



## B9.5

### Integration of underground cables in an overhead line

TASSY J., EDF Production Transport, Courbevoie, France

BOURGEAT X., EDF DER, Moret sur Loing, France

#### Résumé :

Les « siphons » (tronçons souterrains insérés dans une ligne aérienne) subissent des contraintes différentes de celles rencontrées pour des liaisons souterraines classiques (raccordées entre deux postes). Les points à étudier sont :

- les montées de potentiel sur défaut 50 Hz, qui détermineront le mode de connexion des écrans,
- les montées de potentiel sur choc de foudre et de manoeuvre, qui détermineront le type de limiteur de surtension, ainsi que la longueur des câbles de raccordement associés,
- les conditions d'exploitation, qui fixeront les politiques de protection et de réenclenchement,
- l'installation des extrémités, qui sera aussi simple que possible.

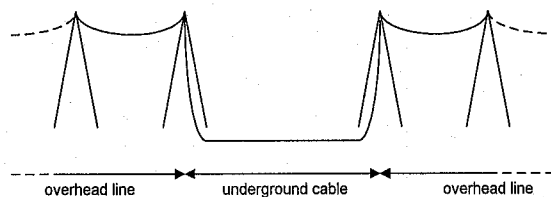
#### Abstract :

Underground cables inserted in an overhead line (this kind of link is called a « siphon »), are subjected to stresses that are different from those of classical underground lines (installed between two substations). The points to be studied are :

- the voltage rises due to 50 Hz faults, which will govern the sheath bonding method,
- the transient potential rises due to switching or lightning impulses, which will give us the type of Surge Voltage Limiter to be used and the associated maximum bonding lead length,
- the operating conditions, which will determine the reclosure and protection systems policies,
- the installation of the terminations, which will be as convenient as possible.

#### 1-Introduction

Because of environmental and technical constraints, utilities have in some cases to build mixed lines, composed of an underground cable link inserted in an overhead line. In this paper, the underground section of a mixed line is called « siphon ».



The terminations of the underground cable are not set up in substations. This generates some specific difficulties which do not exist for classical underground lines (connected between two substations).

These difficulties concern :

- the voltage rises due to 50 Hz faults ; these faults may occur either on the overhead line or on the underground cable ;

- the transient potential rises due to switching or lightning impulses ;
- the operating conditions : reclosure and protection systems policies ;
- the installation of the terminations.

This paper deals briefly with all these points and presents EDF's practices for the 225 kV level. At the end of the paper, two examples of siphons studied by EDF are described.

We shall only consider specially bonded cables, that is to say single point bonded or cross bonded cables.

#### 2-Sheath overvoltages : maximum feasible underground length/major section

##### 2.1 General

We need to protect the main insulation, the cables sheaths, and the cross bonding joints, both during lightning impulses and 50 Hz faults.

The withstand levels for the french 225 kV cables are the followings :