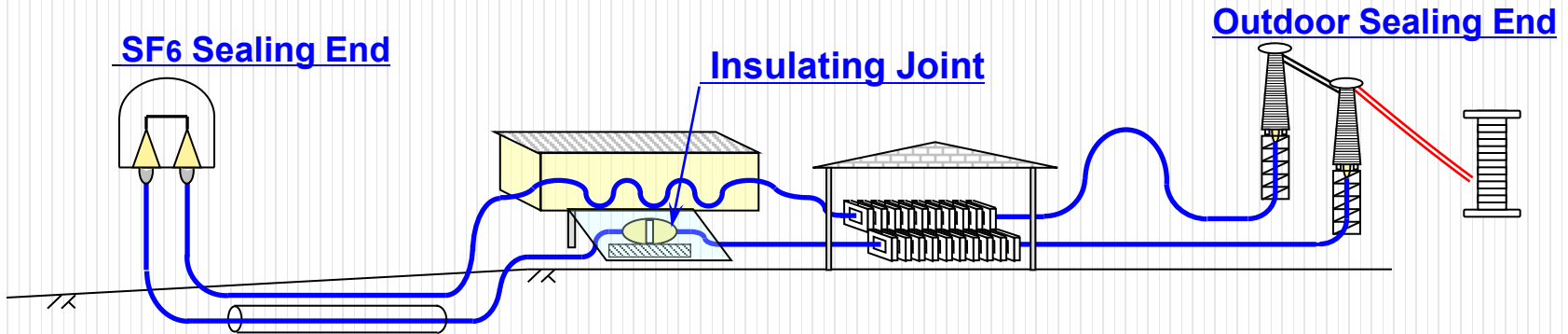
- Examination of the cable system with cable and accessories revealed no signs of deterioration.

Thank you for your attention!



Additional impulse voltage test after IEC 62067 PQ test .

$\pm 1550\text{kV}$ & $\pm 1675\text{kV}$ Imp. voltage



- All accessories successfully passed the impulse voltage tests at $\pm 1,550\text{kV}$ and $\pm 1,675\text{kV}$.