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FIERASYSTEM: A FIRE RISK ASSESSMENT TOOL TO EVALUATE FIRE SAFETY IN BUILDINGS AND LARGE SPACES*

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ABSTRACT

A number of countries have changed, or plan to change their building regulations from prescriptive-based to performance-based. A performance-based code approach establishes clear objectives and safety criteria and leaves the means of achieving these objectives to the designer. This allows for flexibility, innovation and functionality in the design, and may achieve improved fire safety designs at reduced costs. To take full advantage of the opportunities offered by these codes, the fire safety community has recognized that, in a performance-based code environment, there is a need for tools that will facilitate the evaluation of fire safety designs to determine whether or not they satisfy the established objectives. One such tool is FIERAsystem (**FI**re **E**valuation and **R**isk **A**ssessment **system**), which is being developed at the National Research Council of Canada, to evaluate fire protection systems in light industrial buildings.

Following the design approach of performance-based codes, FIERAsystem uses time-dependent deterministic and probabilistic models to evaluate the impact of selected fire scenarios on life, property and business interruption. FIERAsystem allows the user to perform a number of fire protection engineering calculations ranging from simple calculations to full risk analysis in order to evaluate fire protection systems in industrial buildings. The main FIERAsystem models include fire development, smoke movement, fire detection, building element failure, suppression effectiveness, fire department response and effectiveness, occupant response and evacuation, life hazard, expected number of deaths, economics, and downtime. In addition, FIERAsystem can be used to evaluate whether or not a fire protection system for a building will satisfy specific fire safety objectives.

In order to demonstrate the utility of FIERAsystem, case studies have been carried out to evaluate fire protection systems in light industrial buildings. The first case involves performing a hazard analysis of an aircraft hangar that includes the effects of fire and smoke spread in the building, and the evacuation of occupants. The building consists of five compartments on the ground level office area (escape systems storage room, welding shop, fabric shop, main workshop and paint workshop) and a large hangar. The office compartments have a total floor area of 564 m^2 and the large hangar has a floor area of 3443 m^2. The building is of concrete construction and sprinklered with no smoke detectors installed. The total number of occupants in the building is 169. Two potential pool fire scenarios in the paint workshop are considered. The fires occur when the paint fuel (kerosene) is limited to spilling within dyke diameters of 2.7 m and 4.0 m.

The second case is a demonstration of the compliance with a set of objectives, for various fire safety design options, inside a building. For the purpose of this case, a 3-storey building is used as the basis for all analyses, chosen because it represents a typical building found in many Canadian cities. The evaluation of the objectives is based on the fire development, fire and smoke spread in the building, and the evacuation of occupants through corridors and stairs to safety at ground level. The building is of concrete construction and has a square shape with a total area of 400 m^2 (20 m by

20 m). The first level has three compartments representing a restaurant and a bookstore, separated by a 2.5-m corridor. The restaurant has 2 separate compartments, a kitchen and a seating area. In the second level, there is a dentist's office and a medical laboratory. The area of the compartments on the first and second floors is 350 m^2 (for each floor). The third level is an open space software engineering office and is assumed to have an area of 400 m^2. The building has two stair shafts at the two ends of the corridor. The total number of occupants in the building is 112. For the analysis, a t^2 design fire scenario starting in the restaurant kitchen is used.

This paper presents the procedures used in FIERAsystem to perform fire analysis and the two case studies showing: 1) a hazard analysis of an aircraft hangar and 2) how to evaluate the compliance with a set of objectives in a 3-storey building. The paper also briefly outlines the framework for FIERAsystem and its main models.