Abstract

CERN is one of the most complex facilities built until today. As such, it consists of thousands of custom-made components spread both in upper ground facilities and in underground tunnels and chambers. Hazards, including the fire ones are endless and enormous, and deserve serious attention and a scientific and engineering approach in solving them. As it would be impossible addressing each tiny component individually, envelope conservative solutions have to be developed in order to save both financial and time resources.

This thesis is aimed at characterization and better understanding of the potential fire behaviour of most common combustible items present in CERN. After a detailed literature review of fires in electronic cabinets, an Excel calculator for obtaining a design fire in any number of cabinets/racks is developed. As literature for small vehicles in fires is scarce, suggestions on how to address the fires in vehicles used in CERN are given.

Second part of the thesis is dedicated to exploring testing techniques suitable for CERN's needs with the goal of characterizing smoke of most common cables and insulating oils used in CERN. Particle size distribution is obtained by using DMS500 fast particle analyser coupled with cone calorimeter (FTT). Data obtained on smoke particles will in future be used to validate and further improve FDS code in terms of addressing this issue. CERN is particularly interested in knowing the smoke particle size distribution that can be expected, as radioactive particles could be carried around, and endanger the whole facility and the surrounding environment.

Rezime

CERN je jedno od nakompleksnijih postrojenja izgrađenih do današnjeg dana. Kao takvo, sastoji se od hiljada komponenata napravljenih specifično za CERN rasprostranjenih kako u nadzemnim postrojenjima, tako i u podzemnim tunelima i prostorijama. Hazardi, uključujući i one od požara, su beskonačni i ogromni, i zaslužuju ozbiljnu pažnju kao i naučni i inženjerski pristup u rešavanju. Budući da bi bilo nemoguće baviti se svakom sitnom komponentom pojedinačno, sveobuhvatna, konzervativna rešenja moraju da se donesu sa ciljem uštede kako finansijskih tako i vremenskih resursa.

Ova teza je usmerena ka karakterizaciji i boljem razumevanju potencijalnog ponašanja prilikom požara najprisutnijih predmeta prisutnih u CERNu. Nakon detaljne analize literature koja se bavila požarima u električnim kabinetima, napravljen je Eksel kalkulator za dobijanje projektovanog požara u bilo kom broju električnih kabineta / rafova. Pošto je literatura o požarima u malim vozilima izuzetno oskudna, sugestije su date o tome kako da se pristupi požarima u vozilima prisutnim u CERNu.

Drugi deo teze je posvećen istraživanju eksperimentalnih tehnika prikladnim sa potrebama CERNa sa ciljem karakterizacije dima proizvedenog pri gorenju najprisutnijih kablova i izolacionih ulja korišćenih u CERNu. Distribucija čestica dima po veličini je dobijena koristeći DMS500 brzi čestični analizator uparen sa konusnim kalorimetrom (FTT). Podaci o česticama dobijeni u ovim eksperimentima će u budućnosti biti korišćeni da se validira i dalje razvije FDS (fire dynamics simulator – simulator dinamike vatre) u smislu ovog domena. CERN je posebno zainteresovan da sazna očekivanu distribuciju veličina čestica, jer su čestice u mogućnosti da dalje prenose radijaciju i time ugroze kako samo postrojenje, tako i okruženje.