

CISTERN2

Civil Structure Engineering Resilience for Nuclear

EDF, EPRI and CGN collaborate within the MAI on an effort to perform joint research on civil engineering (CE) structures. The primary objective of this research is twofold: to address regulatory concerns about ageing of civil infrastructures and their integrity for Long Term Operation and to minimize unanticipated operational events. The research program includes actions concerning the development of a modelling toolbox related to CE structures (from concrete material formula to meteorological aspects) and the development of a program to evaluate non-destructive testing (NDT) techniques for reinforced pre-stressed concrete with a specific emphasis on corrosion activity of passive steel reinforcement in concrete.



Fig. 1: Degradation of aggregates in boric acid solution (EPRI / CEA)



Fig. 2: The PERMIT cell Method (CGN)

Some results of the project:

- Degradation of concrete in spent fuel pools: This work allowed to identify the degradation mechanisms involved in boric acid media. Both experimental (fig. 1) and modelling approaches were considered. Current work on corrosion detection is made by the same teams.
- Chloride ion permeability characterization of concrete: This work compared a new NDT method (PERMIT) to ease the measurements sensitivity to chloride ions migration with a more established though more intrusive one: Drilling Powder Method (DPM).
- Weather condition history effect on concrete carbonation for large structures: Generalized corrosion due to the carbonation of the concrete cover is considered as an important ageing risk, and an analytical model has been developed allowing the prediction of the carbonation depth spatial variation and its evolution with time.
- NDT comprehensive study (ongoing work between EPRI and EDF): several mock-ups have been designed and are currently being fabricated in order to conduct a benchmark of non-destructive techniques to provide utilities with best available practices (fig. 3 & 4).



Fig. 3: NDT on VERCORS containment building mock-up (EDF)



Fig. 4: Preparation of concrete mock-ups with controlled defects (EPRI)