

Explosion Analysis and Assessment of Capacitor Banks in Technical Buildings

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Internal arcing faults in oil insulated electrical components can lead to a severe accident scenario escalation. When dielectric breakdown occurs in this kind of component, the consequent electric arc decomposes the surrounding oil into a saturated gaseous hydrocarbon mixture by means of a pyrolysis reaction, leading to a sudden pressure build-up into the component enclosure. For severe faults, this can induce the structural failure of the enclosure itself (primary explosion scenario): a hydrocarbon mixture is violently released through the enclosure breaches, together with liquid oil and oil mist. Such an explosive atmosphere may result in a very strong explosion when ignited (secondary explosion scenario). The consequences of a secondary explosion in a confined facility may be crucial if pressure venting is not suitably managed and optimised. Moreover, a domino effect on subsequent fire scenarios can be catastrophic.

Several events contribute to establishing a secondary explosion scenario, dealing with electrical, chemical, physical and mechanical aspects; a comprehensive, multidisciplinary methodological approach is required in order to properly estimate the potential of such scenario.

The case of a capacitor bank is considered in this presentation. The first task of the case study consists in the characterisation of the electrical behaviour of the component. The effects of a secondary explosion consequent to the identified worst-case conditions, are then studied in a subsequent task. Finally, structural assessment of the concrete bay forming the basement is carried out, by means of Finite Element (FE) dynamic transient analyses with ABAQUS code, based on the pressure transient obtained from the explosion analyses.

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