

## Main objectives and results of the EU project ADVANCE with focus on aging assessment of cable insulation used in nuclear power plants through electrical measurements

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### ABSTRACT

This paper presents the main objectives and results of the European project ADVANCE (Aging Diagnostics and Prognostics of low voltage I&C cables) that addressed issues regarding the assessment of safety-related cables in relation with lifetime extension of NPPs (Nuclear Power Plants).

### KEYWORDS

ADVANCE, NPP, cable, ageing, insulation, electrical measurements.

### INTRODUCTION

Extending the lifetime of Nuclear Power Plants (NPPs) to 60 years or more is among one of the most important concerns in the global nuclear industry [1]. As electric cables are one of the long life items that have not been considered for replacement during the design life of NPPs (typically 40 years), assessing their degradation state and predicting their remaining lifetime are very critical issues. Many of these cables are installed in the containment area, where the harshest environmental conditions, characterized by high temperature and gamma-radiation, can significantly stress cable insulations.

This paper presents the main objectives and results of the European project ADVANCE (Aging Diagnostics and Prognostics of low voltage I&C cables) [2]. This project addressed issues regarding the assessment of safety-related cables that are required to operate not only during normal operating conditions but also under accident conditions, like in the case of the Loss Of Coolant Accident (LOCA).

The project was based on the study and the analysis of the results of accelerated ageing tests performed on a representative selection of cables already installed in European Nuclear Power Plants (NPPs) in order to evaluate the ability of electrical condition monitoring (CM) techniques to detect local and global cable ageing. The results were compared and correlated to those obtained with more conventional CM techniques for validation and residual lifetime estimation.

### ADVANCE PROJECT

#### General

ADVANCE (Aging Diagnostics and Prognostics of low voltage I&C cables) is a 3 years collaborative R&D project co-funded by the European Commission under the Euratom 7th Framework Program in nuclear fission and

radiation protection that ended in 2013.

The ADVANCE consortium was composed of a mix of European research and technology actors with significant experience in the area of cable ageing and diagnostic techniques. It gathers eleven partners from eight different countries led by EDF and represents nuclear utilities with their associated competence centres (EDF, FORSMARK, LABORELEC), research and engineering institutes (CEA, INCT, NRI, TECNATOM) and universities (KTH, UNIBO) one cable manufacturer (NEXANS) and one provider of nuclear products and services (WSE). The total budget of the project was 4 M€ with over half funded by the EU.

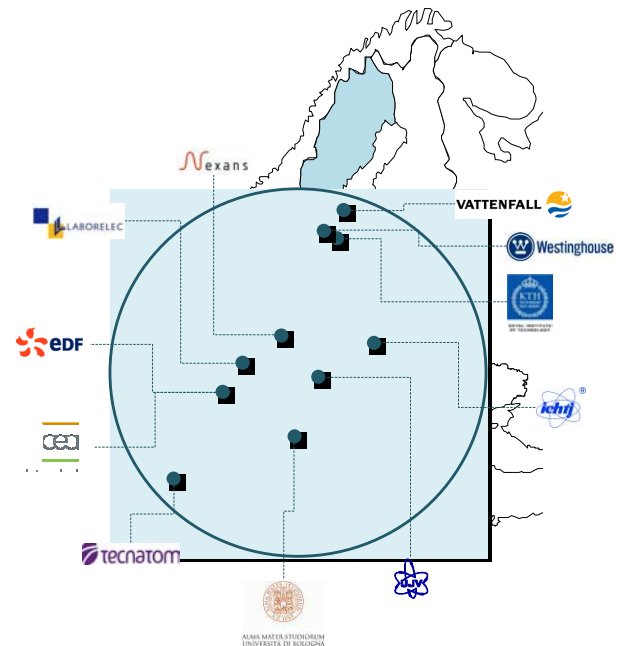


Fig. 1: ADVANCE partners

#### Main goals

The main goals of the project were:

- to adapt, optimize and assess promising electrical condition monitoring techniques for nuclear cables that are non-destructive and can be used in the field to determine the current condition of installed cables over their entire length
- to establish acceptance criteria by correlating physical cables properties to electrical properties in order to evaluate the degree of degradation and to provide information about the cable remaining useful lifetime

So, a particular issue of the project was dedicated to investigate electrical aging markers which can provide