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## B.10.5. Suivi du vieillissement thermique de câbles de type LOCA en EPR/CSPE

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**Résumé**

La durabilité en service des matériaux utilisés en centrale nucléaire est fortement dépendante de l'environnement sévère, c'est à dire des contraintes thermiques et radiochimiques. Les câbles de type LOCA en EPR/CSPE font partie de ces matériaux. Pour prévoir leur durée de vie , il est important de connaitre leur état de dégradation.
Les méthodes généralement utilisées pour suivre et modéliser le vieillissement des polymères (propriétés spectrales ou mécaniques) se révèlent difficiles à appliquer ou à interpréter avec des matériaux formulés. Ce travail présente les résultats que donnent une technique peu courante dans ce domaine: la spectrométrie diélectrique. L'application au suivi du veillissement thermique se révèle parfaitement adaptée aux élastomères formulés, mais aussi directement sur les câbles.

## B.10.5. Thermal ageing monitoring of LOCA cables

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**Abstract**

Long term behaviour of materials used in Nuclear Power Plants is strongly dependent on drastic conditions, i.e. thermal and radiochemical stresses. EPR/CSPE class LOCA insulation cables are used under such conditions, and it is important to know their degradation state. Spectral or mechanical methods are generally used to follow polymer ageing, but are difficult to apply to compounded materials.
This work presents experimental results using dielectric spectroscopy which is a very convenient method for the following of thermal ageing of insulation polymers, and also cables.

### Introduction

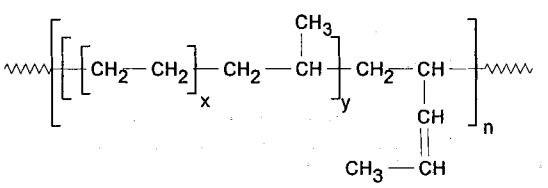
In French Nuclear Power Plants, inside the nuclear reactor containment, the insulation cables most widely used in class LOCA (Loss Of Coolant Accident) equipment are Ethylene-Propylene Rubber (EPR) as insulation part and Chlorosulfonated polyethylene (CSPE) as sheath part. These materials may be required to operate satisfactory for long periods up to the life time of the plant. Therefore, their long term behaviour under such conditions need to be assessed[1].
This work is part of the research program which has been performed to estimate the cable remaining life time.
In normal conditions, the most exposed materials are subjected to thermal stress about 50°C.
The objective of this investigations is to determine the effect of thermal ageing on accelerated aged EPR and CSPE samples, and to verify those results on cables aged in the same conditions.The changes of dielectric properties versus time and temperature have been studied and applied to the following of thermal ageing.

### Experimental

#### Materials

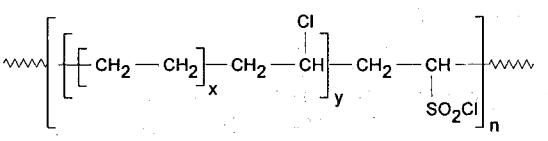
Two different rubbers are used for our LOCA cable manufacturing: Ethylene-Propylene-Rubber (EPR) and Chlorosulfonated Polyethylene (CSPE). These basic materials have respectively the following chemical structures:

EPR:



were x and y are equals to 7 and 12.4.

CSPE:



were x and y are equals to 1.35 and 24.9.

For the processing, compounded materials are used with special formulation containing fillers and protecting agents (table 1).

| | |
|---|---|
| Resin (EPR-CSPE) | 42-46% |
| Fillers (Carbon Black, kaolin,...) | 35-40% |
| Curing Agents | 3-4% |
| Oils | 5-15% |
| Others | 6-7% |

Table 1: Industrial formulations for cables.