A.3.4. Développement d'une jonction temporaire de réparation pour câble 275 kV à isolation polyéthylène réticulé

TOYA A., KATSUTA G., The Tokyo Electric Power Co., Tokyo, Japon
NAKANO T., ADACHI K., The Furukawa Electric Co., Tokyo, Japon
SHIIBA Y., NAKANISHI T., Sumitomo Electric Industries, Osaka, Japon

Résumé

Depuis quelque temps, l'utilisation du câble XLPE à tension de service connaît un essor rapide. En outre, dans la région métropolitaine, l'on est actuellement en train de construire une ligne de transmission souteraine avec câble croissante d'électricité dans la région. Dans le même temps, les exigences de stabilité de l'alimentation électrique sont devenues de plus en plus sévères. En particulier, si une panne venait à se produire dans une ligne de transmission interurbaine majeure, cela aurait des conséquences considérables. Pour limiter les répercussions, il est de toute première importance de réparer la ligne endommagée dans les plus brefs délais. C'est pourquoi nous avons mis au point un joint pour réparations d'urgence conqu pour un usage à court terme uniquement, capable d'être monté en 2 jours contre les 10 jours nécessaires à l'heure actuelle pour monter le joint de type extrudé.

A.3.4. Development of short term use repair joint for 275 kV XLPE insulated cable

TOYA A., KATSUTA G., The Tokyo Electric Power Co., Tokyo, JAPAN
NAKANO T., ADACHI K., The Furukawa Electric Co., Tokyo, JAPAN
SHIIBA Y., NAKANISHI T., Sumitomo Electric Industries, Osaka, JAPAN

Abstract

Recently, the service voltage of XLPE cable in Japan is rapidly rising. Furthermore, in metropolitan areas, the construction of long distance 275kV XLPE cable underground transmission lines are in progress, to cope with the increasing demands of electricity in the areas. Mean while the requirements of the stable power supply becomes severer and severer. Especially, if a breakdown should occur in principal trunk transmission line, its impact would be huge. In order to limit the impact, it is crucially important to restore the damaged line as soon as possible. For this reason, we have developed the emergency repair joint, which could be assembled in 2 days, as being short-term use only, whereas it takes 10 days to assemble the extruded mould type of joint at present.

1. Introduction

XLPE cable, which requires no installation space for fire-fighting equipment or oil supply equipment and presents little possibility of environmental pollution, has recently come to be widely used in Japan in place of Oil-Filled cable, which uses oil for the cable's electrical insulation. XLPE cable is presently being used on underground power transmission lines of up to 275 kV. To cope with the growth in the demand for electric power in urban areas during this century, underground XLPE cable power transmission lines dozens of kilometers long are being built. Such ultra-high-voltage power transmission trunk lines have assumed a very important role today, when a reliable power supply is demanded to support this mainstay of an information oriented society. Under these circumstances, in order to minimize the effect on the public of any accident which would damage the insulation on a power transmission line, an emergency repair joint has been developed which could be assembled in 2 days for phase. This report discusses the results of the development of these short-term-use repair joints, which replaces the extrusion-molded joint (EMJ), which now takes at least 10 days per phase to install.

2. Development specifications

In setting the development specifications, a primary condition was to restore service as quickly as possible: "must be able to repair and restore operation within 48 hours after the occurrence of a breakdown along a power transmission line." The operating condition for this emergency repair joint is set to "provided for emergency response if the breakdown occurs in summer, when the amount of electric power used reaches its peak," and it was decided to be satisfied 3-months-heat-cycle performance and then replaces the EMJs for parmanent restorsion. Based on these premises, the specific deveiopment specifications were set as shown in Table 1.

3. Development subjests

(1) Selection of insulation method

In order to develop a joint of simple structure that can be installed quickly and electrically withstand ultra-high voltages, various conceivable insulation methods were widely identified, and their electrical insulation performance, ease of installation, and difficulty of development were studied and experimentally evaluated as shown in Table 2.

Table 1: Development terget specifications

Item	Premise	Joint development target standard
Restoration time	48 hours/ phase	from removal of the damaged cable to complete restoration of service along the line within 33 hours *1
Electrical performance test	ACvoltage	420kV／3hrs *2①
	Impulse voltage	-1050 kV／3 times(BIL value)
	Heatcycle test	185 kV/3months *2② RT~90℃ 8hrs:ON/DAY
Shape, size	appli-cable to existing manholes	about the same as existing EMJs

*1 Set as requiring 15 hours for inquiry of breakdown point
*2 ① Initial performance voltage: 420 kV/3 hr (H)
AC420kV = 275x (1.15/1.1) x (1/SQRT(3))x K1 x K2 x K3
- K1: degradation coefficient 2.08 (3 months of degradation based on the rule of 9th power) 2.08
- K2: temperature coefficient 1.1
- K3: redundancy 1.1

② Long-term heat cycle performance: 185 kV/3 months
AC 185 kV = 275 x (1.15/1.1) x (1/SQRT(3)) x K1 x K3

Table 2: Evaluation of applicability of various types of joints for emergency restoration use

Insulation method	Applicable system voltage	Assembly time (per phase)	Difficulty of development	Overall evaluation
Extrusion molded(EMJ)	~500kV◎	15days×	(of existing product)	×
Prefabricated molded(PMJ)	~275kV○	10days×	(of existing product)	×
Oil-impregnated paper	~500kV◎	36hrs △	small	△
Tape-wound	~154kV△	11hrs ○	small	○
Gas	~275kV○	15hrs ○	small	○
Shrinkable tube	~66kV ×	5hrs ◎	large	△
Organic block embedded	~22kV ×	2hrs ◎	very large	×