ABSTRACT

The [redacted] in [redacted] was constructed [redacted]. It was designed using the International Building Code (IBC), [redacted] edition. This fire protection analysis report will be reviewing the building based on the 2015 edition of the IBC including several performance based fire scenarios involving the smoke exhaust system.

The passive system section highlights the physical construction of the building. The [redacted] is a business occupancy with three separate stories including a penthouse which is included in the third story. The building has adequate fire ratings for a Type II-B construction except for heavy timber columns within the commons of the building. It seems likely that the designer obtained a waiver for construction with use of these heavy timber beams, but it still needs to be verified.

In addition to the heavy timber construction issue, there was a concern with the egress requirements of the large conference room on the first floor. This conference room has the ability to be partitioned into three separate conference rooms. When this is achieved, the occupant load for each of these three separate smaller conference rooms is higher than an occupant load of 50. There is only one door per each of these smaller conference rooms. This is a violation of the IBC 2015 edition.

The fire suppression section highlighted the capabilities of the sprinkler system. The fire flow test shows that there is a high enough water capacity at a high enough pressure for the worst case locations within the building to be supplied to meet NFPA 13. There is no need for a fire pump in this building.

The fire alarm section highlights the construction of the fire alarm system. The fire alarm system uses Class A wiring as required by [redacted] for this type of construction. In addition to being a Class A wiring connection, additional provisions were included in the fire alarm system to an emergency voice notification system that notifies occupants in case of an emergency on the steps needed to maintain safety in emergency situations. Included in the fire alarm system are various panels including a Fire Alarm Control Panel (FACP), 3 Transponder Panels (TP), 9 Notification Appliance Circuit Panels (NACP), and a Smoke Control Panel included in the fire alarm system. There is an issues with the placement of smoke detectors. There are no smoke detectors protecting the FACP and associated panels which does not meet NFPA 72 requirements.

The smoke control system is interconnected to the fire alarm system via the smoke control panel. In the event of a fire, the smoke is exhausted through the ceiling through use of eight exhaust fans and make up air is funneled through inlets in the floors of the common areas and vents in the commons (conference rooms) through the use of five supply fans. This was a focal point in the performance based fire modeling section of the report.

The performance based fire analysis focuses on two fire scenarios. The first scenario focuses an atrium fire and the second fire scenario focuses on a fire in the main conference room that removes the ability to egress through one of the three doors within the room. The two fire scenarios are not meant to verify acceptability based on NFPA 96 requirements for an exhaust system for an atrium. The fire scenarios shown to illustrate semi-realistic fires in the main conference room on the first floor and in the center of the atrium.

The tenability requirements looked at for these fire scenarios were for visibility, CO (carbon monoxide) concentrations within the space, and the temperature of the air in within the space. The minimum tenability for visibility was determined to be 10 meters. Jin suggests that the criteria for visibility range from 13 ft to 46 ft (4 m to 14 m). Jin suggests a tenability limit of 10 m (33 ft) for occupants unfamiliar with a building based on his studies of people exposed to smoke. 10 m (33 ft) seems like a reasonable selection criteria for limiting visibility criterion in a non-complex building with reasonably sized rooms and square footage of the building. The minimum tenability for both the Oxbow building and the conference room on the first floor was determined due to this rational because there are periodic tours of the building and visitors that tend to join conferences within the conference room on the first floor. The minimum tenability requirement for CO concentrations was 0.1 FED. This value was conservative enough for very low chances of affecting personnel that were sensitive to either toxic gases or asphyxiation because there are other contaminates in addition to CO concentration produced in fires depending on the materials burnt. "Hartzell [2] states that a (Ct)CO of 35,000 ppm·min has the potential to cause serious harm to many occupants and therefore (Ct)CO = 35,000 ppm·min would be a reasonable representation of an FED of 1.0. If LC50 data for rats is used, the value is 171,000 ppm min." The value of 35,000 was determined to be 1.0 in this example. Using 35,000 ppm, 0.1 FED was determined to 1,166 ppm of total exposure. The minimum tenability requirement for air temperature was determined to be 60° C. An exposure to a temperature of 60° C was determined to be the worst case tenable condition for this fire model because exposure to a temperature of 60° C air for 1 second will produce pain and 10 seconds or more will produce burns.

The atrium based fire scenario shows that the building can be fully egressed with the all three of minimum required tenable requirements for visibility, CO concentration, and air temperature. Whereas, the fire scenario for egressing the conference room had visibility and CO concentration tenability issues.

The analysis has determined the following conclusions and recommendations for meeting the IBC, 2015 edition:

1) The number of doors exiting the large conference room is not adequate.
   - Recommendation: Add doors on the far sides of the conference room and include a type of interlock to the room separators to only allow one to be used at a given time.

2) Smoke detectors were not installed near the Fire Alarm Control Panel (FACP), transponder panels, and the Notification Appliance Circuit (NAC) panels.
   - Recommendation: If feasible, install smoke detectors in these locations. At minimum, a smoke detector should be installed near the FACP.

3) Heavy timber columns were installed in the atrium area.
   - Recommendation: Verify waver from fire marshal for construction. If waver was not obtained, the heavy timber beams may need to be encased, replaced, or another alternative acceptable by the fire marshal.