SURREY
CITY OF PARKS

# Corporate Report

***NO: R018***

***COUNCIL DATE: February 23, 2009***

**REGULAR COUNCIL**

TO: **Mayor and Council** DATE: **February 16, 2009**

FROM: **Fire Chief** FILE:

SUBJECT: **Systems Approach in the Management of High Rise Building Fires**

## RECOMMENDATION

The Fire Services Department recommends that Council receive this report as information.

## PURPOSE

The purpose of this report is to inform Council about a comprehensive strategy and deployment model that has been developed for the Surrey Fire Service. Surrey is becoming a large metropolitan city and the building trend is for taller buildings in greater numbers. This form of growth is embraced in the context of sustainability. This report addresses how fire services are being adjusted to reflect the increase in high-rise development in Surrey.

## BACKGROUND

The "high-rise fire problem" has been with us for decades. Surrey, like many communities, had a relatively small number of high-rise buildings, in majority residential uses, dating back to the 1970s. It is expected that there will be more and taller high-rise buildings in more locations throughout the City.

Faced with this high-rise building boom, the Surrey Fire Service reviewed its ability to deal effectively with this growing segment of the built infrastructure in Surrey. Several progressive changes have been made over the years to address high rise development; namely, the adoption of a formal "shelter in place" policy to manage the large number of occupants in these buildings and the requirement for the preparation of a fire safety plan by the building owners prior to occupancy. After surveying other fire services practices, there was consensus that additional adjustments needed to be made.

The Department engaged a consultant to review the high-rise situation in Surrey, and facilitate a more thorough review relying on international best practices and high-rise fire experience. The consultant proposed a systems approach, in which all major elements of the high-rise problem

would be addressed simultaneously. To reflect the challenges unique to Surrey, the City's own data was used along with statistics and fire experience at the provincial and national levels. Case studies of large-loss high-rise fires were also studied as part of the analysis.

**DISCUSSION**

The consultant study involved four phases as follows:

1. Data Collection of:
    a. local fire incident statistics over the last 30 years;
    b. local building count and use data;
    c. BC fire incident data; and
    d. Summary of US fire incident data;
2. Review of major high-rise fire incident reports for lessons learned; and
3. Identification of local vulnerabilities based on information compiled through actions 1. and 2. and a compilation of the resources available to the Surrey Fire Services; and
4. Development of recommendations in relation to fire services delivery adjustments.

In the midst of the study, a site visit to a high rise building was made, during which members of a committee including fire-fighters, officers and administrative staff met with the consultant to convey perceptions and concerns, and to review proposals and suggestions that were being considered. Staff in all areas of the Department was also interviewed, and dispatching facilities and equipment were reviewed. Other site visits were made to select high-rise buildings, and existing installations were reviewed, including informal discussions with building staff.

The purpose of these visits was to gain an understanding of local perceptions, practices and gain a better appreciation for the operating environment in these buildings. These visits proved to be invaluable, and were very useful in breaking through some of the "silos" in terms of fire suppression versus prevention and headquarters versus branch/line companies.

***The Systems Approach***

Based on review of fire experience - successes and large-loss fires - it was found that there were three elements that were critical to successfully managing a high-rise fire incident.

- Building Construction/Code Enforcement;
- Public Education; and
- Fire suppression.

Building construction/code enforcement includes ensuring that the building is constructed to the building code requirements including fire protection systems, occupant communications systems, and structural fire protection. These measures are only as good as the enforcement and oversight mechanisms in place to verify that required installations are installed, operate properly and are maintained over time. Critical to this element is the transition from new construction reviews to periodic inspections during the life of the building, usually made under the authority of the Fire Code.

Due to the complexity of high-rise buildings and the large numbers of occupants affected by even routine fire alarm activations, there is a need to educate the occupants of such buildings.

This includes information related to protective features of their building, necessary actions during a reported or actual fire emergency and an understanding of fire service operations so that such operations are not compromised when they are activated to address an incident.

The final area is fire suppression, which encompasses dispatching, response policies, and fire fighting techniques and tactics.

When any of these areas is neglected or insufficient, the potential for large losses is greatly escalated. Importantly, after-action reviews of major incidents reinforce the notion that each of these areas must be reinforced through sustained effort. Good programs and policies must be communicated and exercised to remain effective over time and not left to wither as organizational attention moves to other issues.

Using previous research (Jennings, 1996), a conceptual model of fire incidence and fire loss was used to illustrate the need for attention to multiple dimensions of the fire problem. This model stated that to understand fire loss, characteristics of the building stock (size, egress capacity, protective systems); occupants (number, age, impairments); and fire service response must be understood.

**Qualitative Findings**

Qualitatively speaking, significant high-rise fires are relatively rare events. In Surrey there are a relatively small number of existing residential high-rise buildings but there are several more under construction and others in the planning stage. These new buildings are tending to be taller, and often contained mixed uses.

A review of local fire data over the last 20 years revealed several interesting facts about high-rise fires in Surrey. The number of high-rise fires has increased over the past nine years, averaging about five per year. This number is expected to increase as more high-rise buildings come on-line.

The vast majority of high-rise fires occurred in residential buildings; further analysis showed that there was an injury rate of 0.1 per fire in both high-rise and non-high-rise buildings. Comparisons were made between Surrey's experience and Provincial and US data. Table 1 shows casualties (injuries and deaths) per fire. Some caution should be exercised in using the numbers contained in this table as they were calculated over different time periods but their relative consistency serves as a “reality check” on the Surrey data.

| Source | Fires | Injuries | Deaths | Casualties per fire |
|---|---|---|---|---|
| Surrey | 59 | 6 | 0 | 0.1 |
| BC OFC | 262 | 17 | 2 | 0.07 |
| US (NFPA) | na | na | na | 0.07 |

Surrey's casualties per fire figures were higher than those for BC and the US, and it is surmised that these differences are related to office occupancies having a lower number of casualties per incident in comparison to residential occupancies. Surrey has only a few high-rise office buildings.

Data on building characteristics (number, use, and square footage) was used to gain a better understanding of fire risk. The results of the analysis of fire risk in Surrey using this data are documented in Table 2.

Table 2: Fire Risk by Residential Building Type

| Building type | Fires | Buildings | Fires/Bldg./Year | Square Footage (millions) | Fires/10,000 Square Feet/Year |
|---|---|---|---|---|---|
| 1 and 2 Family | 2,042 | 81,729 | 0.001 | 219.8 | 0.005 |
| Townhouse | 312 | 6,935 | 0.002 | 104.2 | 0.002 |
| Apartments (All) | 403 | 555 | 0.038 | 102.3 | 0.002 |
| High-rise Apartments | 54 | 12 | 0.234 | 1.78 | 0.016 |

Reviewing fire risk on this basis provides a new perspective on the relative safety of buildings and for targeting interventions to reduce the number and consequences of fires. For example, fires per building might be useful in relation to targeting code-related interventions and inspections by fire services staff, fires on a square foot basis might be more appropriate for targeting public fire education efforts.

This analysis indicates that a fire in a high-rise building is expected roughly once every four years, while a fire in a single family dwelling is a much rarer event, in the order of one in a thousand units for any particular house in any year.

This was only the second time that this methodology was used, but with additional data collection and analysis over a larger number of jurisdictions, it could be a powerful tool to gain a better understanding of fire risk and as a means of comparing fire experience between communities.

An analysis was also undertaken in relation to the role of detection and suppression systems in addressing fires. It is expected that high-rise buildings would have a higher rate of working smoke detectors or suppression systems. It was learned that there were "no smoke detectors installed" in 5 percent of high-rise incidents, versus a 30 percent rate for non-high-rise buildings. Overall, smoke detectors activated in 64 percent of high-rise fires, as opposed to 17 percent of non-high-rise building fires. This reflects the higher level of code compliance that exists in relation to high-rise buildings.

It was also learned that smoke detectors sounded but occupants were unable to react in 28 percent of high-rise incidents versus less than one percent in the non-high-rise buildings. This may be explained by the presence of smoke detectors in high-rise occupancies including hospitals but also indicates that vulnerable populations are more likely to be found in high-rise buildings. This has some important implications for pre-emergency planning and incident response and needs further exploration.

Sixty-one percent of high-rise buildings in the fire reports were equipped with complete sprinkler systems in comparison to only 4.9 percent of non-high-rise buildings experiencing fires. The effect of sprinkler systems on fire service activity at high-rise fires is another notable finding. In looking at the method of extinguishment for high-rise in comparison to non-high-rise buildings, sprinklers extinguished almost 41 percent of high-rise fires while fire service hose lines were used in 25 percent of high-rise fires. In non-high-rise buildings, hose lines extinguished 66 percent of fires. The difference in hose line use correlates almost exactly to the prevalence of sprinkler systems (Table 3).

Table 3: Extinguishment Method by Building Type

| | Non-High-rise | High-rise | Percent Non-High-rise | Percent High-rise |
|---|---|---|---|---|
| undetermined | 279 | 2 | 5.9% | 3.4% |
| Hand Extinguisher | 445 | 5 | 9.5% | 8.5% |
| Standpipe hoseline | 39 | 1 | 0.8% | 1.7% |
| Makeshift means | 477 | 4 | 10.2% | 6.8% |
| Fire service water application | 3,087 | 15 | 65.7% | 25.4% |
| Fire service other than water | 7 | 0 | 0.1% | 0.0% |
| Sprinklers | 62 | 24 | 1.3% | 40.7% |
| Fixed systems other than sprinklers | 7 | 0 | 0.1% | 0.0% |
| Burned out | 137 | 0 | 2,9% | 0.0% |
| Miscellaneous | 159 | 8 | 3.4% | 13.6% |
| Total | 4,699 | 59 | | |

Based on the analysis and review documented in this report over forty recommendations were produced addressing all aspects of the high-rise fire problem in Surrey. The most significant recommendations are summarized in the following paragraphs. The complete report is attatched as an appendix.

## Dispatch and Communications

**Increase initial response to automatic alarms** -- Un-sprinklered high-rise buildings will get an additional company dispatched at the receipt of an alarm. For automatic alarm, un-sprinklered high rises would get two engines and an aerial device, while sprinklered buildings would only receive one engine and one aerial device. Surrey also staffs 2-person rescue companies operating from midi-pumpers, and these companies are routinely assigned to alarms in conjunction with engines and aerials.

Reported fires in a high-rise would receive a response of three engines and one aerial (plus rescue companies). Unsprinklered buildings would get an additional aerial device. These

response levels should result in 16 to 21 personnel responding on the initial alarm. Upon confirmation of a fire (smoke showing or multiple calls), a second alarm would be struck, to which an additional two engines, another staff chief, command vehicle, and rehabilitation unit would respond.

**The caller interrogation protocol for high-rise buildings needs to be revised and pre-arrival instructions need to be tailored to fire safety features present in the building.** This effort was in progress when the study started.

## Codes and Enforcement

**Review the merits of enacting a local by-law to require the installation of public address systems in all high-rise buildings**. The ability to provide information to occupants has been shown to be critical to controlling occupant movement and preventing occupants from using stairwells contaminated with smoke in their attempt to exit from the building.

**Enact a local by-law to standardize elevator keys for firefighter service**.

**Continue to pursue approval at the provincial and national levels to enable dedicated fire service video monitoring of egress routes in high-rise buildings**.

**Require that pressure reducing valves (PRV) be field adjustable and that specifications and resetting instructions are stored on-site and included in pre-fire plan**s.

**Develop a standardized system of stairway and vertical shaft designation throughout Surrey**. Such markings are an aid to communication during an incident, and can help personnel orient themselves during a fire.

**Consider implementing partial evacuation and notification capabilities to better manage occupants and reduce unnecessary alarms, which could cause residents to ignore alarm activations**.

**Require minimum qualifications for a responsible party to be on scene for certain high-rise buildings**. This approach is used in many larger cities, and this person is a resource for the fire service.

## Public education

**Develop a high-rise building education campaign**. Separate programs should be developed for residential and non-residential buildings. Work with building management personnel to adapt these programs to particular circumstances in each building, and include evacuation procedures, protective systems and fire service operations.

**Develop a citywide program for mixed-use high-rise projects**. Issues such as sequence of operation for fire alarm, evacuation procedures, and occupant education should be addressed.

**Training and Mutual Aid**

**Conduct an operational exercise in a nearly completed high-rise**. The exercise would test procedures and assess staffing requirements for high-rise operations.

**Work with BC Ambulance and RCMP in tabletop settings to practice incident command for fire and non-fire incidents** including violent, terrorist, or other criminal scenarios in a high-rise building.

**Conduct interoperability planning and exercises with neighbouring as well as regional assets**. Existing mutual aid agreements should be expanded regionally and common operational guidelines should be developed for high-rise fire and incident command issues.

## CONCLUSION

Working with City data and data from other sources, the City has developed a defensible, multi-faceted approach to addressing high-rise fires and other incidents that has inspired buy-in from all elements of the department. The effort will require immediate and long-term actions by the Fire Services Department. These efforts position the Surrey Fire Service to address current and future needs of the City in relation to fire safety in high-rise buildings.

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