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Fire Following Earthquake in the catastrophe models: Case study – Vancouver region, Canada

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Fire following earthquake (FFE) can pose considerable threat in densely populated urban area with significant earthquake hazard and presence of non-fire-resistant buildings typology. Severe building damage and consequently broken pipelines can lead to release of flammable gasses and liquid, which increase possibility of fire occurrence when they come into contact with ignition sources, like short circuits or open flames. Numerous simultaneous ignitions followed by uncontrolled fire spread to adjacent buildings can lead to major fires and conflagrations, whose damage can substantially exceed the earthquake shaking damage. Well-known example of such high financial losses due to FFE is Mw 7.9 San Francisco 1906, where Great Fire losses were 10 times higher than due to earthquake shaking itself. Thus, the quantification of FFE losses has particularly important role for the current underwriting products and the industry requires their further detailed consideration in the catastrophe models and pricing approaches. Impact Forecasting, Aon's catastrophe model development centre of excellence, has been committed to help (re)insurers on that matter.

This paper presents quantification of FFE contribution to mean losses for case study of the Vancouver region, Canada for specific scenario Mw 7.5 Strait of Georgia crustal earthquake. FFE methodology encompasses 3 phases: ignitions, fire spread and suppression and loss estimation. Number of ignitions (fires that require fire department response) and their location were calculated using HAZUS empirical equation with input variables earthquake shaking intensity and estimated total building floor area. An urban fire spread is a complicated phenomenon that includes numerous uncertainties. An advanced cellular automata (CA) engine is used for simulation of the fire spread and suppression based on Zhao 2011. The CA engine represents collection of grid-arranged cells, where each grid cell changes state as a function of time according to a defined set of rules that includes the states of adjacent cells. The CA simulations include only matrix mathematical operations that allow us to take into account building construction types and their damage due to earthquake shaking, meteorological and environmental data and fire suppression modifiers. Unlike in older empirical approach, the fire spread CA engine enable to consider fire spread not only from initially ignited building as well as fire developing within a single building, building-to-building fire spread, and fire extinguishing works at the same time. An output of CA engine is the building fire-state grades based on which damage functions are created with PGA as input parameter at the level of 3-digit postal codes. For the chosen scenario potential contribution to mean loss due to FFE could be up to 75% depending on typical buildings setting

within 3-digit postal codes.